Submittal to GASSNOVA

CO_2 Capture Facility at Kårstø, Norway

Front-End Engineering and Design (FEED) Study Report

320-CCC FEED Study

Submitted by

Bechtel Overseas Corporation [redacted]

[redacted]

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1.0 Executive Summary

1.1 General Description

This report includes work performed by Bechtel Overseas Corporation [redacted] in executing the front-end engineering and design (FEED) study for the Kårstø CO_2 Carbon Capture and Compression (CCC) Plant Project in Norway. Work was performed per the conditions of the contract number 10112936-FI-B-CON-0014.

The FEED study includes the design of the CCC Plant and ± 20% Capital and Operating cost estimates.

1.2 Base Case

The base case comprised an open-art MEA design arrangement with split flow. The performance and cost data for this approach is summarized below.

	Base Case: Open-art MEA with split flow
Capture rate	85.3%
LP steam required (tons/hr)	198.4
Electricity requirements (MW/hr)	32MW
Capital Cost (excluding contingency)	NOK 2.24billion
Operating cost (yearly avg)	NOK 388million
NPV of cost per tonne of CO2 Capture	199NOK/t

1.3 Risk

Project Risks were evaluated as part of the FEED study and summarized in the Risk Management document. All aspects of project risk including technical, operations, schedule, environmental, construction and financial were considered. The top 10 risks are outlined below.

ID	Risk	Description of Risk and Impact	Risk score	Mitigation Measure
CC3	Hours of operation of Power Plant	If CCPP plant runs for less than 8000 hours it will have major impact on CO2 capture cost	16	Consider range when evaluating CO2 capture cost. Consider Monte-Carlo simulation
OP4	Energy Costs	Electricity is the largest operating costs element and cost may change significantly over the 25 year life.	12	Consider range when evaluating CO2 capture costs as part of investment decision. Consider long term agreement with Naturkraft
SC10	Environmental permit delays	Environmental agencies appear to be unsure of acceptable emissions limits to atmosphere. There is a risk that they may impose extra conditions that delay approval	12	Coordinate with Gassnova and environmental agencies prior to EPC to ensure that appropriate contingency is included in the EPC schedule.
CO2	Other major construction activity at the Kårstø site	There is a risk that other major construction activity will be undertaken at the Kårstø site at the same time as the CO2 project. This will impact the use of the module jetty, labor availability and nearby fabrication facility availability	12	Work with Gassnova to determine risk and then develop mitigation plan options (including early agreements with fabrication shops for shop access)
SC1	Long lead items	Lead time for compressor and columns could impact overall EPC schedule	12	Design prior to NTP. Early procurement negotiation with vendors
NT2	Scale-up issue with liquid distribution in columns	Concerns with liquid distribution	12	Use of circular columns. Vendor performed engineering of distributors during FEED study. Further studies should be undertaken in EPC for final design.

ID	Risk	Description of Risk and Impact	Risk score	Mitigation Measure
PE8	Licensing process	The schedule for the licensing process for a relatively new technology has to be clarified. This applies to the CCC plant and possibly also to the pipeline and storage scope	12	We believe Gassnova is already addressing this issue with the appropriate authorities.
PR1	Delay in supplying forgings for compressor	Large demand for forgings in current market. Forging work is often subcontracted out by compressor vendors. Delay in supply would have major impact on project schedule	12	Detailed investigation of forging capability/availability. Address risk in project schedule.
PR9	World wide economic issues	Risk of supplier or sub-supplier bankruptcy	12	Check supplier's financials prior to award per standard procedures. Require sub-supplier list with bids per procedures. Assign equipment title to Gassnova.
CT12	Inexperience of CCC plant operators	Concern that there is limited availability of operators with CCC or equivalent experience. Could impact to schedule, cost and safety	12	Provide plant operator training, simulators and experienced shift operators. Investigate the availability of the Statoil Hydro training facility. Process Engineering consultants on site for first 18 months of commercial operation.

1.4 Open Issues

The following is a brief description of the open issues at the time of issue of the FEED report

[redacted]

[redacted]

1.4.2 Least Cost Versus Hours Run per Year

The operating costs and Cost of Carbon Capture calculation have been based on the assumption of maximum operation of the Naturkraft combined cycle power plant (CCPP) as outlined in the contract documents. Based on data from the last year, it appears unlikely that the CCPP will operate at these maximum conditions. Any significant reduction in power plant operation will have a significant impact on the financial model. We believe that it would be prudent to run other operating cost and Cost of carbon capture calculations to reflect various scenarios of CCPP operation.

1.4.3 Option to Use Existing Cooling Water Intake at Kårstø

The cooling water demand of for the power plant will be reduced during operation of the CCC Plant (less condenser duty at STG). We believe the option to use some of this 'saved' cooling water for the CCC Plant should be evaluated.

1.5 Conclusions

The conclusions for the Engineering, Procurement and Construction scope of the project are outlined below together with a summary of the financial conclusions and an overall conclusion of the findings of the FEED study

1.5.1 Engineering Conclusions

- For the Kårstø case of relatively low concentrations of CO2 in the flue gas stream, the use of relatively high flue gas temperatures in the absorber is economical.
- Use of MEA @ 35% to 40% concentration is viable with use of 100% stainless steel materials of construction.
- [redacted]
- The use of two absorbers of known industry size and geometry reduces the risk of poor flow distribution in the columns
- Use of stainless steel materials for the amine circuit allows greater flexibility in future use and solvent selection.

- There are several additional design options (optional functionalities) that could reduce project risk and save capital and operating costs. These are described in section 17 of the report.
- Successful initial operations will require significant intellectual investment.

1.5.2 Procurement Conclusions

- Use of two absorbers of maximum 12m diameter allows for maximum pre-assembly in the fabrication shops and also allows for shipping in one piece.
- Significant cost savings can be realized through competitive purchase in the world wide market, especially when maintaining flexibility in suppliers to optimize exchange rate fluctuations.
- Release of engineering prior to financial close can reduce the schedule risk by allowing immediate issue of request for bids for long lead items

1.5.3 Construction Conclusion

- Adjusting the schedule to allow modularization in low cost centers can save large amounts of labor costs with the added benefit of significantly reducing the amount of site labor.

1.5.4 Financial

- Price of electricity will, as expected, have the major impact on operating costs and costs of carbon capture. It appears that the price of electricity used in the contract model included allowances for transmission costs. If this is the case, we recommend that they be excluded from the pricing used to calculate operating costs.
- Any reduction in operating hours for the Naturkraft plant will skew economic model towards less capital cost intensive options

1.5.5 Overall FEED Study Conclusions

The generic open-art MEA design utilizing 2 absorbers and stainless steel materials for the amine system, appear to be a viable solution for the Kårstø Project at this time for the following main reasons:

- The environmental cleanup targets and the production capacity have been achieved with the proposed design.
- MEA appears to be efficient at removing low concentrations of CO2 in high temperature absorbers

- The use of two absorbers of 12m or less in diameter maximizes offsite fabrication and significantly reduces risks associated with poor flow distribution.
- Use of stainless steel materials for the amine system minimize the need for inhibitors and provides increased flexibility for use of new amines or other solvents as they are developed over the life of the project.

[redacted]

1.6 3D Model Aerial Views and Videos

Attached are the following 3D renderings:

- Aerial from the Northeast
- Aerial from the North
- Aerial from the South
- Plant Layout Aerial View
- Plant Overhead View
- CCPP HRSG Stack Tie-in Design

Included on the compact disk (CD) enclosed with the Study Report are two video files providing a means of viewing the 3D CAD model using commercially available software:

- The AVI file plays like a movie in Microsoft Windows Media Player or other commercially available player software.
- The Navisworks NWD file uses Autodesk Navisworks Freedom software available as freeware from http://usa.autodesk.com/adsk/servlet/mform?siteID=123112&id=11091608. The Navisworks file permits the user to navigate the file.

Karsto Carbon Capture and Compression (CCC) Plant
3D Rendering Viewed from the Northeast

Karsto CCC Plant Arrangement Aerial View - from the North

Karsto CCC Plant Arrangement Aerial View - from the South

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Karsto CCC Plant
by Bechtel [redacted]
Plant Layout Aerial
View

Karsto CCC Plant
by Bechtel [redacted]
Plant Overhead View

Karso CCC Plant
by Bechtel [redacted]
CCPP HRSG Stack Tie-in Design

2.0-Study Approach

2.0 Study Approach

Bechtel's project execution approach is based on a philosophy that has demonstrated repeated success. This philosophy includes the following concepts:

- Never compromise on safety goals and quality
- Stay aligned with the Owner's and other project stakeholders' goals
- Use a cost-effective standard approach
- Modify the project approach to suit customer- and project-specific conditions
- Always maintain control of areas affecting schedule and performance targets
- Use designs that support customer objectives

These concepts form the foundation of Bechtel's project approach, which reflects how we accomplish our work. We focus on a seamless approach to executing the work that minimizes the interface complexity between each function in our work process. To help streamline and control execution, we perform more of the detailed work than other engineering, procurement, and construction (EPC) contractors. We find that by performing the work ourselves, we control the outcome with greater certainty. This improved certainty is achieved by optimizing our work process by individual function and then integrating functions into a coherent overall plan.

The key features of our execution approach are as follows:

- **Project Management** is carried out using a dedicated project team organization. All of the functions necessary to execute a project (Engineering, Procurement, Construction, Project Controls, and Startup) assign individuals to the project team on a full-time basis. This team sits together in our Frederick, Maryland, office and is typically located near other projects using similar technologies. Key members of the execution team are strategically assigned to the project during the development phase to facilitate a seamless transition from development to execution. Details of how our project team is structured are provided later in this section.
- **Engineering** is performed at our Center of Excellence for Power in Frederick and can be supported by our New Delhi, India, office. In Frederick, we control the critical aspects of plant performance guarantees by executing all performance cycle and critical design selection activities under the auspices of our senior specialists. In New Delhi, part of the production engineering for foundations,

structural steel, piping, electrical, and control systems designs can be carried out.

- **Procurement** is managed from our Frederick office. We source all major equipment and critical materials from proven suppliers. Our global buying power enables us to secure better pricing, terms, deliveries, and support than can be secured by most other EPC contractors. Noncritical materials are sourced from low-cost, qualified suppliers, provided they meet the project's specification requirements.
- **Contract Administration**, consisting of prime contract and subcontract services, is performed by our Contracts department. Major subcontract packages are formed in the home office and transferred to the subcontract administrator at the site during the execution of the work. Contracts works closely with Engineering and Construction to assign the subcontracted work in accordance with the Project Execution Plan. Subcontractors are sourced and prequalified based on our global experience and resources and to leverage customer experience as well. However, we strive to maximize local content by using local subcontractors with the appropriate capabilities.
- **Construction** and overall site management execution are Bechtel's responsibility. Bechtel's cornerstone is the ability to execute challenging projects safely, on time, and within budget, with exceptional quality. The key to this ability is a dedicated, integrated project team supporting the construction and startup efforts.

  Bechtel's Construction organization consists of a senior site management team supported by qualified, experienced field engineering; craft supervision; subcontract management; cost and scheduling; procurement; security; and environmental, safety & health organizations.

  Bechtel's approach to our work is to have an experienced staff that provides overall management and direction to the direct-hire craft and specialty subcontractor construction workforce. Bechtel provides detailed work scopes, specifications, and drawings for all onsite subcontractors. Bechtel also provides quality assurance, technical support/oversight, and overall schedule management for all site work.
- **Project Controls** incorporates proven and effective project cost and schedule management systems and procedures for each project phase. The project controls model developed by Bechtel features tools designed to promote schedule-driven execution without compromising safety or quality.

- **Startup and Training** are performed directly by experienced Bechtel personnel using proven practices and tools. We integrate the Startup organization into the project early and incorporate its critical input into the design and schedule. A team of technical experts from our Center of Excellence provides oversight and support.

2.1 Project Team Organization

Bechtel assigns a dedicated team to execute projects. The team is led by a project director (PD)/project manager (PM), who provides operational oversight. The PD/PM also provides continuity and technical expertise between other Bechtel fossil-fueled projects and the specific project and liaises with senior management.

The PD/PM manages the day-to-day details of project execution and interfaces with the Owner. The dedicated project team reports to the PD/PM for all matters associated with the project and for day-to-day direction. Functional departments provide technical and quality oversight of the work being performed by the team, as well as staffing and personnel support. Members of the project team are located in a common area to facilitate cross-discipline coordination and design optimization.

To manage the effort, responsibilities are broken down as follows:

- Project engineering manager (PEM)/project engineer (PE) for design engineering
- Project procurement manager (PPM) for procurement of equipment and materials
- Project controls manager (PCM) for planning, scheduling, and cost support
- Site manager (SM) for all field activities
- Project startup manager (PSUM) for startup and commissioning of the new plant
- Project Quality Assurance manager (PQAM) for independent oversight of quality processes and procedures

This project management team interfaces regularly during project execution to:

- Establish short-term project goals/objectives
- Establish overall project priorities
- Coordinate design and constructability

- Address resource needs and organizational modifications
- Resolve critical project issues as required
- Address off-project coordination issues
- Optimize project communications

As project conditions dictate, the project team is augmented by additional Bechtel personnel or expertise provided by the functional departments.

We have used this team approach to successfully complete large, complex projects. Team members are selected based on their relevant experience and skills, including not only technical skills, but also administrative and leadership capabilities. The team approach also provides high visibility to both the Owner and Bechtel senior management. A project with full EPC scope includes the following team members.

Project Director/Project Manager—The PD/PM has the primary responsibility of delivering the project in accordance with the contract. In doing so, the PD/PM provides overall coordination of the various Bechtel entities involved in the project. This individual is the principal contact with the Owner for daily detailed interfaces. The PD/PM has a significant leadership role in addition to responsibility for delivering the project "as-sold." The PD/PM manages the relationships among the functional department managers, the engineering chiefs, and other contributing organizations.

Initially, this individual spends a significant amount of time in the Frederick office, where the design and procurement efforts take place. A critical responsibility is to manage the scope, schedule, and interface coordination among Engineering, Procurement, Construction, Startup, and Project Controls. The PD/PM also coordinates with the Owner in areas such as scope, technical content, project progress, quality, schedule, preoperational testing, and startup. As part of this activity, the PD/PM reviews and approves bid evaluations and major contracts and purchase orders. He/she continually works to facilitate positive relationships among the team members and with the Owner.

As the center of activities shifts to the construction site, the PD/PM and certain key team members spend an increasing amount of time at the jobsite to more directly coordinate field activities, thereby providing continuity of management direction. Typically, the PD/PM's jobsite effort approaches full time as activities shift from construction to startup. In any event, the PD/PM spends whatever time is required at the jobsite to ensure that Bechtel fulfills its obligations to the Owner.

Site Manager—Working as part of the project management team and reporting to the PD/PM, the SM leads the field construction and startup teams in building a quality facility that conforms to the contract scope of work and meets the design document requirements.

Overall responsibility rests with the SM to keep field construction activities on track and meet schedule requirements while maintaining quality and a Zero Accidents workplace. The SM apprises the PD/PM of any adverse trends and recommends corrective action(s) to eliminate or minimize any quality or schedule impacts. In addition, the SM has overall responsibility for industrial labor relations, workforce training, and community relations. At the start of the project, the SM spends considerable time in the Frederick office working with Engineering, Procurement, and Project Controls to optimize the detailed construction plan.

Project Engineering Manager/Project Engineer—The PEM/PE is responsible for the project's design engineering aspects. As the design team leader, the PEM/PE ensures that design deliverables are accomplished on schedule. In addition, he/she makes certain that the design is in accordance with the engineering scope agreed to with the Owner and conforms to applicable codes and standards, or as otherwise accepted by the Owner. The PEM/PE also focuses on integrating the scopes of work being performed by equipment suppliers with that being executed by Bechtel.

Project Procurement Manager—The PPM and his/her procurement team in Frederick purchase most equipment, materials, and services required for the project. The PPM is responsible for purchasing these items in accordance with the specifications and for managing assigned purchase orders. The PPM's principal function is to ensure that material, equipment, and services meet project quality and schedule requirements.

Project Controls Manager—The PCM is responsible for all scheduling and cost control tools. The PCM's principal function is to prepare and monitor the detailed schedules, estimates, budgets, and trends necessary to control the project. These key project controls tools are developed in the Frederick office and rolled out to members of the project team. These same tools are used by Construction. The PCM is responsible for integrating the project's scheduling and cost tools.

Project Startup Manager—The PSUM is assigned before mobilization and initially works in the Frederick office to assist in developing the detailed intermediate level schedule and establishing the project's startup execution plan. Once relocated to the jobsite, the PSUM is responsible for all equipment and system testing and checkout to ensure efficient and successful facility operation. The PSUM acts as the jobsite single point of contact with the Owner's operations personnel for the operations support required during startup and commissioning. He/she coordinates any required system outages and safety lockout and tagout activities. The PSUM also plans and manages all aspects of tie-ins and/or outages during the project's startup and commissioning phases. The PSUM reports to the SM and receives technical direction from the manager of Startup and Operating Services in Frederick.

Project Quality Assurance Manager—A PQAM is assigned as the coordinator/focal point for QA issues. The PQAM interfaces internally with project management and externally with the Owner on quality issues, and helps in their resolution.

At the outset of a project, the PQAM prepares a project-specific project quality plan (PQP) customized to meet contract requirements. The PQP is supported by the Bechtel Quality Management System and identifies the applicable procedures, instructions, and manuals to be implemented. The PQAM oversees, assesses, and reports the effectiveness of PQP implementation through internal and external quality audit/surveillance and reviews. Furthermore, the PQAM monitors project performance via reviews of quality-related reports, such as supplier surveillance inspection reports, project deficiencies reports, and site audit reports.

The one exception to the integrated EPC approach is the PQAM, who coordinates with the PD/PM but reports directly to Bechtel's manager of Quality Services. This arrangement ensures independent oversight of all matters pertaining to quality processes and procedures.

2.2 Work Process and Tools

2.2.1 Engineering

The approach outlined in this section forms the foundation that Bechtel uses to manage our engineering efforts on projects and studies. As project development progresses, we work with our customers to adjust this approach to address the project's specific requirements.

Design processes define the methods that Bechtel Engineering uses to prepare, review, approve, and control drawings and system descriptions. Our key processes are discussed in the following paragraphs.

iCOMET®—Bechtel uses iCOMET, our proprietary conceptual modeling and estimating tool, during the scope development and optimization phase. With iCOMET as the base, Bechtel transitions to 3D computer-aided drafting and design (CADD) as the controlling tool for the detailed design and construction phases to effectively coordinate among engineering disciplines, the construction team, clients, and equipment suppliers. This tool also significantly improves the engineering schedule and provides a superior design.

3D CADD—Exclusive use of 3D CADD to capture engineering data electronically has been Bechtel's standard practice for over a decade. Examples of tasks performed using 3D CADD include:

- Identify and resolve interference issues
- Develop accurate material takeoffs
- Provide composites for the project and the Owner
- Control construction materials and quantities
- Provide the client with a clear understanding of design concepts and perspectives
- Confirm dimensions to eliminate errors or rework
- Determine resource loading requirements for schedule input
- Permit designers and owners to view allocated maintenance access ways
- Allow Construction to plan construction activities

Bechtel's modeling work process uses the 3D model, an intelligent database viewed using Microstation. The 3D model is also integrated into our procurement work process, project controls activities, and the tools used by Construction. The model contains most Bechtel-designed commodities, as well as vendor-supplied packages for both aboveground and underground components. The vendor-supplied packages are included in the model to streamline construction and to identify/resolve any physical problems between suppliers before construction. A Microstation CADD terminal can be provided at any location for viewing the model during project execution.

Drawing Holds—When details of a pending drawing or system description change have not been finalized, but the document must be issued for other purposes, the area of the drawing not finalized is clearly identified as HOLD.

Checking—Drawings and calculations are independently checked by an individual qualified to have originated the drawing or system description; sketches and preliminary design drawings issued off project may be excluded from checking. The checker follows Bechtel's standard checking practices.

Coordination—Drawings are coordinated within the engineering disciplines using Bechtel standard guidelines.

Reviews and Approvals—Review and/or approval are the responsibility of the chief engineer, engineering group supervisor (EGS), and PE.

Drawing Change Notice—The drawing change notice (DCN) provides a means of documenting changes to design drawings without the immediate need to revise the drawings.

Incorporating Change Documents—Outstanding change documents (DCNs, field change requests [FCRs], field change notices [FCNs]) must be incorporated into associated drawings, by drawing revision

Register—Issued revisions of drawings (including sketches), DCNs, and system descriptions are recorded in ***Info****Works*™, Bechtel's proprietary document controls system maintained by Project Administration.

Design Document Submittals—As engineering designs are developed, Bechtel submits to the Owner those design drawings identified in the contract as requiring Owner's review or approval.

ProjectWorks*®—**Bechtel has developed ***Project*Works*, a comprehensive suite of proprietary engineering and equipment management tools, to track characteristic quantities, deliverables, and status over the life of a project. ***Project****Works* encompasses more than 30 automation tools, or Bechtel Standard Application Programs, that can be used selectively to support the execution of fixed price projects. The objectives of ***Project****Works* are to reduce the total installed cost (TIC), shorten project schedules, and support globalization by establishing electronic data linkages and integration among offices, jobsites, customers, vendors, and suppliers at different geographic locations. Engineering uses the following ***Project****Works* components:

- PDS-IPID—This module of Intergraph's Plant Design System (PDS) 2D suite of intelligent schematic tools enables rule-driven P&ID drafting using a consistent symbology set and allows data to be extracted from the P&IDs to facilitate downstream design activities such as construction planning, materials management, equipment list management, and piping design.
- iCOMET®—Bechtel's proprietary suite of software tools is designed for the rapid creation of conceptual, intelligent 3D models for the submittal estimate and the early stages of project execution.
- 3D CADD Model (3DM™)—This is Bechtel's three-dimensional computer modeling system developed for use on engineering and construction projects. The system allows the individual discipline

designers and engineers to easily create 3D computer models in support of their design activities.

- ***Pipe****Works*™—This is Bechtel's engineering and procurement application, which is designed to manage bulk quantities out of the 3D modeling system.
- SETROUTE®—This is Bechtel's electrical cable, raceway, equipment, and wiring database tracking and installation system.
- INSPEC™—This Bechtel engineering database and application develops and maintains the project instrument index and I/O list, and works with the intelligent P&ID (IPID) and 3DM databases.
- ***TEAM****Works*™—This is Bechtel's construction application for tracking mechanical and electrical equipment, piping lines, spooled pipe, bulk pipe, field welds, instruments, valves, receiving information, and installation status dates
- DataBroker™—This Bechtel engineering application is designed to manage the electronic data exchanges among the different ***Project****Works* applications.

Other Engineering Tools—These include:

- CAESAR II—pipe stress analysis
- ETAP—short-circuit, load flow, voltage drop, motor starting, cable ampacity derating in duct bank, and cable pulling
- Multiground+—ground grid design calculation
- FAPPS—structural beam analysis calculations for pipe supports
- InRoads—civil engineering site and highway design
- Founds—foundation design

2.2.2 Procurement

The automated and integrated processes of Bechtel's industry-leading Bechtel Procurement System (BPS) allow us to manage equipment and materials on a real-time basis throughout all project phases, from design to operation.

The PPM dedicated to the project team plans, organizes, staffs, and manages procurement activities. The PPM develops a procurement plan for purchasing equipment and engineered bulk materials. The procurement plan is consistent with the overall project milestone summary schedule (MSS).

Bechtel prepares a material assignment schedule (MAS) for every project. The MAS identifies permanent plant equipment, materials, and services and captures the overall procurement plan, including items subject to shop surveillance and shop expediting per the supplier quality surveillance plan.

Bechtel prepares a supplier quality surveillance plan, designating the equipment and the specific surveillance inspection points we intend to make. Customer-specific quality, inspection, and shop testing requirements are considered and incorporated during plan development.

2.2.3 Construction

Bechtel plans, organizes, and controls all aspects of the construction process and provides all labor, supplies, materials, equipment, tools, and transportation required to perform the work.

Bechtel assigns the SM, project field engineer (PFE), and construction coordinator (CC) at the very outset of the project and may also assign the project field superintendent (PFS) and a PSUM at this time. These individuals are assigned at this early stage to make sure that the complex factors involved in building and testing the facility are taken into account during the project's design and procurement phases. During the several months these team members spend in the office before site mobilization, they:

- Make sure that construction input is integrated into schedules across all functions
- Review the commodity design for constructability and ease of procurement
- Help decide what part of the work is provided to specialty subcontractors
- Plan for the appropriate start of temporary facilities leading to site mobilization

The pre-mobilization period also finds the construction team making decisions on approaches for site access, equipment delivery, traffic and logisitics (T&L), equipment modularization site storage, and similar construction needs. For example, early in the project, opportunities to modularize selected components are evaluated in terms of benefits that could be realized by maximizing offsite shop fabrication/preassembly. Modularizing certain components off site can:

- Decrease onsite craft population
- Reduce time spent in potentially hazardous work situations because less time is required in elevated work locations and congested areas

- Improve schedule performance
- Potentially reduce site cost for support services due to reduced need for cranes and other indirect activities
- Provide greater ability to maintain work product quality

Labor is by far the single largest risk in executing a major project. It is the largest element of project cost and is subject to the most variability. Therefore, Bechtel establishes project labor and industrial relationship management programs to effectively manage the labor forces. Our oversight effort includes recruiting and training the craft worker population while maintaining strong working relationships at all levels of labor leadership.

For each large project, we prepare an Industrial Relations Plan. To begin this process, experienced Bechtel professionals perform a comprehensive labor assessment by researching the local labor market at the project site and surrounding areas. Once we have established craft availability and the effect of competing projects on the workforce, we are in a position to determine the appropriate steps to take to recruit and retain the needed craft workers in accordance with the project's staffing schedule.

Bechtel staffs large projects with a full-time labor relations professional. Should any labor-related issues affect the project, we immediately notify the customer.

Bechtel typically provides a comprehensive Site Security Plan, as well as a site-specific Construction Environmental Control Plan (CEMP), before project mobilization. Both plans carry through to substantial completion.

The detailed procedures and responsibilities in Bechtel's CEMP constitute a comprehensive program for managing environmental compliance during construction. The CEMP also addresses the process for monitoring jobsite activities during construction to maintain conformance with the contract, applicable permits, and applicable laws. Additional CEMP activities include:

- Development of an environmental compliance matrix
- Emergency response training
- Environmental monitoring

We designate an onsite Bechtel representative to monitor construction and startup activities for conformance to the CEMP, applicable permits, and applicable laws.

2.2.4 Project Controls

Bechtel's Project Controls department is responsible for estimating, scheduling, cost control, and management reporting functions. Our Project Controls organization implements and administers proven and effective estimating, cost, and schedule management systems and procedures for each project phase. The estimating, schedule control, cost control, and management reporting systems and procedures used on the project conform to corporate standards and are specifically tailored for the project's needs.

A project estimator is assigned to the project to direct and coordinate the overall estimating effort. Under the project estimator's direction, the estimating team prepares a cost estimate based on the client's Request for Proposal (RFP), company standards, and current market trends. The group uses Bechtel's in-house-developed estimating tools—Estimating Process Integration and Control (EPIC) and Bechtel Intelligence Database (BID).

EPIC allows work process integration across functional departments such as Engineering, Procurement, and Estimating. EPIC also allows development of detailed estimates with the capability to summarize the capital expenditures (CAPEX) estimate at various levels to facilitate review and comparison. BID captures technical and commercial information from both historical and current projects and contains technical parameters and pricing records of more than 8,000 pieces of equipment.

Schedule control is accomplished via a hierarchical system of schedules built on the specific details required by each level of the organization. These schedules are interrelated; hence, each successive detail level ties into the milestone end dates in the preceding summary level, up to the project milestone summary schedule (MSS)—the highest level. Proceeding from the overview level of the MSS, schedule tools falling within Levels II and III in the hierarchy provide the details needed to effectively control designated activities and allow ample communication and coordination among the project team members.

Bechtel's proprietary cost control system, *e***PC***Works*™, is an in-house, module-based desktop software program developed by Bechtel. This program integrates with other Bechtel applications that support engineering, procurement, construction, and finance and accounting and provides accurate, timely reporting of costs, quantities, and commitments. *e***PC***Works* allows specific modules to be selected, as required, for effective control of project elements.

Reports produced are based on specific project and contractual needs and follow normal business practice. Regular reports include:

- Monthly project progress report
- Monthly client review meetings
- Physical percent-complete curves
- Commodity release and installation curves for concrete, steel, underground large bore pipe, aboveground large bore pipe, small bore pipe, cable, conduit, cable tray, and terminations
- Manpower curves

2.2.5 Startup

The PSUM is initially assigned to the design office in Frederick to:

- Provide input from a startup and operation and maintenance (O&M) perspective during design
- Develop and issue the Project Startup Manual

Approximately 3 months before energization, the PSUM relocates to the site and assembles the startup team. This team starts up and commissions each system, provides on-the-job training (OJT) to Owner O&M personnel, conducts system-by-system turnovers, conducts performance tests, and brings the project to Commercial Operation.

Bechtel prepares administrative and technical startup procedures compatible with the requirements of the connecting utilities.

Bechtel Startup prepares and submits system turnover packages on a mutually agreed-to schedule. (Note: Some of these systems are turned over as groups of systems or subsystems.)

Bechtel provides OJT and instruction for the customer's O&M personnel, augmented by classroom training provided by the equipment suppliers. The final O&M training program and schedule are mutually developed with the customer.

2.2.6 Contracts

The Contracts department provides subcontract services that meet or exceed project safety, quality, and cost and schedule objectives. These services include preparing and managing construction, service, and engineering subcontracts. The Contracts department provides services through direct on-project staffing and, when necessary, through off-project support. The Contracts department works closely with the customer and Bechtel's Construction, Engineering, Procurement, and Project Controls groups to prepare the subcontracts to be executed for the project.

The project contracts administrator (PCA), subcontract formation specialists, and field subcontract administrators use tools and methods designed by the department to provide consistency across the project. They also use the tools of other departments, particularly Project Controls, to monitor project performance against schedule and cost requirements, to identify scope and contract changes, to measure and weigh the consequences of project risk, and to measure the Contracts department's own performance and contribution to the project.

Representative tools include, but are not limited to:

- Subcontract compliance matrix (inclusive of responsibility, notices, requirements, and submittals for the subcontracts, scope book, and permits)
- Subcontract management schedule
- Subcontract management responsibilities
- Permits matrix
- Tax guideline (project specific)
- Subcontract formulation status/tracking report
- Scope change report
- Milestone summary schedule (plus Level II schedules)
- Subcontractor status report (field reporting for home-office- and field-issued subcontracts)
- Backcharge log
- Pro formas for home-office- and field issued subcontracts (long form and short form)

Bechtel conducts job fairs for local business organizations at project outset to promote and coordinate local subcontractor involvement. We also optimize local sourcing for other subcontracts to align with customer expectations and the project's goals.

Bechtel provides opportunities to minority, women-owned, and disadvantaged business enterprise (MBE/WBE/DBE) firms to bid subcontract packages that maximize the use of their respective skills and expertise while increasing their knowledge of engineering, procurement, and construction technology. The subcontractors included in the customer's Diverse Suppliers List are included in the bidders list for the relevant commodities.

2.2.7 Quality Management

Bechtel maintains and implements a robust Quality Management System (QMS) that includes integrated, yet independent, quality assurance (QA)/quality control (QC) functions as part of our standard processes. To maintain a high degree of quality control and thereby minimize rework, we use standard procedures and work processes that incorporate independent checks and off-project reviews. These procedures and work processes are implemented from the beginning of a project through its completion and operation.

2.2.8 Environmental, Safety, and Health

Safety and quality are the cornerstones of Bechtel's corporate values. We want our customers and their communities and stakeholders to view us as responsible and responsive in helping to protect the environment, people, and places where we work and live.

The base project document outlining Bechtel's approach to managing safety and health is the Project Environmental, Safety, and Health Plan. This plan addresses the systematic management approach to safety and health in the following areas:

- Project philosophy
- Safety principles
- Ownership
- Duties and responsibilities
- Training
- Contractor's safety plan
- Safety audits/assessments
- Motivation program
- Contractor's Joint Safety Council
- Incident investigations and recording
- Project safe practices

Day-to-day project ES&H management is governed by ES&H procedures. These procedures are developed from existing Bechtel core processes; the requirements of the scope book and EPC contract; the Project Environmental, Safety, and Health Plan; the Project Construction Environmental Control Plan; and applicable regulations and legislation.

2.2.9 Document Control

***Info**Works*, Bechtel's proprietary electronic document management system, controls documents in an electronic format throughout their life cycles, beginning with creation or receipt, through distribution, use, maintenance, and final disposition. ***Info**Works* provides complete document management of project documents from a common repository, streamlining and automating the document handling and management process on projects.

Third-party commercial software vendors supply the basic programs, and Bechtel provides configuration and customizations. ***Info**Works* provides a central repository for all project records; no matter where project execution takes place, these records can then be transferred to a customer at facility turnover. All documents, whether generated by the project team or by vendors, are retained in ***Info**Works*, which offers indexing and searching capabilities for faster retrieval of information by designers, constructors, and operations personnel, thus reducing the cost of the facility.

The ***Info**Works* system supports the following project work processes:

- Data control with the capability to reproduce issued deliverables
- Functionality unique to project automated applications
- Information to start a new project based on historical project data
- Consistent user interface across all developed applications
- Interface with third-party software

Bechtel's globalization initiatives have established a corporate capability to leverage and share information and perform multiproject work simultaneously in multiple project execution locations. This capability exists across all global business units (GBUs) in all regions through the standardization of our numbering system for components, commodities, documents, and plant systems.

Corporate standard numbering system procedures define the numbering structure and codes incorporated into Bechtel's computer applications (e.g., ***Info**Works*) for use in project-, department-, and corporate-related work activities.

2.2.10 Information Systems and Technology

Information Systems and Technology (IS&T) is Bechtel's strategic technology resource and is actively engaged in all phases of EPC projects, providing systems, technology, and business advocacy that enable the work Bechtel does.

The Power GBU IS&T structure includes a dedicated project IS&T manager (ITM), who is assigned to the project and functions as an integral part of the project leadership team. The ITM develops the necessary Automation Plan in concert with all stakeholders in the Bechtel and client organizations to deliver the optimum level of project automation.

Bechtel Standard Application Programs (BSAPs) support Bechtel's EPC work processes. The BSAPs are considered "best in class" for the EPC industry and are used successfully on hundreds of Bechtel projects across various business lines spanning multiple geographical sites and locations. The BSAPs consist of commercial and/or Bechtel-developed applications that are fully supported by our staff. The IS&T Enterprise Systems group maintains a full suite of standard applications to support the project's engineering, procurement, construction, and support service groups.

Bechtel has developed and established a detailed data exchange plan (known as a data exchange map) to fully define the required data exchanges among the BSAPs. The primary goals are to deliver the information necessary to execute Bechtel's work activities in the most expedient manner and to minimize duplicate data entry across all functions. An information integration solution called DataBroker™ is used to exchange and validate data transfers among BSAPs and/or commercial applications.

Bechtel IS&T provides a comprehensive suite of collaboration tools to meet the information sharing and retention needs of our projects and customers around the globe. The following tools are currently in use to facilitate collaboration and promote project success:

- *eRoom*—Allows secure Internet exchange of documents between Bechtel and external parties. It is ideal for project collaboration with clients, suppliers, partners, subcontractors, etc., because it enables collaboration both inside and outside the Bechtel firewall. It is also useful for work groups across Bechtel requiring controlled content collaboration capabilities.
- *LiveMeeting/conference calling*—Enables secure global conference calls and computer desktop sharing with Bechtel global offices and external parties associated with a project.
- *BECTransfer*—Allows secure data file exchange, removing the security vulnerabilities associated with the typical file transfer protocol process used by many organizations.
- *Video conferencing*—Enables Bechtel's dispersed work force to communicate with one another and provides a vehicle for interacting with Bechtel's global client base. IS&T has deployed

video conferencing to all major Bechtel offices, including several project sites. Video conferences involving multiple Bechtel sites, including clients, require the use of a video conferencing bridge that IS&T can help establish.

Bechtel has deployed a highly resilient global network that extends to over 200 offices and project entities across the globe. Major network hubs are located in the US, the UK, and Asia.

A Bechtel 24/7 Global Network Operations Center (NOC), Global Security Operations Center (SOC), and Global Helpdesk (GHD) are in place to maintain our global network and infrastructure in the most cost-effective, secure, and efficient manner. The GHD provides around-the-clock service to resolve support issues related to applications and infrastructure products and services. Infrastructure services of specific interest are:

- Microsoft Windows-based server and domain architecture
- Microsoft Outlook-based e-mail environment
- Global voice over IP (VoIP) and video conferencing services
- eRoom, LiveMeeting, and Sharepoint collaborative environments
- Standardized global wireless network architecture
- Change-management structured process for managing changes to the global computing environment

2.3 HSE Philosophy

2.3.1 Introduction

The objectives of the Kårstø CO_2 Carbon Capture and Compression (CCC) Plant's health, safety, and environmental (HSE) policy are:

- Zero accidents or losses
- Zero harm to people and the environment and no loss in material values from preventable accidents
- Zero work-related illnesses

The overall philosophy adopted for the CCC Plant includes:

- Create a clear HSE commitment, provide professional HSE leadership, and provide for effective coordination in overall project design and execution
- Transfer experience from similar applicable projects

- Create a good working relationship among involved stakeholders participating on the project

All HSE-related design elements apply the concept of achieving levels that are as low as reasonably practicable (ALARP) during the assessment and analysis of risk and mitigation strategies. The HSE principles applied during front-end engineering and design (FEED) span the following general areas and project considerations:

- Occupational health and working environment (WE)
- Plant layout and design
- Fire and explosion (F&E) risk assessment and mitigation
- Escape, evacuation, and rescue planning
- Ignition source controls
- Hazard identification and process hazards analysis (PHA) (inherently safer design)
- Process and emergency shutdown
- Fire and gas (F&G) detection
- Emissions and discharges (land, water/sea, air)

Compliance with project objectives has been detailed in various completed FEED study documents and is summarized in the following subsections.

2.3.2 Occupational Health and Working Environment

The overall WE design goal is to address and treat all hazards to maintain risk at a level that is ALARP. This approach avoids occupational injury and ensures compliance with the overall project and CCC Plant operational goal of "zero harm" to workers and members of the public, whether present or external to the site. This approach is detailed further in Subsection 2.4.

2.3.3 Plant Layout and Design

The best available safety techniques for chemical process plant layout and design (e.g., American Petroleum Institute [API], International Organization for Standardization [ISO], Center for Chemical Process Safety [CCPS], American Institute of Chemical Engineers [AICHE]) were considered. Standard industry practices drove the layout and design development of the plot space.

To assess the design in its early stages during FEED, a hazard identification (HAZID) study was completed. Action items related to plot space development and layout were incorporated into the design.

The project team undertook plant layout reviews during FEED, and layout change requirements were incorporated into the design. The overall assessment of plant layout safety for HSE purposes is provided in the Layout Safety Review Report.

2.3.4 Fire and Explosion Risk Assessment and Mitigation

An F&E strategy was submitted during FEED. The strategy is based on the guidance provided in ISO 13702. The CCC Plant is categorized into three main sections/areas:

- Flue gas tie-in area (blower and quench section)
- Amine process and storage areas
- CO_2 compression and drying section

The flue gas and CO_2 compression/drying sections do not present any credible fire scenarios, and gaseous releases do not create dimensioning events of an explosive nature resulting in extreme overpressure.

Fire hazards associated with the amine process and storage areas are addressed in the design through the provision of fire water protection systems, detection systems, emergency shutdown (ESD)/plant shutdown (PSD) systems, and layout considerations.

CCC Plant staff are expected to respond to a fire condition by escaping to the temporary muster point for the CCC Plant to await instruction. Firefighting activities are to be coordinated with the main site fire brigade for all fire responses.

2.3.5 Escape, Evacuation, and Rescue Planning and Documentation

An escape, evacuation, and rescue strategy (EERS) was submitted during FEED, based on NORSOK S-001 and ISO-13702 standards. This EERS defined the main stores area as a temporary muster point (designated as TR), which is reflected on preliminary escape route drawings.

The CCC Plant is an onshore facility. No credible fire, toxic gas, or explosion hazards are present that can escalate to the designated muster area under a single-failure event (e.g., localized spill or leak). The formal evacuation and rescue provisions required for offshore facilities are not required. Emergency response plans are to be provided in the event of personnel injury.

2.3.6 Ignition Source Controls

Prevention of fire in the CCC Plant is a design absolute. Control of ignition sources through inherently safer design practices is considered in the FEED design.

Under a developing process upset condition, combustible gas release, or fire, central control room (CCR) operators can selectively isolate equipment from service as ignition sources or trigger an emergency shutdown of the unit and call a general escape.

The CCC Plant heating, ventilating, and air-conditioning (HVAC) design criteria consider elevated intake locations to prevent gas aspiration. All HVAC intakes consider the installation of combustible gas detection in the intake ductwork. Appropriate safety and automation system (SAS) interlocks shut down fans on gas detection.

The hazardous area classification is in accordance with the requirements of IP15, 3rd Edition. An atmosphere explosibles (ATEX) assessment was completed, and a preliminary area classification drawing was prepared. The required general outdoor classification of Zone 2, Group IIA, Class T2 has been applied. Below-grade and bunded areas are Zone 1. Electrostatic and natural (i.e., lightning) ignition sources are controlled through bonding and grounding systems considered in the design.

There are no credible hot surface ignition sources since process temperatures are well below the ignition temperatures of the chemicals used in the CCC Plant or outside the battery limits.

2.3.7 Hazard Identification and Process Hazards Analysis (Inherently Safer Design)

To assess the various design elements during early FEED, a HAZID study was completed. In this study, 41 action items were identified and 22 recommendations were entered for treatment during FEED. All risks treated during FEED were considered for incorporation, some during the engineering, procurement, and construction (EPC) design stage.

A hazard operability (HAZOP) assessment (a PHA) was completed in the latter stages of FEED. During this analysis, 104 action items were identified to address risk and hazards related to fire, explosion, exposure to hazardous airborne materials/liquids/solids, material spills, electrical shock, and exposure to ionizing radiation. All risks treated during FEED were considered for incorporation into the design during the EPC design stage.

2.3.8 Process and Emergency Shutdown

The CCC Plant CCR is a pivotal element in the overall plant design for HSE risk mitigation. The human-machine interface (HMI) in the CCR design ensures operator situational awareness of process conditions and drives appropriate actions during upset conditions or emergencies.

The distributed control system (DCS)-based PSD system provides functions to shut down the CCC Plant automatically in a safe and controlled manner in the event of abnormal operating conditions that could endanger human safety.

The ESD system can actuate the appropriate PSD sequences, provide ignition source control, and safely depressurize the unit. The ESD functions are manually initiated by the operator, usually as the result of a fire, major spill, combustible gas detection, etc. This system is shown conceptually in the SAS architecture diagram, drawing number 10112936-PB-I-DRW-0001 (25474-000-JD-JD-00001).

2.3.9 Fire and Gas Detection

The F&G system status and alarms are annunciated at the DCS operator stations. A manual operator response is required for F&G alarms.

The F&G detection system is largely an alarm system but does have some executive actions in compliance with CCC Plant HSE requirements (e.g., HVAC system shutdown). This logic is depicted in applicable cause-and-effect charts for the CCC Plant design.

Audible and visual annunciation (horns/bells and strobe lights/ beacons) are placed with consideration to normal paths of travel and prevention of access and/or egress from an enclosed spaced under a leakage condition or exposure.

2.3.10 Emissions and Discharges

The primary airborne discharge from the CCC Plant is vapor emissions from the absorber towers.

The primary water discharge from the CCC Plant is warmed seawater from the open heat exchange system employed in the design.

The CCC Plant design reduces effluents to land, water, and air to minimize their impact on the environment and workers. The design also provides for recycling of effluents into the process.

Emissions and discharge data forms document the potential effluents from the CCC Plant and consider normal operations, upset conditions, fugitive emissions, process waste, and amine degradation byproducts from amine regeneration. Coordination with the main site waste disposal plans (StatOilHydro WR1839 document) is taken into consideration.

Professional services for waste disposal, chemical and waste storage, emissions abatement, and effluent treatment prior to disposal are considered in the design.

A formal Environmental Impact Assessment (EIA) is required during FEED. The emissions and discharge data forms provide input to this.

2.4 Occupational Health Approach

2.4.1 Occupational Health Objectives and Overview

A fundamental principle of the CCC Plant HSE program documentation states that the operations are to achieve zero harm to people. To achieve this objective, the project and operational occupational health approach allows the following actions to be performed:

- Identify the HSE authority requirements applicable to the CCC Plant design
- Define the standards applicable to the HSE design
- Provide necessary and correct input for HSE-related studies and assessments
- Assist in coordinating HSE activities with all project stakeholders
- Implement the HSE strategies, programs, and regulatory requirements and demonstrate risk mitigation in accordance with the overall project goal of achieving levels that are ALARP.

The family of NORSOK standards commonly employed for offshore project development HSE activities is the key source of design guidance. Per NORSOK S-002, Working Environment, Clause 4.4.2.0-1, the plant WE impact is to be assessed during the project development cycle and through construction, commissioning, and operation.

WE impact and risk assessments are to be developed and updated to optimize the design to eliminate hazards to workers in the plant areas; to provide efficient, safe, and healthy workplaces; and to reduce the need for modifications during operations.

To optimize the project design, it is necessary to consider technological solutions to prevent unacceptable WE risks for planned tasks that are foreseeable and reasonable.

Use of NORSOK standards must not result in contravention of any legislation, regulations, codes, or stakeholder requirements.

The front-end engineering and design (FEED) project development stage adopted the NORSOK S-002 approach to WE assessment and complies with the requirements of jurisdictional laws, regulations, and codes, as well as stakeholder HSE requirements. This includes the preparation of a detailed concept WE impact assessment (cWEIA) and submission of WE area charts (WEACs) for all foreseeable working environments that could expose workers to hazard or injury.

2.4.2 Concept Working Environment Impact Assessment

During the FEED project development stage, a cWEIA was prepared in accordance with the FEED requirements stipulated in NORSOK S-002, Working Environment, in concert with all requirements from Exhibit E8.1, Section 2.0, HSE Requirements. The following are addressed in the FEED-level assessment:

- Job hazard/risk of occupational injuries
- Ergonomics/prevention of musculoskeletal strains and injuries
- Ergonomics/human factors in work systems
- Hazardous chemicals
- Noise and vibration control
- Illumination
- Outdoor operations – cold stress
- Outdoor operations – precipitation and shelters
- Outdoor operations – flaring
- Constructability

2.4.3 Working Environment Area Charts

Concurrent with the development of the cWEIA, detailed WEACs have been prepared in accordance with the requirements of NORSOK S-002.

A total of 29 WEACs were developed for the various WE exposures. The charts include appropriate WE area limits (WEALs) and requirements as tabulated in NORSOK S-002, Annex A, as modified by stakeholder requirements. Where required by NORSOK S-002, the WEACs include preliminary predictions of worker exposures in relation to the WEALs.

WEACs are updated through the project development cycle to further evaluate and document the design during detailed engineering and then to validate the design during construction, commissioning, and operation.

Certain requirements depend on occupancy or "manning." Therefore, manning levels are required to be defined on the WEACs. Three manning levels are defined in NORSOK S-002:

- **Permanently Manned**: Areas manned at least 8 hours per day at least 50% of the time
- **Intermittently Manned:** Work areas for which inspection, maintenance, and other tasks are planned to last at least 2 hours a day during at least 50% of the days
- **Normally Unmanned:** All other work areas

Functional and working area requirements applicable to the various staffing levels have been considered in the design.

2.5 Risk Management

The project conducts weekly risk management meetings chaired by the PM or assistant PM. All department supervisors and engineering group supervisors or their deputies attend this meeting. The agenda for the meetings is as follows:

- Review newly identified risks
- Review and provide input to the analysis of these risks BEFORE response measures
- Identify the person(s) responsible for completing the Risk Response and Monitoring form for newly identified risks; add name(s) to the Risk Register along with schedule for completing the form
- Update the Risk Register with newly identified risks
- Update the Risk Register with information on previously identified risks, including:

  - Review updates to the Risk Response and Monitoring forms for previously identified risks
  - Review and provide input to the analysis of the risks AFTER response measures
- Update the Risk Register
- Review status of the Risk Management Document
- Identify which risks need to be included in the monthly report

[redacted]

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SECTION 2.6

IS

REDACTED

3.0-Tie-In to Existing CCPP

3.0 Tie-In to Existing CCPP

3.1 Existing Stack Demolition and/or Modification

The existing Naturkraft combined cycle power plant (CCPP) uses a 50-meter-tall, 20-meter-diameter, carbon steel stack to exhaust the combustion turbine flue gas to atmosphere. The flue gas passes through the heat recovery steam generator (HRSG) before exiting the stack through a motor-operated stack damper, which, when closed during plant shutdown, bottles up the HRSG to maintain the HRSG internals hot to allow rapid CCPP restart.

The stack requires modification to accept the new Kårstø CO_2 Carbon Capture and Compression (CCC) Plant flue gas duct connection. The existing stack is used at its current location and height. This maintains the current emissions point location for this source and leaves all upper structures, platforms, and equipment on the stack unchanged. A new exterior structural steel support structure constructed around the stack, with the major portion on the south side of the existing stack, provides lateral bracing of the stack and the new stack breeching (see Figure 3-1). Part of the new support structure is placed on part of the existing HRSG stack foundation, and part is placed on two new foundations placed as part of the modification work.

Figure 3-1. HRSG Stack Modification with Duct Work

The stack is fitted with support shoes at the mid-point level. These shoes are fitted to seats on the support structure to transfer the weight of the upper portion of the stack to the new support structure and relieve the weight from the lower half of the stack. No modification of or connection to the existing HRSG steel stair tower is required.

The stack is modified by cutting an 80-hole pattern in the east face of the stack (see Figure 3-2) exactly like the hole pattern currently being used at the HRSG breeching connection on the west face of the stack. This modification is achieved during plant shutdown. The new stack breeching is placed as a single piece and connected to the stack and new flue gas duct, using the required expansion joints.

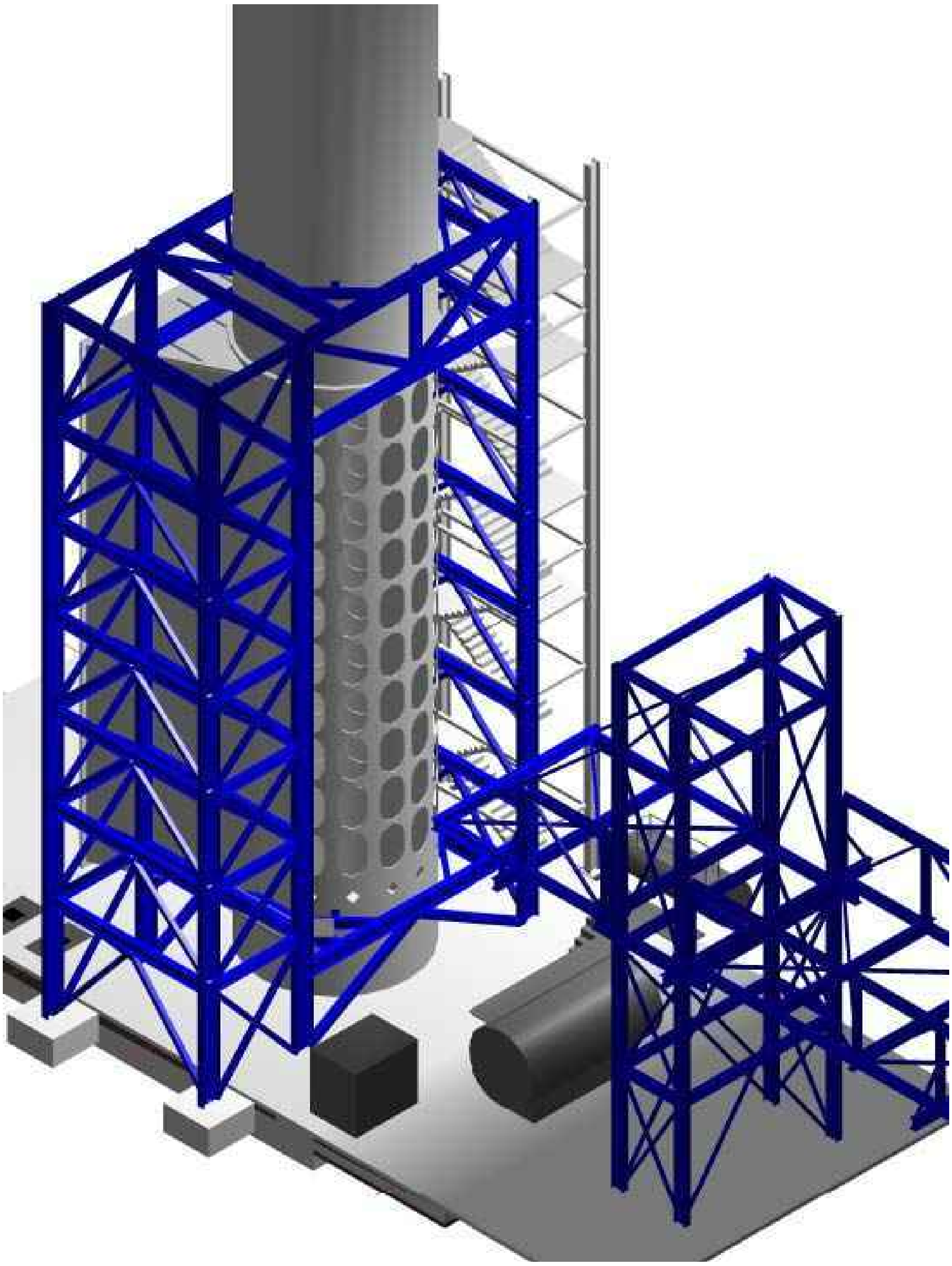


Figure 3-2. HRSG Stack—New Steel Support Structure and Stack Hole Pattern

The existing stack damper is reused but modified with the addition of a pneumatic controller outfitted with a local air reservoir to permit the damper to be modulated from full open to full closed rapidly.

The chemical treatment equipment and stack continuous emissions monitoring system (CEMS) located at the base of the stack are shifted to a nearby location on the stack foundation. The electrical and piping are reconnected using electrical terminal boxes and flanges. The CEMS umbilical is entirely replaced and the system recalibrated. The existing auxiliary boiler is not changed or modified. The auxiliary boiler stack is rerouted from the boiler up the new steel tower, but the upper portion running alongside the HRSG stack remains unchanged. This maintains the current emissions point location for this source.

The flue gas duct, its support bridge steel and two support towers, and the two flue gas duct guillotine isolation dampers located within the CCPP, along with the new stack support structure, are installed during normal CCPP plant operation. The portion of flue gas duct located within the CCPP is designed to be fabricated off site and lifted into place in one piece.

3.2 Alternate Stack Study (If required)

Other stack modification options involving lower costs and possibly a shorter outage exist for constructing the connection of the CCC Plant flue gas duct to the HRSG stack. One such option is to penetrate the existing stack's east face by perforating the side with 80 holes the same size and location as the current west face design. The openings then would be reinforced with ribbing vertically and horizontally to provide the necessary structural reinforcing to avoid the need for an exterior steel support structure. These options are most appropriately pursued during the project's engineering, procurement, and construction (EPC) phase when opportunities to coordinate outages and modifications acceptable to Naturkraft can be openly discussed.

3.3 Emissions Dispersion for Modified/New CCPP Stack

The present CCPP HRSG stack is modified so that an exit breeching can be attached on its east side to redirect the combustion turbine flue gas into the ducting to the CCC Plant instead of out the top of the stack.

At startup, the existing stack damper is open, permitting the flue gas to exit the stack at the top, at the current mass flow and temperature, velocity, and gas composition. Once the CCC Plant becomes available, its flue gas blowers are started, the HRSG stack damper is slowly closed in synchronism with the blower variable frequency drive (VFD), and 100% of the CCPP flue gas is redirected to the CCC Plant.

The CCC Plant uses two flue gas blowers to create a negative pressure in the duct, causing the flue gas to be pulled into the plant. The use of variable speed drives on these blowers plus, as necessary, inlet damper control on each blower, enables the CCC Plant to control the flue gas flow so that essentially no flue gas exits the HRSG stack.

Some small amount of stack damper leakage can be expected through the present split-half Raumag Janich DN 7000 damper. This leakage is expected to be a minimal amount coming into the stack during normal and part load operation and affects neither CCC Plant nor CCPP operations. Emissions from the HRSG stack during CCC Plant operation are expected to be essentially zero.

Based on CCC Plant design, no change is necessary in the HRSG stack emissions parameters, such as mass flow and velocity, temperature, and gas composition, during CCPP operation without the CCC Plant, and these stack emissions parameters are essentially zero when the CCC Plant is operating. Under partial output operation of the CCPP (plant turn-down) with the CCC Plant not in operation, flue gas mass flow and velocity, temperature, and gas composition remain unchanged from the present design. With the CCC Plant in operation, the emissions from the CCPP are again essentially zero, with minimum stack damper leakage. Under partial operation of the CCC Plant, CCPP flue gas mass flow out of the HRSG stack is reduced proportionally, with velocity, temperature, and gas composition unchanged from the present design.

3.4 Flue Gas Ductwork to CCC Plant

The flue gas duct to the CCC Plant is approximately 6 x 6 meters square and made of carbon steel up to the fogging system grid, at which point it changes to stainless steel all the way to the absorbers. The ductwork is supported by bridge steel to permit offsite fabrication and to permit installation at the site by crane. This also permits the individual duct sections to be removed for future heavy haul access as required. The support towers and their foundations are placed as early as they become available from the fabricator. The duct is fully insulated for thermal protection and for noise. Platforms are provided for access to instrumentation and to service the guillotine isolation dampers.

Two guillotine isolation dampers in series are provided at the HRSG stack to allow positive shutoff of the flue gas. These are strictly open–closed devices with a seal air system to provide positive pressure between the dampers to prevent gas from entering the ductwork during interior duct maintenance.

Piping, power, air, instrumentation, and controls to service the ductwork and the CCC Plant tie-in are provided from the CCC Plant and are routed along with the ductwork.

3.5 Conclusions and Recommendations

The design provides the necessary stack modifications without revising the location of the emissions points of the CCPP combustion turbine and auxiliary boiler, with minimum impact to other Naturkraft equipment and facilities, and is achievable within the prescribed maximum 4-week breaker-to-breaker CCPP outage requirement.

4.0-Flue Gas Cooling

4.0 Flue Gas Cooling

4.1 Cooling Alternatives

The Kårstø CO_2 Carbon Capture and Compression (CCC) Plant flue gas comes from the Naturkraft combined cycle power plant (CCPP) gas turbine/heat recovery steam generator (HRSG) discharge. It is relatively dry compared with that of coal-fired power plant flue gas, which is normally downstream of a wet flue gas desulfurization process. Methods of cooling the CCC Plant flue gas include the following alternatives:

- Indirect flue gas cooling using water-cooled fin-tube coils
- Evaporative cooling using direct contact water spray or fogging
- Direct-contact cooling using a packed bed with a side-water cooler

The first option is considered to be very costly. It requires the cooler to have a cross-sectional area the same as the HRSG. If seawater cooling is used in the tube side, the cold water may cause flue gas condensation on the fin-tube, so a stainless steel fin-tube material would be required. The flue gas from the CCPP is relatively dry, but to keep it from drying out the amine solvent must be saturated with water before it is sent to the amine scrubber. This cooling system, being dry, would not provide the needed water for saturating the flue gas, only if the wet bulb is above the cooled temperature.

The second option of using evaporative cooling by a spraying or fogging system can reduce the flue gas temperature and saturate the flue gas with water. This is a low-cost option because water spraying does not require special equipment and provides a very efficient means of cooling by using water evaporation. However, it cannot reduce the flue gas to below its dew point. The flue gas has a dew point of about 48 °C, and the design flue gas temperature entering the absorber tower is therefore set at about 50 °C. This temperature was chosen to achieve a balance between capital and operating costs.

The third option is to use a packed bed, direct-contact cooling section, either in a separate vessel (quench tower) or as an integral packed bed in the absorber bottom section. The packed bed can be sized to cool the flue gas to as low as 25 °C with the available 11 °C seawater temperature.

The current alternative selected is the second option, using just a fogger, as the most economical approach for a generic monoethanolamine (MEA) solvent.

4.2 Cooling Equipment Selection and Layout

As noted, the evaporative fogger has been selected for the FEED study base case. It involves two stages of water spraying. The primary fogger is a single spray grid located in the main duct run from the CCPP upstream of the flue gas blowers. Because the flue gas blowers increase the flue gas temperature by about 5 °C, a trim fogger is added downstream of the blower to further cool the flue gas to near its dew point. The fogging system consists of spray nozzles with spray trees. The spray water is supplied by two 100% pumping systems. A water tank is provided to supply water to the pumps.

4.3 Cooling Performance

Cooling the flue gas affects steam consumption and electrical power consumption, as described below.

4.3.1 Steam Consumption

The amine plant reboiler steam consumption is influenced mainly by the following parameters:

- Inlet flue gas temperature
- Solvent CO_2 loading

Inlet flue gas temperature affects steam rate because, at lower gas temperature, the CO_2 loading in the amine solvent can be increased. At higher CO_2 loading, the amine circulation rate is reduced, and the steam needed to regenerate the rich amine is also reduced.

Solvent concentration also plays an important role in steam consumption. At higher concentrations, CO_2 loading is increased per cubic meter of circulating solvent, and the heat needed to regenerate the rich amine is reduced.

Simulation runs performed to document the effects of flue gas temperature at absorber inlet and solvent concentration on steam use rate produced the results shown in Table 4-1.

Table 4-1. Results of Simulation Runs

MEA (%)	Flue Gas Temperature (°C)	CO_2 Capture Efficiency (%)	Steam Rate - Gross (kg steam per kg CO_2)	Case
35	50	85.3	1.56	Normal
35	35	84.4	1.46	Normal
36	35	85.5	1.44	Normal
38	35	85.7	1.38	Winter

The table shows that the reduction of flue gas temperature has a significant impact on steam rate. To reduce the flue gas temperature from 50 °C to 35 °C requires a packed bed cooling section or separate quench tower.

Increasing the MEA concentration is an approach that has a positive impact on steam rate, but it increases the corrosiveness of the solvent on carbon steel. Because the design employs an all stainless steel (SS) system, a higher concentration is potentially feasible without negative impacts on equipment life.

4.3.2 Electric Power Consumption

Cooling the flue gas temperature to 50 °C reduces the power consumption of the flue gas blower. A further reduction in electric power consumption is possible by further reducing the flue gas to as low as 25 °C as noted above.

4.4 Conclusions and Recommendations

The current design employs a fogger to reduce the flue gas temperature entering the absorber to 50 °C. This simple design provides a system that has a minimum capital cost. If economically justified, a lower steam rate is possible by including a separate direct contact cooler (DCC) or a short packed bed at the bottom section of the absorber tower to further cool the flue gas and increase its rich amine loading factor.

Further flue gas cooling leads to a lower flue gas effluent temperature at the absorber overhead (top) discharge, depending on wash water temperature. A low-temperature discharge flue gas has low buoyancy, and may have a negative impact on flue gas dispersion.

5.0-CCC Plant Process Design

5.0 CCC Plant Process Design

5.1 Design Basis

5.1.1 Battery Limit Conditions

The Norwegian Government intends to develop the Kårstø CO_2 Capture and Compression (CCC) Plant in association with an existing 420 MW gas-fired Naturkraft combined cycle power plant (CCPP) in Kårstø, Norway. The CCC Plant is required to recover at least 85% of the CO_2 contained in the flue gas from the CCPP and deliver liquefied CO_2 to the CCC Plant battery limit (B/L). B/L conditions for the incoming flue gas and the CO_2 product stream are presented in this section.

The flue gas conditions for the seasonal cases are shown in Table 5.1-1.

Table 5.1-1 CCPP Flue Gas Conditions

Parameter	Normal	Summer	Winter
Mass flow (100% load) (kg/s)	704	645	725
Temperature (C)	90	85	100
Composition			
Oxygen (wt %)	14.4	14.2	14.5
Nitrogen (wt %)	73.6	72.7	73.8
Argon (wt %)	1.2	1.2	1.2
Water (wt %)	4.9	4.9	4.9
CO_2 (wt %)	5.9	5.9	5.9
NO_x (ppmv)	4	4	4
NH_3 (ppmv)	4	4	4
SO_2 (ppmv)	0.1	0.1	0.1

The CO_2 product is required to meet the criteria shown in Table 5.1-2.

Table 5.1-2 CO_2 Product Specifications

Composition	Specification
Carbon dioxide (mol %)	>99.6
Nitrogen (wt %)	<0.04
Water (ppmw)	<50
Hydrogen sulfide (ppmw)	<100
Oxygen (wt %)	<200
Ammonia	Trace
Amine	Trace
Physical Properties	
Temperature (C)	50 max.
Pressure (barg)	200
Phase	Liquid

5.1.2 Process Variables and Configuration

The process variables and configuration were established to capture a minimum of 85% of the yearly emitted CO_2 from the flue gas produced by the CCPP.

The CO_2 must be captured via an amine absorption process. The amine solution employed in the base design case is aqueous monoethanolamine (MEA) at 35% (wt).

Due to Kårstø ship size restrictions, the largest diameter vessel that can be received is 12 meters. To treat the flue gas from the CCPP, a single cylindrical absorber vessel would have to be approximately 17 meters in diameter. Cylindrical vessels were chosen because their fluid flow patterns are well documented and understood versus those of other geometric configurations, and vessels of a maximum of 12 meters in diameter were selected to operate in parallel.

Downstream of the absorbers, the flows combine into a single-train configuration because the equipment sizes are small enough to be handled by ship.

To meet the water specifications in the product CO_2, a molecular sieve dryer is specified.

5.2 Process Overview

5.2.1 Process Description of Normal Operation

The CCC Plant consists of the following systems:

- Flue gas diversion—The flue gas is directed from the existing stack to the plant.
- Flue gas cooling—The flue gas as supplied is too hot to process efficiently in the absorber and is cooled to its saturation temperature before entering the absorber.
- CO_2 absorption—Parallel absorbers use an amine solution to remove the CO_2 from the flue gas.
- Heat integration—Heat is recovered from internal streams to enhance plant energy efficiency.
- CO_2 stripping—The amine is regenerated for reuse by liberating the CO_2 from the amine solution.
- CO_2 compression and drying—The CO_2 is compressed, dried, further compressed, and liquefied to meet the CO_2 specifications.

- Amine reclamation—Heat stable salts (HSS) are removed from the amine solution.
- Amine storage—Fresh amine and lean amine are stored and injected into the absorption system to maintain the amine solution concentration.

Refer to the following diagrams at the end of Section 5.0 for the design:

- 10112936-PB-P-FLD-0001 (25474-000-M5-YA-00001), Block Flow Diagram
- 10112936-PB-P-HMB-0002 (25474-000-M4-CN-00002), [Overall] Process Heat and Mass Balance Diagram
- 10112936-PB-P-FLD-0003 (25474-000-M5-BA-00001), Process Flow Diagram—Blower and Quench Section
- 10112936-PB-P-FLD-0004 (25474-000-M5-CN-00001), Process Flow Diagram—Absorber T-101
- 10112936-PB-P-FLD-0005 (25474-000-M5-CN-00002), Process Flow Diagram—Absorber T-102
- 10112936-PB-P-FLD-0006 (25474-000-M5-CN-00003), Process Flow Diagram—Lean Amine Cooling, Sheet 1 of 2
- 10112936-PB-P-FLD-0007 (25474-000-M5-CN-00004), Process Flow Diagram—Lean Amine Cooling, Sheet 2 of 2
- 10112936-PB-P-FLD-0008 (25474-000-M5-CN-00005), Process Flow Diagram Stripper
- 10112936-PB-P-FLD-0009 (25474-000-M5-CY-00001), Process Flow Diagram—Fresh and Lean Amine Storage
- Water Balance—Split Flow Design
- 10112936-PB-P-HMB-0001 (25474-000-M4-CN-00001), Heat and Mass Balance Diagrams

5.2.2 Flue Gas Diversion and Cooling

The flue gas is diverted from the existing CCPP stack in a manner that does not affect power plant operation. The duct that directs the flue gas to the CCC Plant is tied into the existing stack near its base. A pair of shutoff dampers installed at this point isolate the duct from the main stack when the plant is shut down. In normal operation, the shutoff dampers are wide open and the existing stack damper is closed. The stack damper motor operator is replaced by a modulating pneumatic operator. The stack damper is closed when the plant is in operation, to divert 100% of the flue gas into the plant, and is modulated during plant startup/shutdown or if the plant is operating at reduced capacity.

The flue gas is drawn through the duct to the CCC Plant by two blowers operating in parallel. The flue gas blowers (K-101/K-102) are controlled using variable frequency drives (VFDs) (and suction throttling dampers as secondary) to control the pressure at the heat recovery steam generator (HRSG) outlet and to maintain the desired flow through each blower. It is necessary to maintain precise pressure control on the duct to avoid any negative impact on CCPP operation and to prevent air ingress into the CCC Plant through the stack opening.

Both upstream and downstream of the flue gas blowers (K-101/K-102), the flue gas water fogger system (X-101 A/B/C) cools the flue gas to approximately 50 °C before it enters the absorber towers.

The water used in the flue gas water fogger system (X-101 A/B/C) is recycled process water that is directed to the process surge water tank (TK-104).

5.2.3 CO_2 Absorption

The CO_2 is absorbed from the flue gas using two absorption towers operating in parallel.

Cooled flue gas enters the bottom of the CO_2 absorbers (T-101, T-102) and passes through the stainless steel structured packing. The flue gas is contacted counter-currently with 35% (wt) MEA solution as it passes through the absorption section of the tower.

Partially regenerated amine (semi-lean amine) is injected partway through the packed bed section to absorb part of the CO_2 from the flue gas. Fully regenerated lean amine is directed to the top of the packed bed section. As it leaves the absorption section, the flue gas passes through a mist eliminator to limit amine solution carryover into the water wash section of the absorber tower.

Internal to the absorbers, the water wash section serves to reduce both the ammonia and MEA content in the flue gas to < 5 ppm each. In addition, the water wash section cools the flue gas to approximately 40–45 °C to reduce the amount of water vapor leaving the tower. Wash water is prevented from entering the absorption section of the column by using a chimney tray. The water is collected on the chimney tray and pumped out by the wash water recirculation pump (P-102 A/B [absorber 1], P-104 A/B [absorber 2]). The recirculated water is first cooled in the wash water cooler (E-101 [absorber 1], E-104 [absorber 2]) and is then injected above the second bed of packing on flow control.

Above the first bed, fresh process water makeup is supplied from the discharge of the absorber makeup water pump (P-119 A/B). Level control on the chimney tray sends the excess water (makeup water and water condensed from the flue gas) and collected amine back to the lean amine stream. This blowdown of the water wash system keeps the amine concentration from building up in the water wash system and helps to maintain the lean amine concentration at 35% (wt).

The rich amine leaves the bottom of the CO_2 absorbers (T-101, T-102) through the rich amine pump (P-101 A/B [absorber 1], P-124 A/B [absorber 2]). An equalization line between the two towers ensures that the liquid is pumped out of the towers at equal rates. A high level control signal from the absorber bottoms diverts any excess lean amine to the lean amine solvent storage tank to balance system inventories.

5.2.4 CO_2 Stripping

The rich amine flow is preheated in the lean/rich amine heat exchanger (E-108) prior to being fed to the stripper (T-103).

The rich amine falls through the packed section of the stripper (T-103), where it is counter-currently heated with steam generated in the stripper reboiler (E-110). As the temperature of the rich amine increases, the CO_2 is liberated from the solution.

Plate-and-frame thermosyphon reboilers are used to heat the column. Liquid is diverted into the stripper reboiler (E-110) via a segregated sump compartment. Excess liquid overflows from the reboiler sump compartment to the lean amine sump compartment for return to the absorber. The heating medium supplied to the stripper reboiler (E-110) is 2 barg saturated steam.

The level in the bottom of the stripper (T-103) is controlled by balancing the flow of rich amine feed to the stripper (T-103) with lean amine that is fed to the CO_2 absorbers (T-101, T-102) in a three-element arrangement.

Vapor leaves the top of the stripper (T-103) and is fed to the overhead stripper condenser (E-111), cooling the stream to approximately 50 °C. The condensed MEA and water are separated from the gas stream in the stripper reflux drum (V-102). From the stripper reflux drum (V-102), approximately 10% of the liquid is pumped back to the column as reflux via the reflux pump (P-107 A/B), while the balance flows to the process water surge tank (TK-104). The gas stream leaving the stripper reflux drum (V-102) is approximately 97% CO_2, with the balance of the composition being predominantly water vapor.

The lean amine flows from the bottom of the stripper (T-103) to the suction of the lean amine pump (P-105 A/B).

5.2.5 Heat Integration

Approximately 25% (wt) of the rich amine leaving the rich amine filter (F-102 A/B) is diverted to a series of exchangers (the semi-lean/rich amine heat exchanger [E-103], the flash-feed heat exchanger [E-107] and the flash-feed heater [E-109]), where it is heated to approximately 120 °C. The rich amine is flashed in the semi-lean flash drum (V-101). The CO_2-rich vapor leaves the top of the semi-lean flash drum (V-101) and is directed to the stripper (T-103). The semi-lean amine leaves the bottom of the semi-lean flash drum (V-101), is pumped via the flash drum pump (P-106 A/B), and is cooled in the semi-lean/rich amine heat exchanger (E-103) before being fed to the two CO_2 absorbers (T-101, T-102).

The lean amine pump (P-105 A/B) forces the stripper bottoms fluid through the lean amine filter (F-105 A/B) to remove particulates. The flow passes through the flash-feed heat exchanger (E-107), where part of the rich amine is heated to produce semi-lean amine, which is described above. The stripper bottoms fluid is then further cooled as it exchanges heat with the bulk rich amine flow in the lean/rich amine heat exchanger (E-108).

The stripper bottoms fluid is even further cooled in the lean amine cooler (E-102) before the flow is split and fed back to each of the two CO_2 absorbers (T-101, T-102). The temperature of the lean amine returning to the CO_2 absorbers (T-101, T-102) is a key variable in controlling the overall recovery of CO_2, maintaining the system water balance and the heat input required to the stripper (T-103).

5.2.6 CO_2 Compression and Drying

The gas stream leaving the stripper reflux drum (V-102) is approximately 97% CO_2, with the balance of the composition being predominantly water vapor. Any liquid carried over from the stripper reflux drum (V-102) or that condenses in the line is removed in the CO_2 compressor suction drum (V-103). The gas enters the CO_2 compressor (K-103) suction at less than 1 barg and is compressed to approximately 92 barg. Some of the heat generated during compression is recovered by generating steam in steam generators (E-112/114/116) where the steam is directed to the semi-lean amine flash feed heat exchanger (E-109).

CO_2 is dried to less than 50 ppmvw by passing the partially compressed gas to the CO_2 drying package (X-104), an adsorption bed dryer.

The gas is then cooled in the CO_2 cooler (E-117), where the CO_2 stream is totally condensed, becoming a liquid. The liquid CO_2 is then fed to the CO_2 surge drum (V-106), where it is pumped to the B/L by the CO_2 product send-out pump at a pressure of 200 barg on level control. Any noncondensable gas that collects in the CO_2 surge drum is vented back to the CO_2 absorbers (T-101, T-102) stack.

5.2.7 Amine Reclamation

On an annual basis, approximately 0.5–1% of the lean amine mass flow from the lean amine pump (P-105 A/B) discharge is fed to the amine reclaimer (X-102). During normal operation, the amine is subject to thermal degradation and undergoes chemical reactions, producing undesirable compounds. Chemical reactions with oxygen and sulfur dioxide and other flue gas contaminants in the flue gas can produce acids, which combine with amine, producing heat stable salts (HSS). Amine bound in HSS does not absorb CO_2. In the amine reclaimer (X-102), amine is released from the HSS by heating with high pressure steam and through a neutralization reaction with soda ash. Water is added to the amine reclaimer (X-102) to improve amine recovery and reduce the amount of amine degradation that occurs in the reclaiming process. Much of the amine and water from the lean amine solution is vaporized and returned to the stripper (T-103). The residual sludge (a very viscous liquid when hot, and with usable heating value) is removed for proper disposal.

5.2.8 Amine Storage

Fresh, concentrated amine (85%) is delivered by truck and stored in the amine storage tank (TK-101). To maintain the solution concentration at 35% MEA, fresh amine is made up to the system (TK-102) as required using the fresh amine metering pump (P-110 A/B).

The lean amine solvent storage tank (TK-102) is used to store lean amine removed from the system based on the absorber tower level control as required. During a plant shutdown, this tank is also used to store the amine inventory. Amine is returned to the system using the lean amine solvent fill pump (P-112 A/B).

5.3 Process and Equipment Alternatives

5.3.1 Flue Gas Cooling

To improve amine absorption of CO_2 in the CCC Plant, the flue gas must be cooled from its supply temperature of 90 °C. Two cooling options were investigated: a water fogger system and a quench tower. The lowest capital cost cooling system, the fogging system, was selected.

5.3.2 Absorber Towers

Based on the best knowledge of fluid flow patterns discussed in Subsection 5.1.2, two cylindrical absorbers, each 12 meters in diameter, were selected to operate in parallel. The value of the cylindrical geometry was confirmed when the internal packing suppliers completed a computational flow dynamics (CFD) model showing good flow distribution through the packing with no flow straighteners required. The use of 12 meter cylindrical towers also permit these to be fabricated off site.

5.3.3 Heat Exchange Equipment

The large mass flows associated with this CO_2 capture process require a significant amount of heat transfer at many points in the process. To optimize the heat transfer and reduce the plot space required, plate-and-frame heat exchangers were selected in all low pressure (LP) services. The CO_2 compression system is the only area using shell-and-tube heat exchangers. The duties in this area are relatively much smaller than those in the amine section; therefore, the effect on plot space is not as pronounced.

5.4 HSE Considerations for Design

5.4.1 Equipment Selection

The CCC Plant equipment and process have been selected to reduce the risk and magnitude of impact on the health and safety of workers and neighbors and the impact on the surrounding environment. Specific examples include the following:

- Closed amine drain system—All amine-containing streams are drained into a closed system to limit fugitive emissions and worker exposure.

- Sound limits—Generally, equipment is selected to produce a noise level not exceeding 85 dB at 1 meter. A noise study was conducted to ensure that the noise level does not exceed permit limits.
- Pump seals—Pumps are specified to have high integrity seals to reduce the risk of environmental releases.

5.4.2 Plant Layout and Design

The equipment has been laid out using industry best practices to ensure that incompatible pieces of equipment/processes are kept a sufficient distance apart and to ensure safe access to and egress from the operating areas.

The plant layout was reviewed regularly for hazard identification (HAZID) and hazard and operability (HAZOP) purposes, to ensure that the layout was compatible with health, safety, and environment (HSE) requirements.

5.4.3 Process and Emergency Shutdown

The plant has process and emergency shutdown systems to safely shut down specific pieces of equipment and put the entire plant in order to protect equipment and the safety of the workers during upset or abnormal operating conditions.

5.4.4 Fire and Gas Detection

The plant has detection equipment and audible/visible alarms to alert operating personnel of unsafe conditions.

5.5 Hazards and Safety Analysis

5.5.1 HAZID

A CCC Plant HAZID review was conducted on October 15, 2008, to identify possible HSE hazards related to the plant design. Participation included senior members from the Gassnova, Fichtner, and Bechtel[redacted] teams. Process flow diagrams were used in conjunction with the preliminary plot plan as a basis for the review.

Using the HAZID review methodology, recommendations were developed to be resolved by completion of the front-end engineering and design (FEED) stage or during detailed engineering.

The HAZID Report 10112936-PB-S-HSE-0003 (25474-0001-U4R–0000-00001, Rev. 0) contains a complete explanation of the methodology and the list of recommendations.

5.5.2 HAZOP

A CCC Plant FEED stage process HAZOP study was conducted from November 24–26, 2008, to identify and address potential risks associated with the plant design.

The study was conducted with senior members from the Gassnova, Fichtner, and Bechtel [redacted] teams to identify situations that pose a hazard to health, safety, the environment, and equipment. The team used the fault tree analysis (FTA) method to review the process flow diagrams, piping and instrumentation diagrams (P&IDs), and 3D model to identity potential risks. The study produced a list of recommendations to reduce the risk associated with designing and operating this plant.

The HAZOP report 10112936-PB-S-HSE-0013 (25474-000-U4R-0000-00003, Rev. 0) contains a complete explanation of the methodology and the list of recommendations.

5.6 Equipment Selections

The two absorber towers and one stripper column are stainless steel, fitted with stainless steel structured packing to achieve a low pressure drop across the vessel internals.

Plate-and-frame heat exchangers were selected for most plant heat transfer services. These exchangers have a smaller plot space requirement for a given area than other types of heat exchangers. Also, they can have much lower approach temperatures than other configurations and, therefore, increase the amount of heat exchanged between streams and increase the plant's energy efficiency.

Stainless steel has been selected for the amine portion and cooled flue gas equipment in the plant and pipe to avoid corrosion problems associated with the high amine concentration employed and to avoid onerous inhibitor programs. Titanium has been selected to provide corrosion protection for equipment in contact with seawater.

5.7 Plant Layout

The main focus of the CCC Plant arrangement is on safety, followed by ease of operation and employing the most economical and cost-effective measures that successfully and effectively minimize piping quantities, use the most cost-effective materials, and integrate automation and controls requirements.

5.7.1 Arrangement

The CCC Plant is located adjacent to the Kårstø gas terminal and the CCPP owned and operated by Naturkraft AS. The plant site size specifications of 70 m x 210 m define the fixed area in which an arrangement has been developed that includes two flue gas blowers, two absorber columns, one stripper column, a CO_2 compressor building, an electrical building, a tanks/unloading area, and a control/administration/workshop/stores building. As the origination of the flue gas duct into the plant, the breach connection to the existing CCPP HRSG is the determining factor with respect to how the absorbers are arranged. The two 11.8 m diameter absorber columns are set to accommodate the incoming 6.2 m square flue gas duct in an equal distribution through the two flue gas blowers, with the assistance of the variable frequency drives (VFDs). The associated equipment, pumps, exchangers, etc., are strategically located to accommodate the shortest possible pipe runs and symmetrical configuration for the process design.

To control the average circuit and umbilical lengths, the electrical building and the continuous emissions monitoring system (CEMS) building have been located to be central to the process.

The tank unloading area is located to accommodate a road design that allows trucks to enter and exit the facility through the northeast gate and exit through the southeast gate without having to travel around the plant process area. The control/administration/workshop/stores building and parking are set to the far east of the site, since the building acts as a safety bunker, placing it nearest the safety egress point. The plant loop road provides access to all sides of the process area. The pipe racks are designed to make available an additional access through the center of the site by permitting access under the center east-west pipe rack.

5.7.2 Piping

The piping is routed with particular attention to achieving the shortest route. Certain process parameters have been incorporated with regard to equipment and piping symmetry. Special attention has been given to pipe supports and hangers. The piping sizes and wall thicknesses are based on the system design pressures and temperatures. The piping sizes and pipe class designations for each system are shown on their respective P&IDs. The piping material, size, and schedule information for each system is provided in Pipe Class Selection 10112936-PB-L-TED-0001 (25474-000-3DS-P72G-00001). In addition, LCC Pipe Design Report 10112936-PB-L-TED-003 (25474-000-3OR-M90G-00001) outlines the evaluation used in the system piping design for the FEED Study. It evaluates the major systems that have the most impact on overall plant design, capital costs, and operating cost.

5.7.3 Piping and Arrangement Safety

Safety measures are planned and incorporated with regard to head clearances, walkways, clear safety escape routes, pull spaces, and machinery maintenance areas.

5.8 Process Performance and Optimization

The CCC Plant process has been simulated for five operating cases: normal (reclaimer off), normal (reclaimer on), summer, winter, and turndown. In each case, the goal was to achieve the specified CO_2 recovery rate of 85% while minimizing any recovery exceeding this level in an effort to reduce plant energy consumption and capital investment. The water balance is for the modeled cases. This plant can be run in a "water balanced" condition. The simulation was calculated for the base case with a requirement for the import of a small amount of water, to eliminate an issue arising with possibly having to dump amine-laden water to the ocean when the system produces too much. There is some indication that the amine limit in seawater may need to be be as low as reasonably possible (ALARP). A small desalination system is provided in case makeup water is required.

Table 5.8-1 summarizes the CO_2 recovery level and the energy consumption (as measured in pounds of steam consumed in the stripper reboiler per pound of CO_2 leaving the stripper overhead) for this process.

Table 5.8-1 CCC Plant Performance

Case	CO_2 Recovery (%)	Energy Consumption (lb/lb)
Normal (reclaimer off)	85.3	1.56
Normal (reclaimer on)	85.2	1.47
Summer	85.1	1.58
Winter	85.1	1.55
Turndown	85.7	1.59

5.9 Process Cooling

The cooling of various process streams is essential to the CCC Plant's operation. The process design philosophy maximizes heat recovery to limit the quantity of externally supplied heating energy or heat sink medium. Where necessary to reject heat from the process, once-through seawater cooling is used. The cold supply temperature of the seawater makes it an excellent heat sink medium, providing significant process benefits in terms of water recovery from the absorber off-gas and improving compressor efficiency. The temperature rise for seawater cooling is limited to 10 °C, per project requirements with a maximum discharge temperature of 21 °C.

A cooling philosophy study 10112936-PB-P-TDO-0008 (25474-000-30R-M84G-00001) was performed and provides additional information on this topic.

5.10 Steam, Water, and Chemical Requirements

The CCC Plant utilities are as follows:

- Steam and condensate
- Cooling (seawater)
- Potable water
- Fire water
- Fuel gas (natural)
- Compressed air
- Inerting gases (nitrogen)
- Desalination water

The requirements for these utilities are summarized in Table 7.1-1, Utility Requirements, of Section 7.0.

5.11 Exhaust, Emissions, and Waste

The CCC Plant employs a 35% (wt) aqueous solution of MEA to capture CO_2 gas from the CCPP diverted flue gas stream.

MEA and ammonia emissions from the absorber outlet are 3 ppm and 4 ppm, respectively, which is less than the 5 ppm limit stipulated in the design basis. The process configuration can be modified to reduce these emissions further with some additional capital expenditure, should further restrictions be imposed.

The plant is expected to generate airborne, liquid, and solid wastes under normal operating conditions. The amine system emissions are summarized in Table 5.11-1.

Table 5.11-1 Exhaust and Emissions Summary

Emission (1)	Flow Rate	Flow Type	Annually Emitted Quantity (2)
Airborne			
Oxygen	182,472 kg/h	Continuous	3.197E+09 kg
Nitrogen	932,643 kg/h	Continuous	1.634E+10 kg
Water	65,918 kg/h	Continuous	1.155E+09 kg
Carbon dioxide	10,961 kg/h	Continuous	1.920E+07 kg
Sulfur dioxide	0.28 kg/h	Continuous	4.872E+03 kg
MEA	7.79 kg/h	Continuous	1.364E+05 kg
Argon	15,206 kg/h	Continuous	2.664E+08 kg
NO	4.23 kg/h	Continuous	7.406E+04 kg
NO_2	1.06 kg/h	Continuous	1.851E+04 kg
Ammonia	2.99 kg/h	Continuous	5.246E+04 kg
Liquid			
Lubricating oil	To be determined in EPCI phase	Intermittent	To be determined in EPCI phase
Solid			
Reclaimer Waste (3)	225 kg/h	Intermittent	1.971E+06 kg
F-101 Filter cartridges (4)	14 elements/ change	Intermittent	28 elements
F-102 Filter cartridges (4)	57 elements/ change	Intermittent	114 elements
F-105 Filter cartridges (4)	57 elements/ change	Intermittent	114 elements
Activated carbon	21,736 kg/month	Intermittent	2.608E+05 kg

Notes:

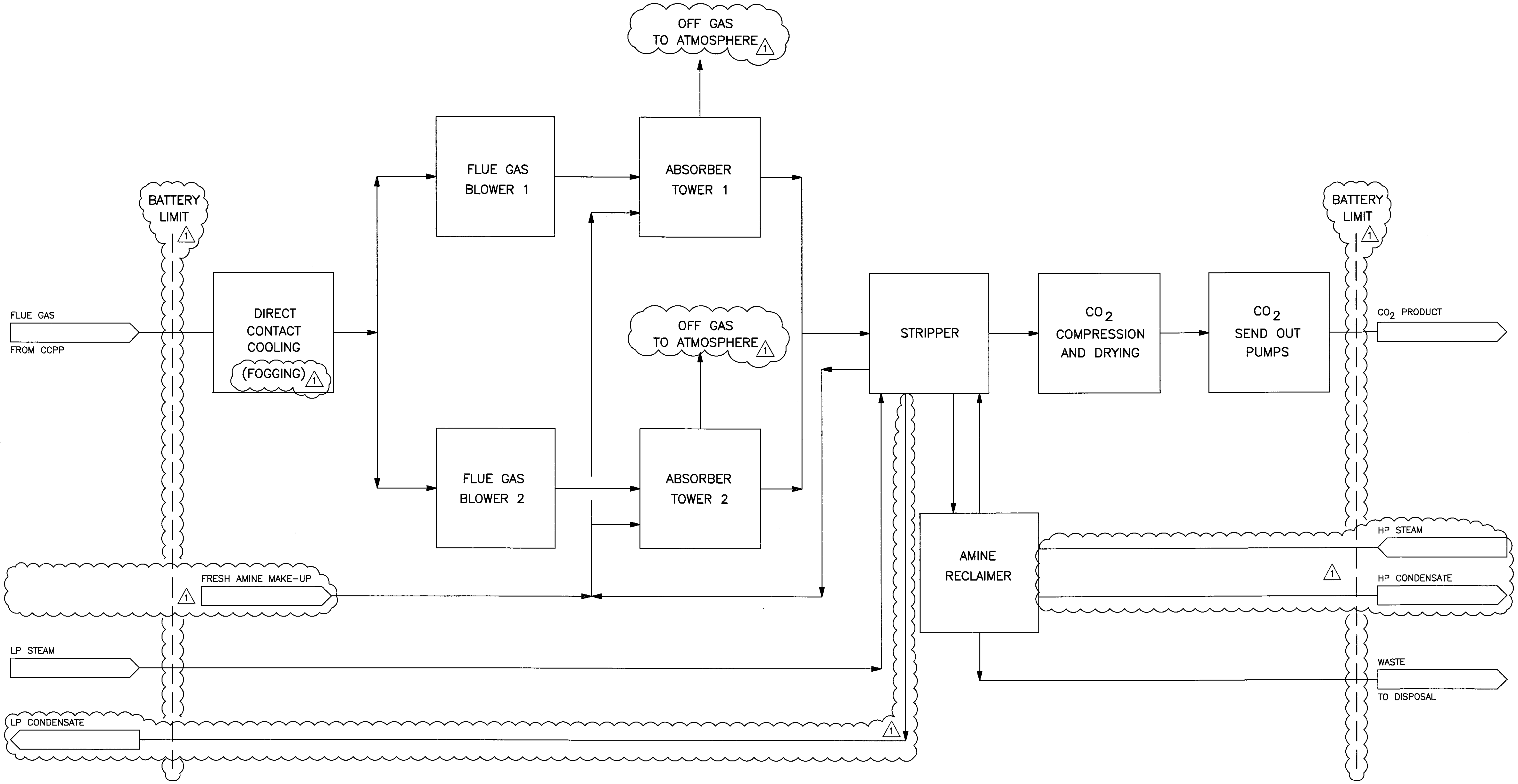
1. Emissions from each absorber tower. Expected to contain small amounts (< 1 ppmv per component) each of piperazine, formaldehyde, and acetaldehyde. These *decomposition products* of amine degradation reactions occur in the circulating process streams over time.
2. Annually emitted quantity is based on 8760 hours per year operation for continuous operations, and is total for two absorber towers.
3. The quantity is based on 170.5 kg/hr of sludge on a dry basis. The additional quantity includes flushing water. The annually emitted quantity is based on 8760 hours per year operation for continuous operations. Actual operation is expected to be from 2 to 10% of plant operation time. Waste is emitted intermittently.
4. Filters are changed semi-annually.

5.12 Conclusions and Recommendations

The proposed amine absorption process using MEA is capable of absorbing CO_2 from the CCPP flue gas and achieving a CO_2 recovery rate of at least 85%.

The quality of the LP steam available at the site is a constraint that increases CCC Plant operating and capital costs. An investigation is recommended of the possibility of elevating the LP steam pressure by a minimum of 1 bar. Additional recommendations for improvement options to be examined in the engineering, procurement, construction, and installation (EPCI) phase are found in Section 17.0.

NOTES:
1.



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NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR

Owner
GASSNOVA

CO2 KARSTO PROJECT

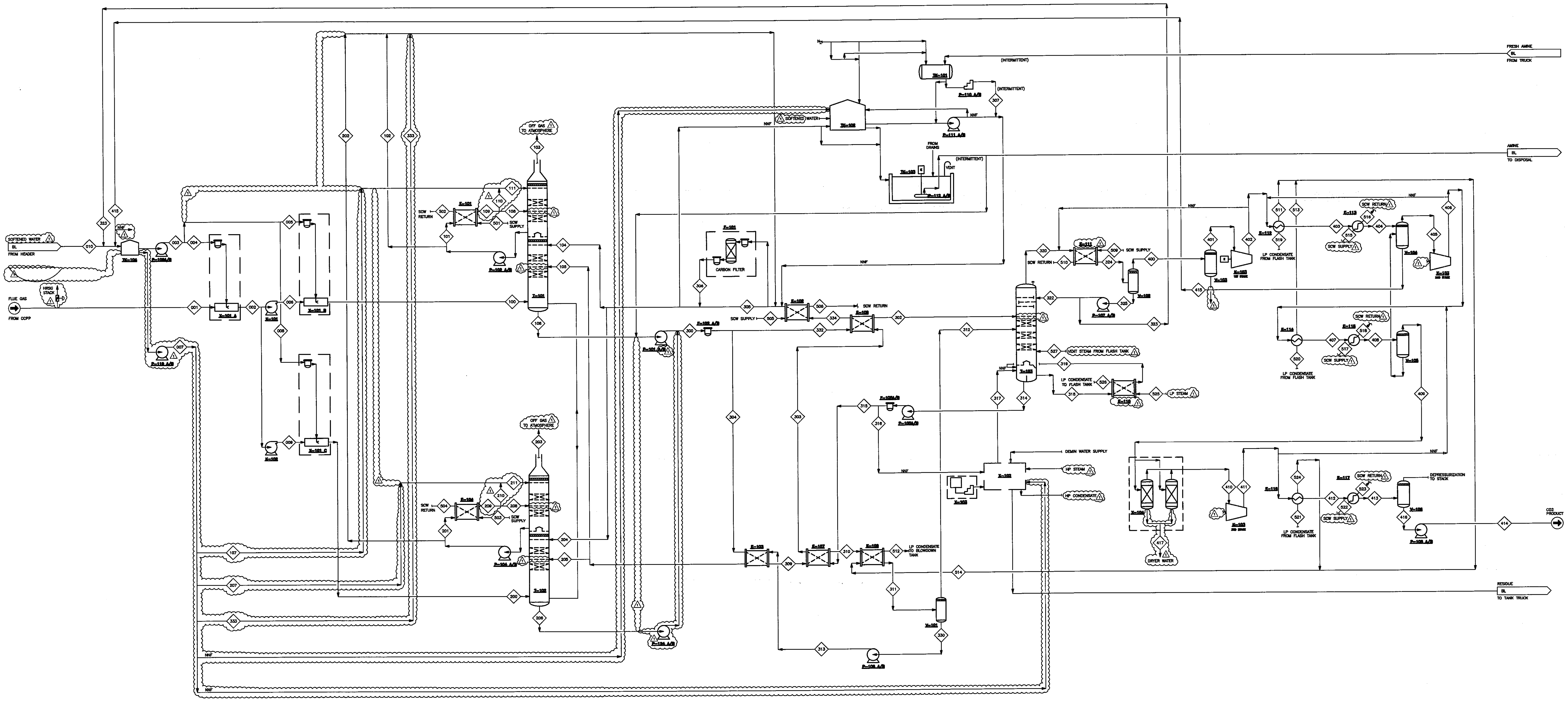
Owner Drawing No.
10112936-PB-P-FLD-0001

BLOCK FLOW DIAGRAM

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

Sheet Size 594x841 "A1"
Scale: N.T.S.

JOB NO.	DRAWING NO.	REV.
25474	000-M5-YA-00001	1



NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	14 NOV 08	RE-ISSUED FOR COMMENT	GR	DM	–	RS	BR	
0	10/10/08	ISSUED FOR COMMENT	KJ	DM	–	RS	–	–

Owner
GASSNOVA

Owner Drawing No.
10112936-PB-P-HMB-0002

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

PROCESS HEAT & MASS BALANCE DIAGRAM

Sheet Size 594x841 "A1"
Scale N.T.S.

JOB NO.	DRAWING NO.	REV.
25474	000-M4-CN-00002	1

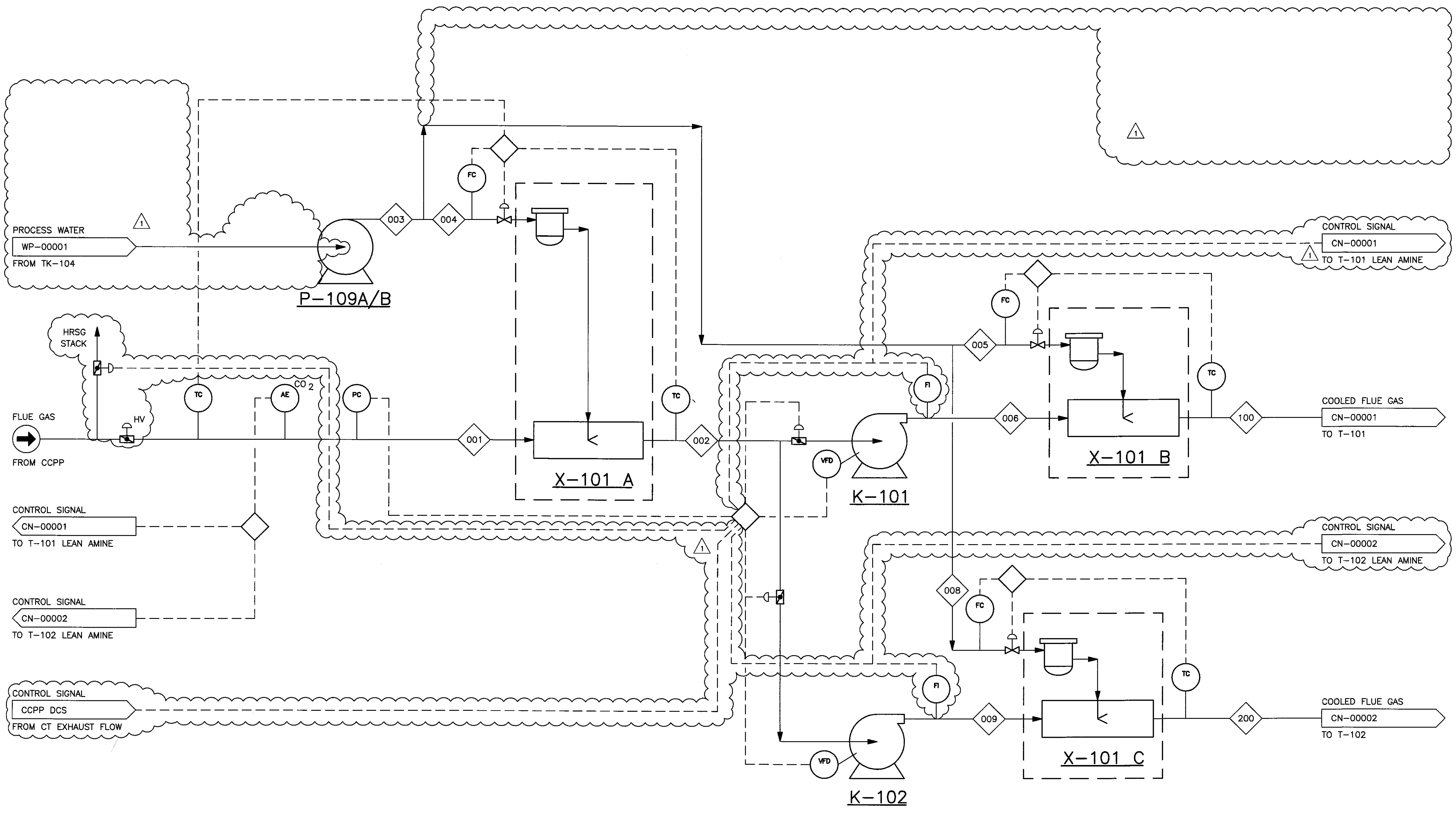
X–101 A

FLUE GAS WATER FOGGER SYSTEM
NORMAL FLUE GAS FLOW RATE: 2.68 x 10^6 Am^3/h

X–101 B/C

FLUE GAS WATER FOGGER SYSTEM
NORMAL FLUE GAS FLOW RATE: 1.17 x 10^6 Am^3/h

NOTES:
1. –



P–109A/B

FLUE GAS FOGGER WATER SUPPLY PUMP
NORMAL FLOW: 72.4 Am^3/h

K–101

FLUE GAS BLOWER (ABSORBER 1)
NORMAL VOLUMETRIC CAPACITY AT INLET CONDITIONS:
1.17 x 10^6 Am^3/h

K–102

FLUE GAS BLOWER (ABSORBER 2)
NORMAL VOLUMETRIC CAPACITY AT INLET CONDITIONS:
1.17 x 10^6 Am^3/h

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 Nov 08	RE–ISSUED FOR APPROVAL	DM	UP	–	RS		
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	–	RS	–	–

Owner
GASSNOVA

CO2 KARSTO PROJECT

Owner Drawing No.
10112936–PB–P–FLD–0003

PROCESS FLOW DIAGRAM
BLOWER & QUENCH SECTION

Contractor
BECHTEL
POWER
CORPORATION
FREDERICK, MARYLAND

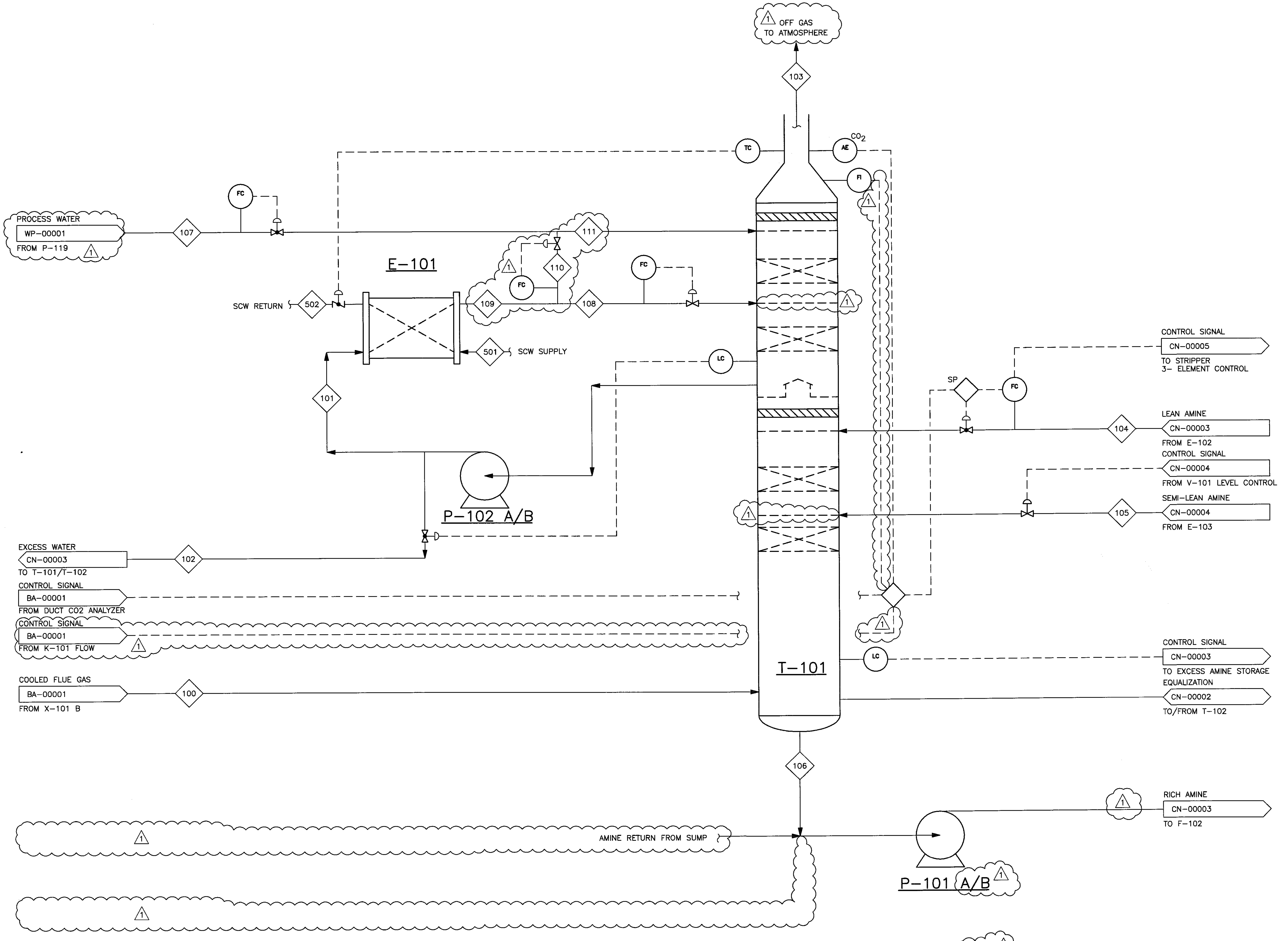
Sheet Size 594x841 "A1"
Scale: N.T.S.

JOB NO.	DRAWING NO.	REV.
25474	000–M5–BA–00001	1

E-101
WASH WATER COOLER (ABSORBER 1)
NORMAL DUTY: 52.7 x 10^3 kW

T-101
CO2 ABSORBER
INTERNAL DIAM: 11.8 m
LENGTH T/T: 43.4 m
PACKING TYPE: STRUCTURED PACKING
PACKING MATERIAL: SS

NOTES:
1. –



P-102 A/B
WASH WATER RECIRCULATION PUMP (ABSORBER 1)
NORMAL CAPACITY: 1.46 x 10^3 Am^3/h

P-101 A/B
RICH AMINE PUMPS (ABSORBER 1)
NORMAL CAPACITY: 1.21 x 10^3 Am^3/h

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 NOV 08	RE-ISSUED FOR APPROVAL	DM	UP	–	RS Bm	WLS	
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	–	RS	–	–

Owner
GASSNOVA

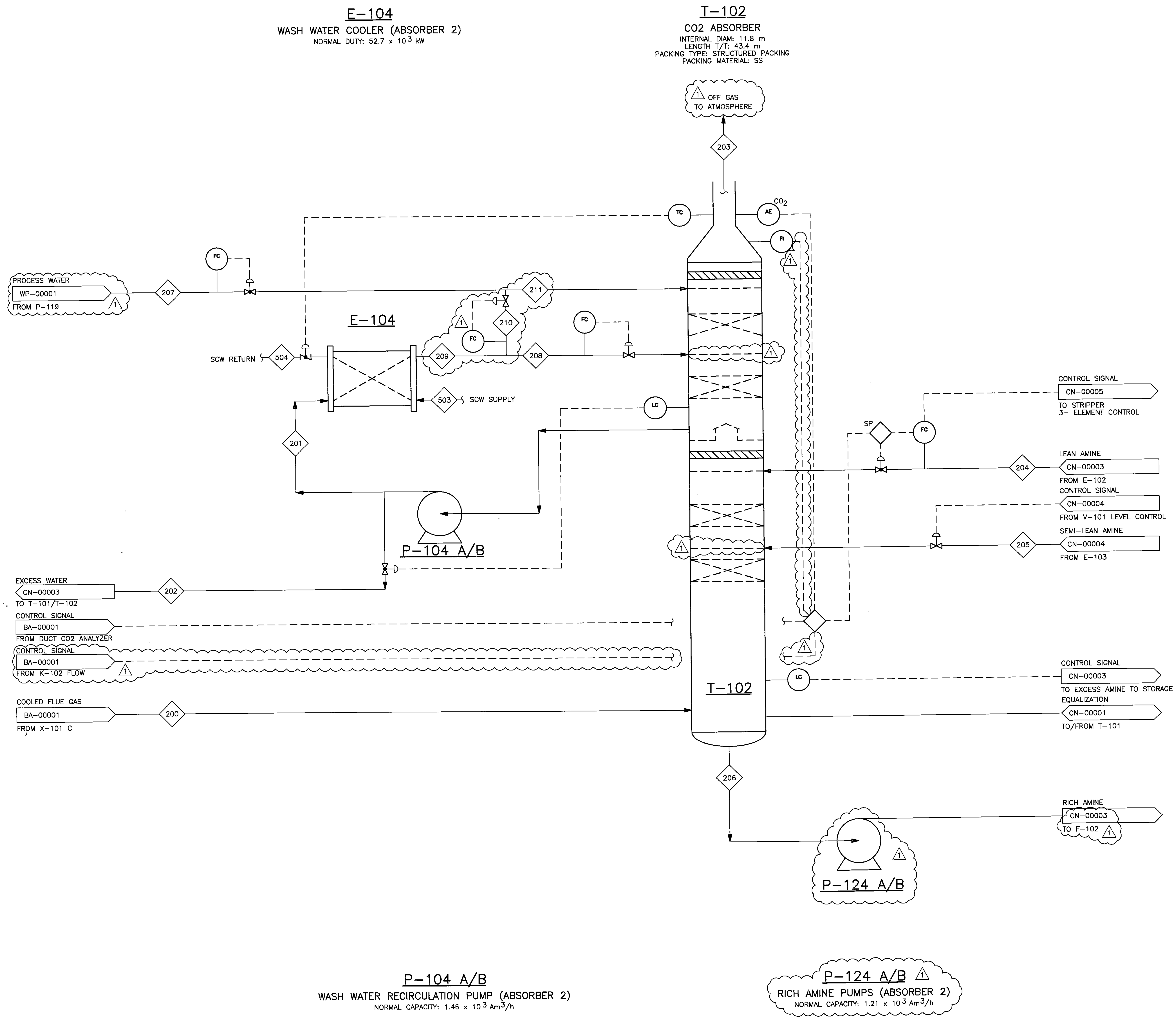
CO2 KARSTO PROJECT

Owner Drawing No.
10112936-PB-P-FLD-0004

PROCESS FLOW DIAGRAM
ABSORBER T-101

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

Sheet Size 594x841 "A1"	Scale: N.T.S.	
JOB NO.	DRAWING NO.	REV.
25474	000-M5-CN-00001	1



NOTES:

1. -

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 NOV 08	RE-ISSUED FOR APPROVAL	DM	UP	-	RS	Brewer	
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	-	RS	-	-

Owner
GASSNOVA

Owner Drawing No.
10112936-PB-P-FLD-0005

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

PROCESS FLOW DIAGRAM
ABSORBER T-102

Sheet Size 594x841 "A1"
Scale: N.T.S.

JOB NO.	DRAWING NO.	REV.
25474	000-M5-CN-00002	1

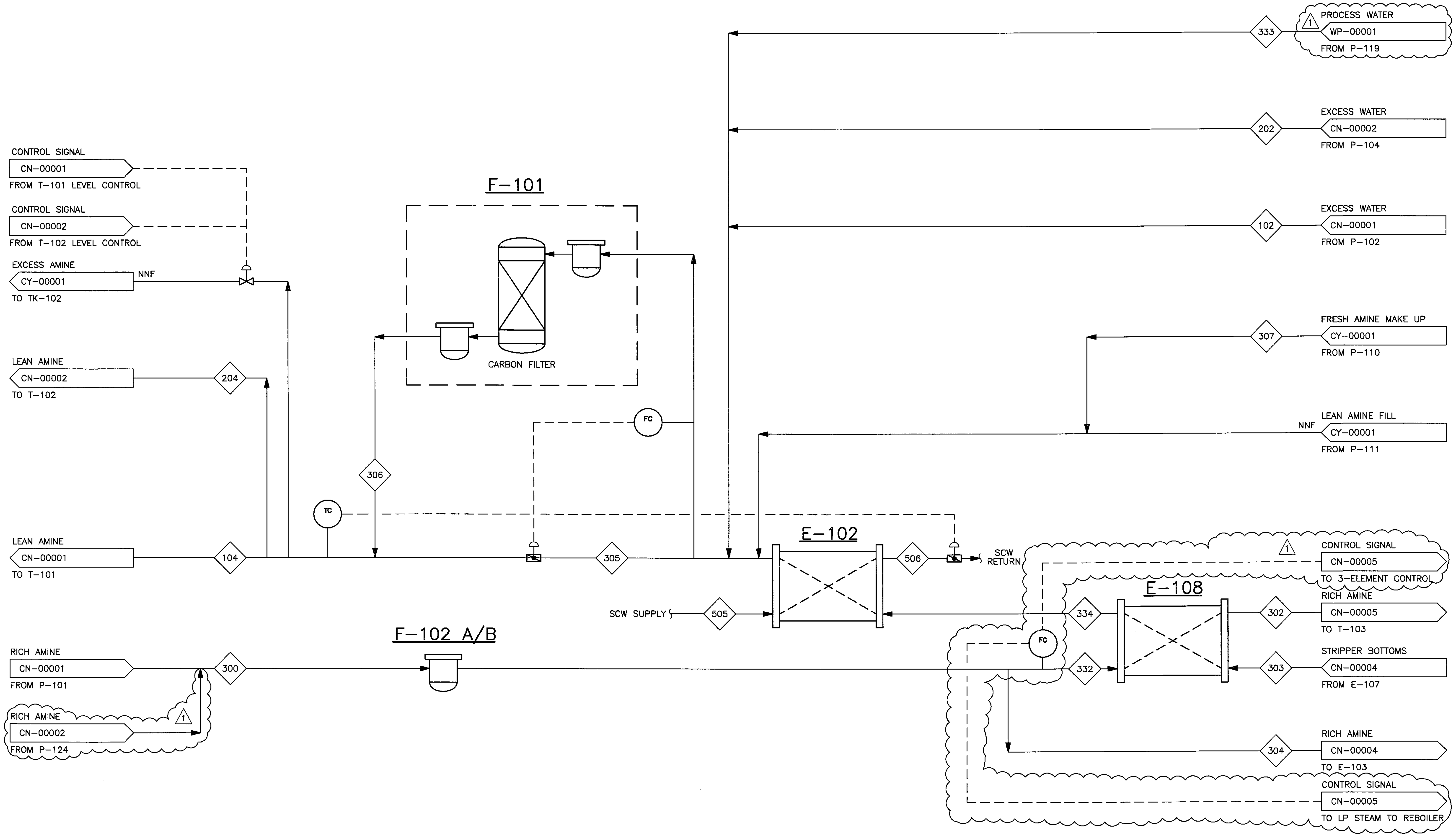
F-102 A/B
RICH AMINE MECHANICAL FILTER
NORMAL FLOW: 2.41 x 10^3 Am^3/h
PARTICLE SIZE REMOVAL: 10 MICRON

F-101
LEAN AMINE SIDE STREAM CARBON FILTER
NORMAL FLOW: 0.4 x 10^3 Am^3/h
PARTICLE SIZE REMOVAL: 10 MICRON

E-102
LEAN AMINE COOLER
NORMAL DUTY: 4.6 x 10^3 kW

E-108
LEAN/RICH AMINE HEAT EXCHANGER
NORMAL DUTY: 140.4 x 10^3 kW

NOTES:
1. -



NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 Nov 08	RE-ISSUED FOR APPROVAL	DM	UP	-	RS	Bre	wRE
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	-	RS	-	-

Owner
GASSNOVA

CO2 KARSTO PROJECT

Owner Drawing No.
10112936-PB-P-FLD-0006

Contractor
BECHTEL
POWER
CORPORATION
FREDERICK, MARYLAND

PROCESS FLOW DIAGRAM
LEAN AMINE COOLING
SHEET 1 OF 2

Sheet Size	Scale:	
594x841 "A1"	N.T.S.	
JOB NO.	DRAWING NO.	REV.
25474	000-M5-CN-00003	1

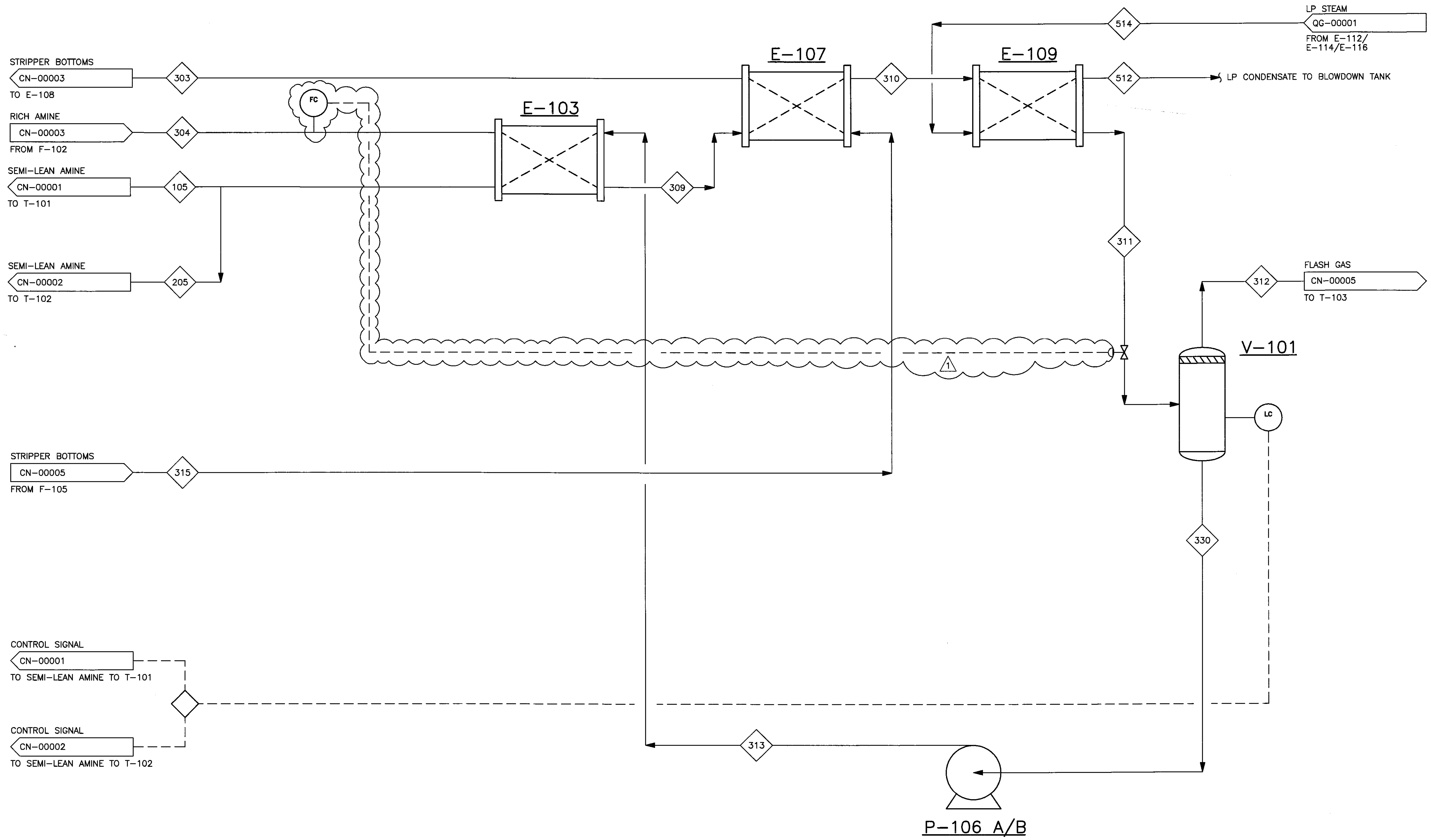
E–103
SEMI–LEAN/RICH AMINE HEAT EXCHANGER
NORMAL DUTY: 29.8 X 10^3 kW

E–107
FLASH FEED HEAT EXCHANGER
NORMAL DUTY: 2.78 X 10^3 kW

E–109
FLASH FEED HEATER
NORMAL DUTY: 5.21 X 10^3 kW

V–101
SEMI–LEAN FLASH DRUM

NOTES:
1. –



P–106 A/B
FLASH DRUM PUMP
NORMAL CAPACITY: 0.485 x 10^3 Am^3/h

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 NOV 08	RE–ISSUED FOR APPROVAL	DM	UP	–	RS	BJR	WRS
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	–	RS	–	–

Owner
GASSNOVA

CO2 KARSTO PROJECT

Owner Drawing No.
10112936–PB–P–FLD–0007

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

PROCESS FLOW DIAGRAM
LEAN AMINE COOLING
SHEET 2 OF 2

Sheet Size 594x841 "A1"
Scale: N.T.S

JOB NO.	DRAWING NO.	REV.
25474	000–M5–CN–00004	1

F–105A/B
LEAN AMINE MECHANICAL FILTER
NORMAL FLOW: 1.97 x 10^3 Am^3/h
PARTICLE SIZE REMOVAL: 10 MICRON

X–103
RECLAIMER CHEMICAL FEED PACKAGE
CHEMICAL: SODA ASH

T–103
STRIPPER
INTERNAL DIAMETER: 6.67 m
LENGTH T/T: 42.6 m
PACKING TYPE: STRUCTURED PACKING
PACKING MATERIAL: SS

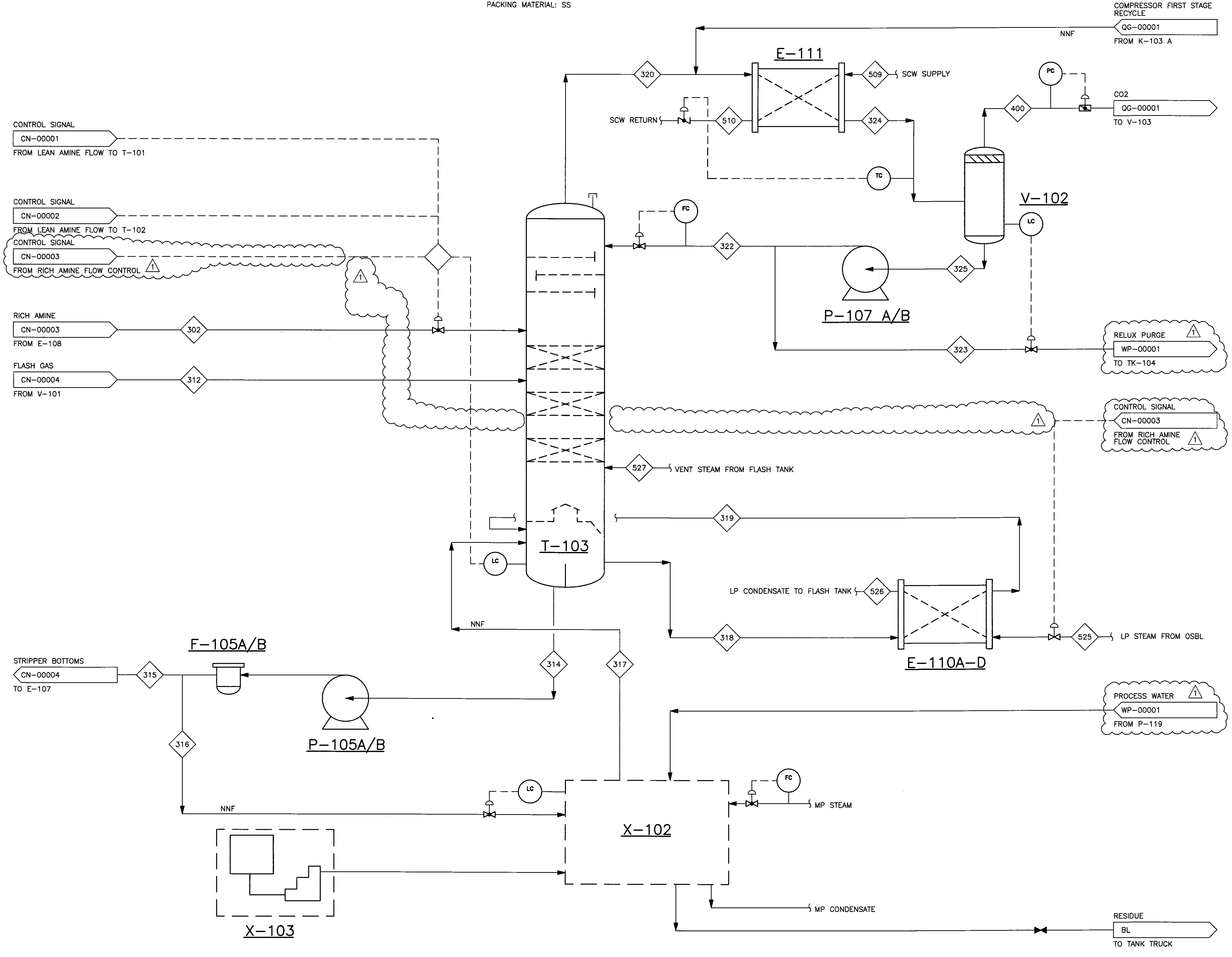
X–102
AMINE RECLAIMER
NORMAL CAPACITY: 59.1 Am^3/h

E–111
OVERHEAD STRIPPER CONDENSER
NORMAL DUTY: 54.1 x 10^3 kW

E–110A–D
STRIPPER REBOILER
NORMAL DUTY: 115.9 x 10^3 kW

V–102
STRIPPER REFLUX DRUM

NOTES:
1. –



P–105A/B
LEAN AMINE PUMP
NORMAL CAPACITY: 1.97 x 10^3 Am^3/h

P–107 A/B
REFLUX PUMP
NORMAL CAPACITY: 77.0 Am^3/h

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 NOV 08	RE–ISSUED FOR APPROVAL	DM	UP	–	RS	Bn	WRE
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	–	RS	–	–

Owner
GASSNOVA

Owner Drawing No.
10112936–PB–P–FLD–0008

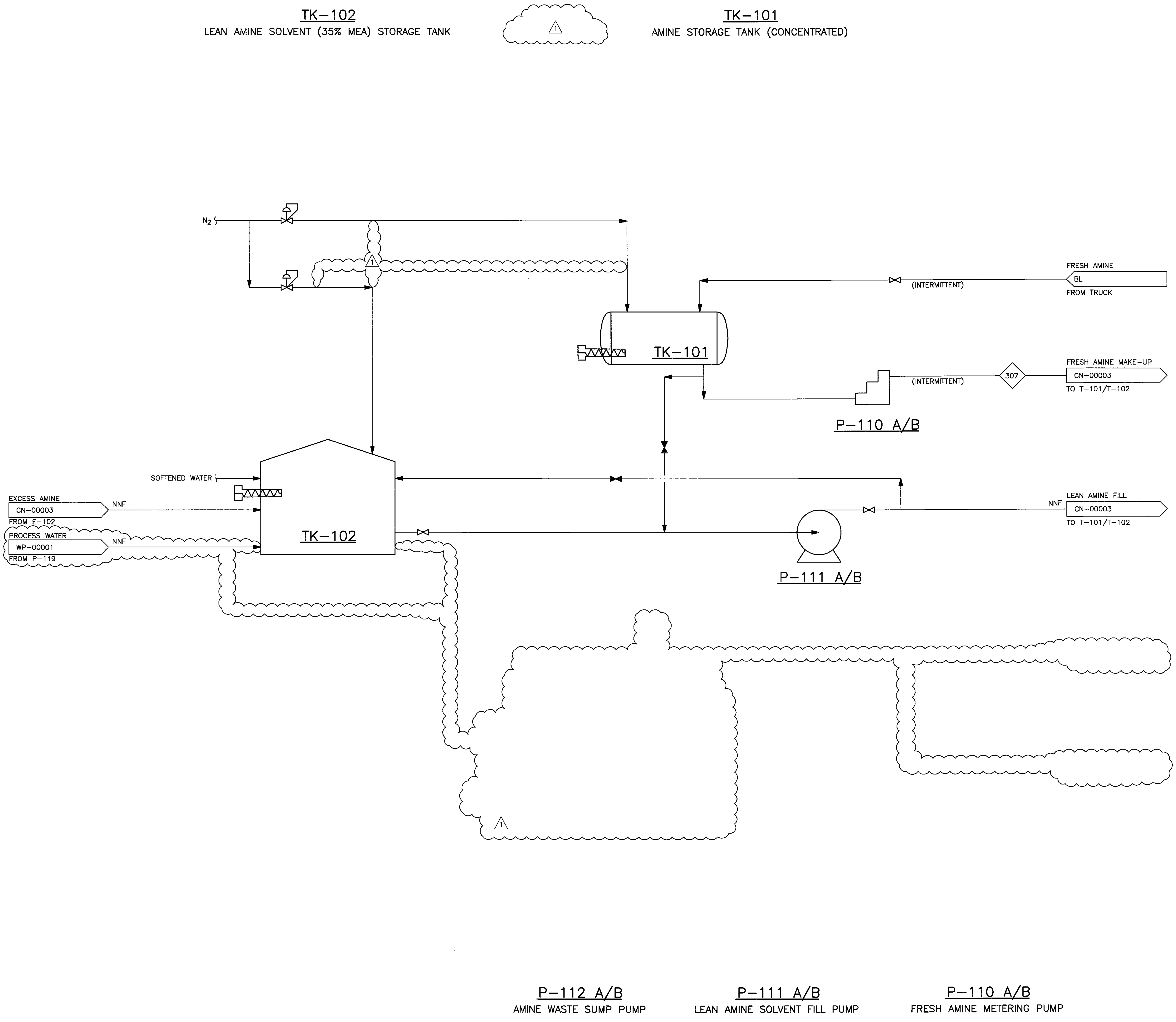
Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

PROCESS FLOW DIAGRAM
STRIPPER

Sheet Size 594x841 "A1"
Scale: N.T.S.

JOB NO.	DRAWING NO.	REV.
25474	000–M5–CN–00005	1



NOTES:
1. –

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	12 Nov 08	RE–ISSUED FOR APPROVAL	DM	UP	–	RS	Boe	
0	10/10/08	ISSUED FOR APPROVAL	GR	DM	–	RS	–	–

Owner
GASSNOVA

Owner Drawing No.
10112936–PB–P–FLD–0009

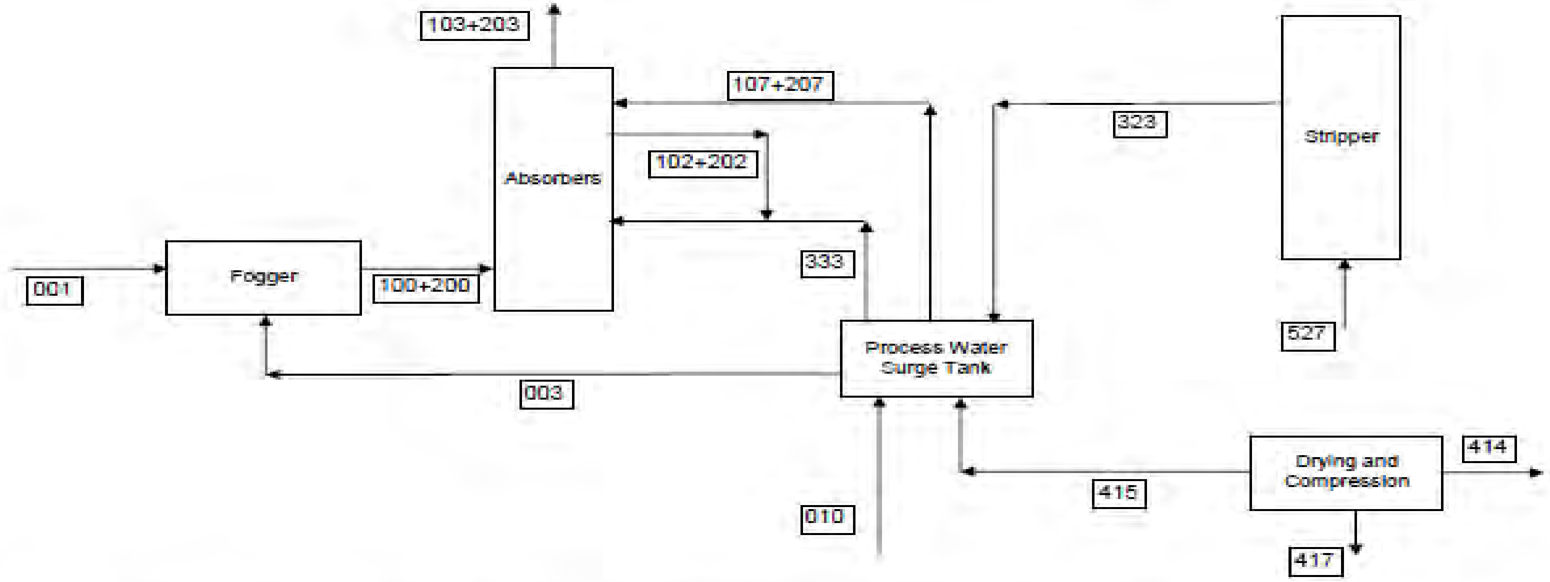
Contractor
BECHTEL
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

PROCESS FLOW DIAGRAM
FRESH & LEAN AMINE STORAGE

Sheet Size 594x841 "A1"
Scale: N.T.S.
JOB NO. 25474
DRAWING NO. 000–M5–CY–00001
REV. 1

CCC Plant Water Balance



Stream No.	001	003	010	100 + 200	102 + 202	103 + 203	107 + 207	323	333	414	415	417	527
Case	Flue Gas From CCPP	Process Water to Foggers	Softened Water	Cooled Flue Gas to Absorbers	Excess Water to Absorbers	Off Gas to Atmosphere	Process Water to Upper Bed	Reflux Purge	Process Water to Absorbers	CO2 Product	Inter-stage Liquid	Dryer Water	Vent Steam
Normal	124185	59284	2237	183468	148594	131836	10800	68180	3883	6	3555	93	5515
Winter	117567	67852	5828	185420	160014	128956	10800	70035	867	6	3658	96	5669
Summer	139319	47519	3642	186838	135814	147980	10800	63923	12490	5	3249	85	5113
Normal Reclaimer On	124185	59288	4172	183472	149654	133462	10800	67975	5603	6	3551	93	5197
Turn down	96864	45897	4359	142760	111248	105194	10800	50750	967	4	2558	67	4043

Units = kg/hr of water

Karsto CCC Plant—Water Balance for Split Flow Design, Revision 0

Kårstø CO_2 Capture and Compression Plant

Kårstø, Norway

Heat and Mass Balance Diagrams
(25474-000-M4-CN-00001)

for Front-End Engineering and Design (FEED) Study Report

Contents

Process Streams		001	002	003	004	005	006	007	008	009	010	100	101	102	103		Process Streams
		Flue Gas From CCPP	Flue Gas From Common Fogger	Process Water to Foggers	Process Water to Common Fogger	Process Water to Abs. 1 Fogger	Abs 1. Flue Gas Blower Discharge	Process Water to Absorbers	Process Water to Abs. 2 Fogger	Abs 2. Flue Gas Blower Discharge	Softened Water	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 1)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 1)		
Mole Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mole Fraction**
Oxygen		12.8084*	12.4336	1.04054E-08	1.04054E-08	1.04054E-08	12.4336	1.04054E-08*	1.04054E-08	12.4336	0	12.3515	0.000214797	0.000214797	13.1744		Oxygen
Nitrogen		74.7787*	72.5908	9.25780E-09	9.25780E-09	9.25780E-09	72.5908	9.25780E-09*	9.25780E-09	72.5908	0	72.1115	0.000673590	0.000673590	76.9164		Nitrogen
Water		7.74143*	10.4383	99.9138	99.9138	99.9138	10.4383	99.9138*	99.9138	10.4383	100	11.0291	99.3907	99.3907	8.45335		Water
Carbon Dioxide		3.81568*	3.70576	0.0588102	0.0588102	0.0588102	3.70576	0.0588102*	0.0588102	3.70576	0	3.68167	0.152185	0.152185	0.575377		Carbon Dioxide
Sulfur Dioxide		9.86294E-06*	9.57672E-06	8.07619E-08	8.07619E-08	8.07619E-08	9.57672E-06	8.07619E-08*	8.07619E-08	9.57672E-06	0	9.51402E-06	1.08742E-07	1.08742E-07	1.00290E-05		Sulfur Dioxide
MEA		0*	0.000723049	0.0247119	0.0247119	0.0247119	0.000723049	0.0247119*	0.0247119	0.000723049	0	0.000881450	0.456031	0.456031	0.000294483		MEA
Argon		0.854973*	0.829957	8.26903E-10	8.26903E-10	8.26903E-10	0.829957	8.26903E-10*	8.26903E-10	0.829957	0	0.824477	1.51314E-05	1.51314E-05	0.879404		Argon
NO		0.000316434*	0.000307175	8.14342E-13	8.14342E-13	8.14342E-13	0.000307175	8.14342E-13*	8.14342E-13	0.000307175	0	0.000305147	7.84911E-09	7.84911E-09	0.000325473		NO
NO2		5.15967E-05*	5.00872E-05	4.78076E-09	4.78076E-09	4.78076E-09	5.00872E-05	4.78076E-09*	4.78076E-09	5.00872E-05	0	4.97565E-05	1.19001E-08	1.19001E-08	5.30586E-05		NO2
NH3		0.000396083*	0.000463089	0.00268616	0.00268616	0.00268616	0.000463089	0.00268616*	0.00268616	0.000463089	0	0.000477768	0.000220370	0.000220370	0.000406187		NH3
Molar Flow		kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h		**Molar Flow**
Oxygen		11405.2*	11405.2	3.42713E-07	2.79269E-07	3.17217E-08	5702.58	8.48797E-08*	3.17217E-08	5702.58	0	5702.58	0.160147	0.00891279	5702.5		Oxygen
Nitrogen		66586.2*	66586.2	3.04916E-07	2.48469E-07	2.82231E-08	33293.1	7.55185E-08*	2.82231E-08	33293.1	0	33293.1	0.502213	0.0279500	33292.8		Nitrogen
Water		6893.30*	9574.88	3290.77	2681.58	304.595	4787.45	815.025*	304.595	4787.45	124.178	5092.04	74103.3	4124.12	3658.98		Water
Carbon Dioxide		3397.64*	3399.22	1.93698	1.57840	0.179288	1699.61	0.479732*	0.179288	1699.61	0	1699.79	113.465	6.31477	249.048		Carbon Dioxide
Sulfur Dioxide		0.00878239*	0.00878455	2.65998E-06	2.16756E-06	2.46209E-07	0.00439228	6.58797E-07*	2.46209E-07	0.00439228	0	0.00439252	8.10752E-05	4.51213E-06	0.00434101		Sulfur Dioxide
MEA		0*	0.663240	0.813912	0.663240	0.0753361	0.331620	0.201582*	0.0753361	0.331620	0	0.406956	340.006	18.9226	0.127465		MEA
Argon		761.305*	761.305	2.72350E-08	2.21932E-08	2.52088E-09	380.653	6.74528E-09*	2.52088E-09	380.653	0	380.652	0.0112816	0.000627863	380.645		Argon
NO		0.281766*	0.281766	2.68212E-11	2.18561E-11	2.48259E-12	0.140883	6.64281E-12*	2.48259E-12	0.140883	0	0.140883	5.85211E-06	3.25692E-07	0.140879		NO
NO2		0.0459440*	0.0459441	1.57459E-07	1.28310E-07	1.45745E-08	0.0229721	3.89980E-08*	1.45745E-08	0.0229721	0	0.0229721	8.87243E-06	4.93783E-07	0.0229661		NO2
NH3		0.352690*	0.424783	0.0884716	0.0720936	0.00818897	0.212392	0.0219118*	0.00818897	0.212392	0	0.220581	0.164303	0.00914404	0.175815		NH3
Mass Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mass Fraction**
Oxygen		14.3999*	14.1299	1.84556E-08	1.84556E-08	1.84556E-08	14.1299	1.84556E-08*	1.84556E-08	14.1299	0	14.0700	0.000376588	0.000376588	15.1151		Oxygen
Nitrogen		73.5995*	72.2197	1.43750E-08	1.43750E-08	1.43750E-08	72.2197	1.43750E-08*	1.43750E-08	72.2197	0	71.9134	0.00103387	0.00103387	77.2557		Nitrogen
Water		4.89997*	6.67852	99.7703	99.7703	99.7703	6.67852	99.7703*	99.7703	6.67852	100	7.07331	98.1052	98.1052	5.46029		Water
Carbon Dioxide		5.89996*	5.79204	0.143461	0.143461	0.143461	5.79204	0.143461*	0.143461	5.79204	0	5.76809	0.366964	0.366964	0.907915		Carbon Dioxide
Sulfur Dioxide		2.21998E-05*	2.17890E-05	2.86783E-07	2.86783E-07	2.86783E-07	2.17890E-05	2.86783E-07*	2.86783E-07	2.17890E-05	0	2.16979E-05	3.81693E-07	3.81693E-07	2.30366E-05		Sulfur Dioxide
MEA		0*	0.00156855	0.0836684	0.0836684	0.0836684	0.00156855	0.0836684*	0.0836684	0.00156855	0	0.00191672	1.52623	1.52623	0.000644952		MEA
Argon		1.19999*	1.17750	1.83098E-09	1.83098E-09	1.83098E-09	1.17750	1.83098E-09*	1.83098E-09	1.17750	0	1.17250	3.31192E-05	3.31192E-05	1.25959		Argon
NO		0.000333598*	0.000327344	1.35441E-12	1.35441E-12	1.35441E-12	0.000327344	1.35441E-12*	1.35441E-12	0.000327344	0	0.000325955	1.29043E-08	1.29043E-08	0.000350164		NO
NO2		8.33994E-05*	8.18361E-05	1.21911E-08	1.21911E-08	1.21911E-08	8.18361E-05	1.21911E-08*	1.21911E-08	8.18361E-05	0	8.14891E-05	2.99961E-08	2.99961E-08	8.75209E-05		NO2
NH3		0.000236998*	0.000280092	0.00253568	0.00253568	0.00253568	0.000280092	0.00253568*	0.00253568	0.000280092	0	0.000289658	0.000205629	0.000205629	0.000248028		NH3
Mass Flow		kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h		**Mass Flow**
Oxygen		364951*	364951	1.09664E-05	8.93629E-06	1.01506E-06	182476	2.71605E-06*	1.01506E-06	182476	0	182476	5.12452	0.285199	182472		Oxygen
Nitrogen		1.86531E+06*	1.86531E+06	8.54172E-06	6.96047E-06	7.90626E-07	932654	2.11553E-06*	7.90626E-07	932654	0	932653	14.0687	0.782975	9.32643E+05		Nitrogen
Water		124185*	172494	59284.1	48309.4	5487.37	86247.2	14682.9*	5487.37	86247.2	2237.11	91734.4	1.33499E+06	74297.2	65918		Water
Carbon Dioxide		149529*	149598	85.2455	69.4648	7.89037	74799.1	21.1128*	7.89037	74799.1	0	74806.9	4993.56	277.910	10960.5		Carbon Dioxide
Sulfur Dioxide		0.562633*	0.562772	0.000170408	0.000138862	1.57731E-05	0.281386	4.22050E-05*	1.57731E-05	0.281386	0	0.281402	0.00519399	0.000289064	0.278102		Sulfur Dioxide
MEA		0*	40.5127	49.7163	40.5127	4.60176	20.2564	12.3132*	4.60176	20.2564	0	24.8581	20768.6	1155.85	7.7860		MEA
Argon		30412.6*	30412.6	1.08798E-06	8.86574E-07	1.00704E-07	15206.3	2.69461E-07*	1.00704E-07	15206.3	0	15206.3	0.450678	0.0250819	15206.0		Argon
NO		8.45470*	8.45470	8.04801E-10	6.55815E-10	7.44927E-11	4.22735	1.99325E-10*	7.44927E-11	4.22735	0	4.22735	0.000175599	9.77273E-06	4.22723		NO
NO2		2.11367*	2.11368	7.24400E-06	5.90298E-06	6.70508E-07	1.05684	1.79412E-06*	6.70508E-07	1.05684	0	1.05684	0.000408180	2.27167E-05	1.05657		NO2
NH3		6.00649*	7.23428	1.50672	1.22779	0.139462	3.61714	0.373169*	0.139462	3.61714	0	3.75660	2.79816	0.155728	2.99423		NH3
Process Streams		**001**	**002**	**003**	**004**	**005**	**006**	**007**	**008**	**009**	**010**	**100**	**101**	**102**	**103**		**Process Streams**
Property	**Units**															**Units**	**Property**
Temperature	℃	90*	47.1439	49.4136	49.4136	49.4134	59.6823	47.2373*	49.4134	59.6823	20.0000	50.2334	52.9286	52.9286	42.7843	℃	Temperature
Pressure	bar	1.0017*	1.0017	138*	138	138	1.08857	4.13685*	138	1.08857	4.13685	1.08857	4.48079	4.48079	1.01273	bar	Pressure
Mole Fraction Vapor	%	100	100	0	0	0	100	0	0	100	0	100	0	0	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	28.4622	28.1573	18.0412	18.0412	18.0412	28.1573	18.0412	18.0412	28.1573	18.0153	28.0905	18.2513	18.2513	27.8903	kg/kmol	Molecular Weight
Mass Density	kg/m^3	0.944399	1.05981	989.875	989.875	989.875	1.10824	988.904	989.875	1.10824	997.903	1.13808	987.729	987.729	1.07581	kg/m^3	Mass Density
Molar Flow	kmol/h	89044.3	91728.2	3293.61	2683.89	304.858	45864.1	815.728	304.858	45864.1	124.178	46168.9	74557.7	4149.41	43284.4	kmol/h	Molar Flow
Mass Flow	kg/h	2.53440E+06*	2.58282E+06	59420.6	48420.6	5500	1.29141E+06	14716.7*	5500	1.29141E+06	2237.11	1.29691E+06	1.36078E+06	75732.3	1.20722E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	2.10950E+06	2.17308E+06	78027.1	63582.6	7222.22	1.08654E+06	19325.0	7222.22	1.08654E+06	2941.84	1.09376E+06	1.76630E+06	98301.3	1.02543E+06	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	2962.14	3010.62	59.4975	48.4832	5.50711	1505.31	14.7357	5.50711	1505.31	2.23931	1510.82	1362.77	75.8433	1407.19	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.983118	0.972586	0.990811	0.990811	0.990811	0.972586	0.989839	0.990811	0.972586	0.998846	0.970278	0.988662	0.988662	0.963364		Specific Gravity
Mass Enthalpy	kJ/kg	-1117.26	-1391.25	-15732.4	-15732.4	-15732.4	-1377.89	-15753.3	-15732.4	-1377.89	-15885.0	-1438.77	-15552.4	-15552.4	-795.631	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0205100	0.0186190	0.556163	0.556163	0.556164	0.0191597	0.563552	0.556164	0.0191597	1.01302	0.0187333	0.524860	0.524860	0.0186124	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0293	0.0265	0.6350	0.635 0	0.6350	0.0274	0.6325	0.6350	0.0274	0.5991	0.0267	0.6282	0.6282	0.0265	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm			67.9491	67.9491	67.9492		68.3735	67.9492		73.8205		67.0193	67.0193		dyne/cm	Surface Tension

Process Streams	104	105	106	107	108	109	110	111	200	201	202	203	204	Process Streams
	Lean Amine (Abs. 1)	Cooled Semi-Lean Amine (Abs. 1)	Rich Amine (Abs. 1)	Process Water to Upper Bed (Abs. 1)	Cooled Wash Water to Lower Bed (Abs. 1)	Cooled Wash Water (Abs. 1)	Cooled Wash Water to Upper Bed (Abs. 1)	Combined Wash Water to Upper Bed (Abs. 1)	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 2)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 2)	Lean Amine (Abs. 2)	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	2.03133E-05	4.10160E-07	0.000204316	1.04054E-08	0.000214797	0.000214797	0.000214797	0.000171839	12.3515	0.000214797	0.000214797	13.1744	2.03133E-05	Oxygen
Nitrogen	6.37014E-05	8.71616E-07	0.000641523	9.25780E-09	0.000673590	0.000673590	0.000673590	0.000538874	72.1115	0.000673590	0.000673590	76.9164	6.37014E-05	Nitrogen
Water	82.3485	79.0389	78.7083	99.9138	99.3907	99.3907	99.3907	99.4953	11.0291	99.3907	99.3907	8.45335	82.3485	Water
Carbon Dioxide	3.29511	6.03259	6.59730	0.0588102	0.152185	0.152185	0.152185	0.133510	3.68167	0.152185	0.152185	0.575377	3.29511	Carbon Dioxide
Sulfur Dioxide	1.04242E-08	3.00188E-08	1.02893E-07	8.07619E-08	1.08742E-07	1.08742E-07	1.08742E-07	1.03146E-07	9.51402E-06	1.08742E-07	1.08742E-07	1.00290E-05	1.04242E-08	Sulfur Dioxide
MEA	14.3561	14.9282	14.6932	0.0247119	0.456031	0.456031	0.456031	0.369767	0.000881450	0.456031	0.456031	0.000294483	14.3561	MEA
Argon	1.43098E-06	2.77143E-08	1.43827E-05	8.26903E-10	1.51314E-05	1.51314E-05	1.51314E-05	1.21053E-05	0.824477	1.51314E-05	1.51314E-05	0.879404	1.43098E-06	Argon
NO	7.42291E-10	2.46260E-11	7.46719E-09	8.14342E-13	7.84911E-09	7.84911E-09	7.84911E-09	6.27945E-09	0.000305147	7.84911E-09	7.84911E-09	0.000325473	7.42291E-10	NO
NO2	1.13371E-09	1.97765E-10	1.12648E-08	4.78076E-09	1.19001E-08	1.19001E-08	1.19001E-08	1.04762E-08	4.97565E-05	1.19001E-08	1.19001E-08	5.30586E-05	1.13371E-09	NO2
NH3	0.000219977	0.000303949	0.000322211	0.00268616	0.000220370	0.000220370	0.000220370	0.000713528	0.000477768	0.000220370	0.000220370	0.000406187	0.000219977	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0.00891280	4.31312E-05	0.109161	3.12162E-08	0.157570	0.160147	0.00257756	0.00257759	5702.58	0.160147	0.00891279	5702.5	0.00891280	Oxygen
Nitrogen	0.0279500	9.16566E-05	0.342750	2.77734E-08	0.494130	0.502213	0.00808308	0.00808311	33293.1	0.502213	0.0279500	33292.8	0.0279500	Nitrogen
Water	36131.7	8311.50	42051.9	299.741	72910.7	74103.3	1192.69	1492.43	5092.04	74103.3	4124.12	3658.98	36131.7	Water
Carbon Dioxide	1445.78	634.370	3524.77	0.176431	111.639	113.465	1.82622	2.00265	1699.79	113.465	6.31477	249.048	1445.78	Carbon Dioxide
Sulfur Dioxide	4.57379E-06	3.15669E-06	5.49733E-05	2.42286E-07	7.97703E-05	8.10752E-05	1.30490E-06	1.54719E-06	0.00439252	8.10752E-05	4.51213E-06	0.00434101	4.57379E-06	Sulfur Dioxide
MEA	6298.96	1569.81	7850.20	0.0741356	334.534	340.006	5.47237	5.54651	0.406956	340.006	18.9226	0.127465	6298.96	MEA
Argon	0.000627864	2.91436E-06	0.00768432	2.48071E-09	0.0111000	0.0112816	0.000181577	0.000181579	380.652	0.0112816	0.000627863	380.645	0.000627864	Argon
NO	3.25692E-07	2.58960E-09	3.98953E-06	2.44303E-12	5.75792E-06	5.85211E-06	9.41893E-08	9.41917E-08	0.140883	5.85211E-06	3.25692E-07	0.140879	3.25692E-07	NO
NO2	4.97433E-07	2.07964E-08	6.01850E-06	1.43423E-08	8.72963E-06	8.87243E-06	1.42801E-07	1.57143E-07	0.0229721	8.87243E-06	4.93783E-07	0.0229661	4.97433E-07	NO2
NH3	0.0965183	0.0319624	0.172149	0.00805848	0.161658	0.164303	0.00264444	0.0107029	0.220581	0.164303	0.00914404	0.175815	0.0965183	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	2.59434E-05	5.04548E-07	0.000250893	1.84556E-08	0.000376588	0.000376588	0.000376588	0.000301970	14.0700	0.000376588	0.000376588	15.1151	2.59434E-05	Oxygen
Nitrogen	7.12240E-05	9.38656E-07	0.000689655	1.43750E-08	0.00103387	0.00103387	0.00103387	0.000829010	71.9134	0.00103387	0.00103387	77.2557	7.12240E-05	Nitrogen
Water	59.2118	54.7391	54.4146	99.7703	98.1052	98.1052	98.1052	98.4351	7.07331	98.1052	98.1052	5.46029	59.2118	Water
Carbon Dioxide	5.78798	10.2062	11.1421	0.143461	0.366964	0.366964	0.366964	0.322676	5.76809	0.366964	0.366964	0.907915	5.78798	Carbon Dioxide
Sulfur Dioxide	2.66543E-08	7.39302E-08	2.52961E-07	2.86783E-07	3.81693E-07	3.81693E-07	3.81693E-07	3.62886E-07	2.16979E-05	3.81693E-07	3.81693E-07	2.30366E-05	2.66543E-08	Sulfur Dioxide
MEA	35	35.0545	34.4422	0.0836684	1.52623	1.52623	1.52623	1.24038	0.00191672	1.52623	1.52623	0.000644952	35	MEA
Argon	2.28160E-06	4.25613E-08	2.20490E-05	1.83098E-09	3.31192E-05	3.31192E-05	3.31192E-05	2.65568E-05	1.17250	3.31192E-05	3.31192E-05	1.25959	2.28160E-06	Argon
NO	8.88986E-10	2.84066E-11	8.59845E-09	1.35441E-12	1.29043E-08	1.29043E-08	1.29043E-08	1.03476E-08	0.000325955	1.29043E-08	1.29043E-08	0.000350164	8.88986E-10	NO
NO2	2.08172E-09	3.49764E-10	1.98878E-08	1.21911E-08	2.99961E-08	2.99961E-08	2.99961E-08	2.64680E-08	8.14891E-05	2.99961E-08	2.99961E-08	8.75209E-05	2.08172E-09	NO2
NH3	0.000149526	0.000198996	0.000210582	0.00253568	0.000205629	0.000205629	0.000205629	0.000667337	0.000289658	0.000205629	0.000205629	0.000248028	0.000149526	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0.285199	0.00138015	3.49301	9.98880E-07	5.04205	5.12452	0.0824789	0.0824799	182476	5.12452	0.285199	182472	0.285199	Oxygen
Nitrogen	0.782975	0.00256761	9.60158	7.78027E-07	13.8423	14.0687	0.226435	0.226435	932653	14.0687	0.782975	9.32643E+05	0.782975	Nitrogen
Water	650923	149734	757576	5399.92	1.31351E+06	1.33499E+06	21486.6	26886.5	91734.4	1.33499E+06	74297.2	65918	650923	Water
Carbon Dioxide	63628.1	27918.3	155123	7.76463	4913.19	4993.56	80.3709	88.1356	74806.9	4993.56	277.910	10960.5	63628.1	Carbon Dioxide
Sulfur Dioxide	0.000293014	0.000202230	0.00352180	1.55217E-05	0.00511039	0.00519399	8.35968E-05	9.91186E-05	0.281402	0.00519399	0.000289064	0.278102	0.000293014	Sulfur Dioxide
MEA	384760	95888.6	479514	4.52843	20434.4	20768.6	334.270	338.798	24.8581	20768.6	1155.85	7.7860	384760	MEA
Argon	0.0250819	0.000116423	0.306973	9.90994E-08	0.443424	0.450678	0.00725363	0.00725373	15206.3	0.450678	0.0250819	15206.0	0.0250819	Argon
NO	9.77275E-06	7.77039E-08	0.000119710	7.33057E-11	0.000172773	0.000175599	2.82625E-06	2.82633E-06	4.22735	0.000175599	9.77273E-06	4.22723	9.77275E-06	NO
NO2	2.28847E-05	9.56750E-07	0.000276884	6.59823E-07	0.000401611	0.000408180	6.56964E-06	7.22946E-06	1.05684	0.000408180	2.27167E-05	1.05657	2.28847E-05	NO2
NH3	1.64376	0.544336	2.93179	0.137240	2.75312	2.79816	0.0450362	0.182276	3.75660	2.79816	0.155728	2.99423	1.64376	NH3

Process Streams		104	105	106	107	108	109	110	111	200	201	202	203	204		Process Streams
Property	**Units**														**Units**	**Property**
Temperature	℃	54.0660	58.8945	53.3528	47.2376	20.0000	20.0000	20.0000	25.5617	50.2334	52.9286	52.9286	42.7843	54.0660	℃	Temperature
Pressure	bar	3.68912	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	1.08857	4.48079	4.48079	1.01273	3.68912	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	100	0	0	100	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	25.0547	26.0126	26.0583	18.0412	18.2513	18.2513	18.2513	18.2093	28.0905	18.2513	18.2513	27.8903	25.0547	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1088.56	1142.49	1151.91	988.904	999.814	999.814	999.814	997.898	1.13808	987.729	987.729	1.07581	1088.56	kg/m^3	Mass Density
Molar Flow	kmol/h	43876.6	10515.7	53427.5	300	73357.7	74557.7	1200	1500	46168.9	74557.7	4149.41	43284.4	43876.6	kmol/h	Molar Flow
Mass Flow	kg/h	1.09931E+06	273542	1.39223E+06	5412.36	1.33888E+06	1.36078E+06	21901.6	27314.0	1.29691E+06	1.36078E+06	75732.3	1.20722E+06	1.09931E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	1.03946E+06	249122	1.26572E+06	7107.13	1.73788E+06	1.76630E+06	28428.5	35535.7	1.09376E+06	1.76630E+06	98301.3	1.02543E+06	1.03946E+06	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	1106.22	277.877	1417.30	5.41936	1340.84	1362.77	21.9337	27.3531	1510.82	1362.77	75.8433	1407.19	1106.22	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.08959	1.14357	1.15300	0.989839	1.00076	1.00076	1.00076	0.998842	0.970278	0.988662	0.988662	0.963364	1.08959		Specific Gravity
Mass Enthalpy	kJ/kg	-11403.7	-11154.7	-11195.7	-15753.3	-15688.5	-15688.5	-15688.5	-15701.3	-1438.77	-15552.4	-15552.4	-795.631	-11403.7	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	1.76569	2.16333	2.58560	0.563550	1.04930	1.04930	1.04930	0.907633	0.0187333	0.524860	0.524860	0.0186124	1.76569	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.4170	0.3877	0.3816	0.6325	0.5881	0.5881	0.5881	0.5977	0.0267	0.6282	0.6282	0.0265	0.4170	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm	59.3829	92.7571	95.5100	68.3735	73.3744?	73.3744?	73.3744?	72.3816?		67.0193	67.0193		59.3829	dyne/cm	Surface Tension

Process Streams	205	206	207	208	209	210	211	300	302	303	304	305	306	Process Streams
	Cooled Semi-Lean Amine (Abs. 2)	Rich Amine (Abs. 2)	Process Water to Upper Bed (Abs. 2)	Cooled Wash Water to Lower Bed (Abs. 2)	Cooled Wash Water (Abs. 2)	Cooled Wash Water to Upper Bed (Abs. 2)	Combined Wash Water to Upper Bed (Abs. 2)	Combined Cold Rich Amine	Hot Rich Amine	Stripper Bottoms to E-108 Inlet	Rich Amine to E-103	Lean Amine	Filtered Lean Amine	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	4.10160E-07	0.000204316	1.04054E-08	0.000214797	0.000214797	0.000214797	0.000171839	0.000204316	0.000204316	0	0.000204316	2.03133E-05	2.03133E-05	Oxygen
Nitrogen	8.71616E-07	0.000641523	9.25780E-09	0.000673590	0.000673590	0.000673590	0.000538874	0.000641523	0.000641523	0	0.000641523	6.37014E-05	6.37014E-05	Nitrogen
Water	79.0389	78.7083	99.9138	99.3907	99.3907	99.3907	99.4953	78.7083	78.7083	80.5160	78.7083	82.3485	82.3485	Water
Carbon Dioxide	6.03259	6.59730	0.0588102	0.152185	0.152185	0.152185	0.133510	6.59730	6.59730	3.63314	6.59730	3.29511	3.29511	Carbon Dioxide
Sulfur Dioxide	3.00188E-08	1.02893E-07	8.07619E-08	1.08742E-07	1.08742E-07	1.08742E-07	1.03146E-07	1.02893E-07	1.02893E-07	0	1.02893E-07	1.04242E-08	1.04242E-08	Sulfur Dioxide
MEA	14.9282	14.6932	0.0247119	0.456031	0.456031	0.456031	0.369767	14.6932	14.6932	15.8506	14.6932	14.3561	14.3561	MEA
Argon	2.77143E-08	1.43827E-05	8.26903E-10	1.51314E-05	1.51314E-05	1.51314E-05	1.21053E-05	1.43827E-05	1.43827E-05	0	1.43827E-05	1.43098E-06	1.43098E-06	Argon
NO	2.46260E-11	7.46719E-09	8.14342E-13	7.84911E-09	7.84911E-09	7.84911E-09	6.27945E-09	7.46719E-09	7.46719E-09	0	7.46719E-09	7.42291E-10	7.42291E-10	NO
NO2	1.97765E-10	1.12648E-08	4.78076E-09	1.19001E-08	1.19001E-08	1.19001E-08	1.04762E-08	1.12648E-08	1.12648E-08	0	1.12648E-08	1.13371E-09	1.13371E-09	NO2
NH3	0.000303949	0.000322211	0.00268616	0.000220370	0.000220370	0.000220370	0.000713528	0.000322211	0.000322211	0.000215357	0.000322211	0.000219977	0.000219977	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	4.31312E-05	0.109161	3.12162E-08	0.157570	0.160147	0.00257756	0.00257759	0.218322	0.174657	0	0.0436643	0.0142605	0.00356512	Oxygen
Nitrogen	9.16566E-05	0.342750	2.77734E-08	0.494130	0.502213	0.00808308	0.00808311	0.685499	0.548399	0	0.137100	0.0447200	0.0111800	Nitrogen
Water	8311.50	42051.9	299.741	72910.7	74103.3	1192.69	1492.43	84103.7	67283.0	63799.5	16820.7	57810.8	14452.7	Water
Carbon Dioxide	634.370	3524.77	0.176431	111.639	113.465	1.82622	2.00265	7049.54	5639.63	2878.84	1409.91	2313.25	578.312	Carbon Dioxide
Sulfur Dioxide	3.15669E-06	5.49733E-05	2.42286E-07	7.97703E-05	8.10752E-05	1.30490E-06	1.54719E-06	0.000109947	8.79572E-05	0	2.19893E-05	7.31807E-06	1.82952E-06	Sulfur Dioxide
MEA	1569.81	7850.20	0.0741356	334.534	340.006	5.47237	5.54651	15700.4	12560.3	12559.8	3140.08	10078.3	2519.58	MEA
Argon	2.91436E-06	0.00768432	2.48071E-09	0.0111000	0.0112816	0.000181577	0.000181579	0.0153686	0.0122949	0	0.00307373	0.00100458	0.000251146	Argon
NO	2.58960E-09	3.98953E-06	2.44303E-12	5.75792E-06	5.85211E-06	9.41893E-08	9.41917E-08	7.97905E-06	6.38324E-06	0	1.59581E-06	5.21107E-07	1.30277E-07	NO
NO2	2.07964E-08	6.01850E-06	1.43423E-08	8.72963E-06	8.87243E-06	1.42801E-07	1.57143E-07	1.20370E-05	9.62959E-06	0	2.40740E-06	7.95893E-07	1.98973E-07	NO2
NH3	0.0319624	0.172149	0.00805848	0.161658	0.164303	0.00264444	0.0107029	0.344298	0.275438	0.170645	0.0688596	0.154429	0.0386073	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	5.04548E-07	0.000250893	1.84556E-08	0.000376588	0.000376588	0.000376588	0.000301970	0.000250893	0.000250893	0	0.000250893	2.59434E-05	2.59434E-05	Oxygen
Nitrogen	9.38656E-07	0.000689655	1.43750E-08	0.00103387	0.00103387	0.00103387	0.000829010	0.000689655	0.000689655	0	0.000689655	7.12240E-05	7.12240E-05	Nitrogen
Water	54.7391	54.4146	99.7703	98.1052	98.1052	98.1052	98.4351	54.4146	54.4146	56.2517	54.4146	59.2118	59.2118	Water
Carbon Dioxide	10.2062	11.1421	0.143461	0.366964	0.366964	0.366964	0.322676	11.1421	11.1421	6.20071	11.1421	5.78798	5.78798	Carbon Dioxide
Sulfur Dioxide	7.39302E-08	2.52961E-07	2.86783E-07	3.81693E-07	3.81693E-07	3.81693E-07	3.62886E-07	2.52961E-07	2.52961E-07	0	2.52961E-07	2.66543E-08	2.66543E-08	Sulfur Dioxide
MEA	35.0545	34.4422	0.0836684	1.52623	1.52623	1.52623	1.24038	34.4422	34.4422	37.5474	34.4422	35	35	MEA
Argon	4.25613E-08	2.20490E-05	1.83098E-09	3.31192E-05	3.31192E-05	3.31192E-05	2.65568E-05	2.20490E-05	2.20490E-05	0	2.20490E-05	2.28160E-06	2.28160E-06	Argon
NO	2.84066E-11	8.59845E-09	1.35441E-12	1.29043E-08	1.29043E-08	1.29043E-08	1.03476E-08	8.59845E-09	8.59845E-09	0	8.59845E-09	8.88986E-10	8.88986E-10	NO
NO2	3.49764E-10	1.98878E-08	1.21911E-08	2.99961E-08	2.99961E-08	2.99961E-08	2.64680E-08	1.98878E-08	1.98878E-08	0	1.98878E-08	2.08172E-09	2.08172E-09	NO2
NH3	0.000198996	0.000210582	0.00253568	0.000205629	0.000205629	0.000205629	0.000667337	0.000210582	0.000210582	0.000142233	0.000210582	0.000149526	0.000149526	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	0.00138015	3.49301	9.98880E-07	5.04205	5.12452	0.0824789	0.0824799	6.98603	5.58882	0	1.39721	0.456318	0.114080	Oxygen
Nitrogen	0.00256761	9.60158	7.78027E-07	13.8423	14.0687	0.226435	0.226435	19.2032	15.3625	0	3.84063	1.25276	0.313190	Nitrogen
Water	149734	757576	5399.92	1.31351E+06	1.33499E+06	21486.6	26886.5	1.51515E+06	1.21212E+06	1.14937E+06	303030	1.04148E+06	260369	Water
Carbon Dioxide	27918.3	155123	7.76463	4913.19	4993.56	80.3709	88.1356	310247	248197	126696	62049.3	101805	25451.2	Carbon Dioxide
Sulfur Dioxide	0.000202230	0.00352180	1.55217E-05	0.00511039	0.00519399	8.35968E-05	9.91186E-05	0.00704359	0.00563487	0	0.00140872	0.000468823	0.000117206	Sulfur Dioxide
MEA	95888.6	479514	4.52843	20434.4	20768.6	334.270	338.798	959029	767223	767190	191806	615616	153904	MEA
Argon	0.000116423	0.306973	9.90994E-08	0.443424	0.450678	0.00725363	0.00725373	0.613947	0.491157	0	0.122789	0.0401310	0.0100328	Argon
NO	7.77039E-08	0.000119710	7.33057E-11	0.000172773	0.000175599	2.82625E-06	2.82633E-06	0.000239420	0.000191536	0	4.78841E-05	1.56364E-05	3.90910E-06	NO
NO2	9.56750E-07	0.000276884	6.59823E-07	0.000401611	0.000408180	6.56964E-06	7.22946E-06	0.000553768	0.000443014	0	0.000110754	3.66155E-05	9.15386E-06	NO2
NH3	0.544336	2.93179	0.137240	2.75312	2.79816	0.0450362	0.182276	5.86357	4.69086	2.90618	1.17271	2.63001	0.657503	NH3

Process Streams		205	206	207	208	209	210	211	300	302	303	304	305	306	Process Streams	
Property	**Units**														**Units**	**Property**
Temperature	℃	58.8945	53.3528	47.2376	20.0000	20.0000	20.0000	25.5617	53.4987	117*	126.354	53.4987	54.0660	54.0660	℃	Temperature
Pressure	bar	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	10.7412	9.70702	5.41280	10.7412	3.68912	3.68912	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	0	0	0	0	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0126	26.0583	18.0412	18.2513	18.2513	18.2513	18.2093	26.0583	26.0583	25.7862	26.0583	25.0547	25.0547	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1142.49	1151.91	988.904	999.814	999.814	999.814	997.898	1151.99	1132.35	1067.79	1151.99	1088.56	1088.56	kg/m^3	Mass Density
Molar Flow	kmol/h	10515.7	53427.5	300	73357.7	74557.7	1200	1500	106855	85483.9	79238.3	21371.0	70202.6	17550.6	kmol/h	Molar Flow
Mass Flow	kg/h	273542	1.39223E+06	5412.36	1.33888E+06	1.36078E+06	21901.6	27314.0	2.78446E+06	2.22757E+06	2.04326E+06	556892	1.75890E+06	439726	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	249122	1.26572E+06	7107.13	1.73788E+06	1.76630E+06	28428.5	35535.7	2.53144E+06	2.02515E+06	1.87719E+06	506288	1.66313E+06	415783	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	277.877	1417.30	5.41936	1340.84	1362.77	21.9337	27.3531	2834.60	2267.68	2056.85	566.920	1769.96	442.490	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.14357	1.15300	0.989839	1.00076	1.00076	1.00076	0.998842	1.15307	1.13342	1.06880	1.15307	1.08959	1.08959		Specific Gravity
Mass Enthalpy	kJ/kg	-11154.7	-11195.7	-15753.3	-15688.5	-15688.5	-15688.5	-15701.3	-11194.4	-10966.7	-10823.5	-11194.4	-11403.7	-11403.7	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	2.16333	2.58560	0.563550	1.04930	1.04930	1.04930	0.907633	2.57968	0.687667	0.518578	2.57968	1.76569	1.76569	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3877	0.3816	0.6325	0.5881	0.5881	0.5881	0.5977	0.3817	0.3948	0.4154	0.3817	0.4170	0.4170	W/(m*℃)	Thermal Conducti vity
Surface Tension	dyne/cm	92.7571	95.5100	68.3735	73.3744?	73.3744?	73.3744?	72.3816?	92.9823?	87.0585	46.6229?	92.9823	59.3829	59.3829	dyne/cm	Surface Tension

Process Streams	307	309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	325	Process Streams
	Fresh Amine	Rich Amine to E-107	Rich Amine to E-109	Rich Amine to V-101	Flash Gas	Hot Semi-Lean Amine	Stripper Bottoms	Bottoms to E-107	Reclaimer Feed	Reclaimer Product	Stripper Reboiler Inlet	Stripper Reboiler Discharge	Stripper Overhead	Stripper Reflux	Reflux Purge	Cooled Stripper Overhead	Stripper Overhead Liquid	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0	0.000204316	0.000204316	0.000204316	0.0128335	4.10161E-07	0	0	0	0	0	0	0.00298447	2.19560E-07	2.19560E-07	0.00298447	2.19560E-07	Oxygen
Nitrogen	0	0.000641523	0.000641523	0.000641523	0.0403213	8.71618E-07	0	0	0	0	0	0	0.00937200	3.66121E-07	3.66121E-07	0.00937200	3.66121E-07	Nitrogen
Water	0	78.7083	78.7083	78.7083	58.2345	79.0389	80.5160	80.5160	80.5160	95.6822	80.5160	80.5160	60.2801	99.8826	99.8826	60.2801	99.8826	Water
Carbon Dioxide	0	6.59730	6.59730	6.59730	41.5730	6.03259	3.63314	3.63314	3.63314	4.31750	3.63314	3.63314	39.6905	0.0880881	0.0880881	39.6905	0.0880881	Carbon Dioxide
Sulfur Dioxide	0	1.02893E-07	1.02893E-07	1.02893E-07	4.61648E-06	3.00188E-08	0	0	0	0	0	0	1.42132E-06	7.10486E-08	7.10486E-08	1.42132E-06	7.10486E-08	Sulfur Dioxide
MEA	100	14.6932	14.6932	14.6932	0.137029	14.9282	15.8506	15.8506	15.8506	0	15.8506	15.8506	0.0151947	0.0263917	0.0263917	0.0151947	0.0263917	MEA
Argon	0	1.43827E-05	1.43827E-05	1.43827E-05	0.000903482	2.77144E-08	0	0	0	0	0	0	0.000210094	1.63991E-08	1.63991E-08	0.000210094	1.63991E-08	Argon
NO	0	7.46719E-09	7.46719E-09	7.46719E-09	4.68433E-07	2.46261E-11	0	0	0	0	0	0	1.09047E-07	1.18544E-11	1.18544E-11	1.09047E-07	1.18544E-11	NO
NO2	0	1.12648E-08	1.12648E-08	1.12648E-08	6.96718E-07	1.97766E-10	0	0	0	0	0	0	1.64052E-07	1.70519E-10	1.70519E-10	1.64052E-07	1.70519E-10	NO2
NH3	0	0.000322211	0.000322211	0.000322211	0.00145348	0.000303946	0.000215357	0.000215357	0.000215357	0.000255923	0.000215357	0.000215357	0.00166651	0.00288469	0.00288469	0.00166651	0.00288469	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0	0.0436643	0.0436643	0.0436643	0.0435780	8.62627E-05	0	0	0	0	0	0	0.218236	9.24350E-07	8.31915E-06	0.218236	9.24350E-06	Oxygen
Nitrogen	0	0.137100	0.137100	0.137100	0.136917	0.000183314	0	0	0	0	0	0	0.685318	1.54137E-06	1.38724E-05	0.685318	1.54137E-05	Nitrogen
Water	0	16820.7	16820.7	16820.7	197.743	16623.0	63799.5	63799.5	0	0	42533.0	42533.0	4407.92	420.507	3784.57	4407.92	4205.07	Water
Carbon Dioxide	0	1409.91	1409.91	1409.91	141.167	1268.74	2878.84	2878.84	0	0	1919.23	1919.23	2902.33	0.370852	3.33767	2902.33	3.70852	Carbon Dioxide
Sulfur Dioxide	0	2.19893E-05	2.19893E-05	2.19893E-05	1.56759E-05	6.31338E-06	0	0	0	0	0	0	0.000103932	2.99116E-07	2.69204E-06	0.000103932	2.99116E-06	Sulfur Dioxide
MEA	0.255161	3140.08	3140.08	3140.08	0.465301	3139.61	12559.8	12559.8	0	0	8373.19	8373.19	1.11110	0.111110	0.99999	1.11110	1.11110	MEA
Argon	0	0.00307373	0.00307373	0.00307373	0.00306790	5.82872E-06	0	0	0	0	0	0	0.0153629	6.90405E-08	6.21365E-07	0.0153629	6.90405E-07	Argon
NO	0	1.59581E-06	1.59581E-06	1.59581E-06	1.59063E-06	5.17922E-09	0	0	0	0	0	0	7.97393E-06	4.99070E-11	4.49163E-10	7.97393E-06	4.99070E-10	NO
NO2	0	2.40740E-06	2.40740E-06	2.40740E-06	2.36581E-06	4.15929E-08	0	0	0	0	0	0	1.19961E-05	7.17889E-10	6.46100E-09	1.19961E-05	7.17889E-09	NO2
NH3	0	0.0688596	0.0688596	0.0688596	0.00493551	0.0639241	0.170645	0.170645	0	0	0.113764	0.113764	0.121862	0.0121446	0.109301	0.121862	0.121446	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0	0.000250893	0.000250893	0.000250893	0.0142160	5.04549E-07	0	0	0	0	0	0	0.00336972	3.89243E-07	3.89243E-07	0.00336972	3.89243E-07	Oxygen
Nitrogen	0	0.000689655	0.000689655	0.000689655	0.0391020	9.38658E-07	0	0	0	0	0	0	0.00926385	5.68231E-07	5.68231E-07	0.00926385	5.68231E-07	Nitrogen
Water	0	54.4146	54.4146	54.4146	36.3179	54.7390	56.2517	56.2517	56.2517	90.0711	56.2517	56.2517	38.3185	99.6932	99.6932	38.3185	99.6932	Water
Carbon Dioxide	0	11.1421	11.1421	11.1421	63.3369	10.2062	6.20071	6.20071	6.20071	9.92868	6.20071	6.20071	61.6348	0.214782	0.214782	61.6348	0.214782	Carbon Dioxide
Sulfur Dioxide	0	2.52961E-07	2.52961E-07	2.52961E-07	1.02382E-05	7.39302E-08	0	0	0	0	0	0	3.21290E-06	2.52175E-07	2.52175E-07	3.21290E-06	2.52175E-07	Sulfur Dioxide
MEA	100	34.4422	34.4422	34.4422	0.289756	35.0545	37.5474	37.5474	37.5474	0	37.5474	37.5474	0.0327497	0.0893148	0.0893148	0.0327497	0.0893148	MEA
Argon	0	2.20490E-05	2.20490E-05	2.20490E-05	0.00124944	4.25613E-08	0	0	0	0	0	0	0.000296143	3.62953E-08	3.62953E-08	0.000296143	3.62953E-08	Argon
NO	0	8.59845E-09	8.59845E-09	8.59845E-09	4.86583E-07	2.84067E-11	0	0	0	0	0	0	1.15456E-07	1.97071E-11	1.97071E-11	1.15456E-07	1.97071E-11	NO
NO2	0	1.98878E-08	1.98878E-08	1.98878E-08	1.10960E-06	3.49764E-10	0	0	0	0	0	0	2.66308E-07	4.34628E-10	4.34628E-10	2.66308E-07	4.34628E-10	NO2
NH3	0	0.000210582	0.000210582	0.000210582	0.000856915	0.000198994	0.000142233	0.000142233	0.000142233	0.000227745	0.000142233	0.000142233	0.00100145	0.00272183	0.00272183	0.00100145	0.00272183	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0	1.39721	1.39721	1.39721	1.39445	0.00276030	0	0	0	0	0	0	6.98330	2.95781E-05	0.000266203	6.98330	0.000295781	Oxygen
Nitrogen	0	3.84063	3.84063	3.84063	3.83550	0.00513524	0	0	0	0	0	0	19.1981	4.31792E-05	0.000388612	19.1981	0.000431792	Nitrogen
Water	0	303030	303030	303030	3562.40	299468	1.14937E+06	1.14937E+06	0	0	766244	766244	79409.9	7575.56	68180.0	79409.9	75755.6	Water
Carbon Dioxide	0	62049.3	62049.3	62049.3	6212.69	55836.6	126696	126696	0	0	84464.3	84464.3	127730	16.3210	146.889	127730	163.210	Carbon Dioxide
Sulfur Dioxide	0	0.00140872	0.00140872	0.00140872	0.00100426	0.000404459	0	0	0	0	0	0	0.00665830	1.91625E-05	0.000172462	0.00665830	0.000191625	Sulfur Dioxide
MEA	15.58600	191806	191806	191806	28.4220	191777	767190	767190	0	0	511460	511460	67.8693	6.78692	61.0823	67.8693	67.8692	MEA
Argon	0	0.122789	0.122789	0.122789	0.122556	0.000232846	0	0	0	0	0	0	0.613717	2.75803E-06	2.48223E-05	0.613717	2.75803E-05	Argon
NO	0	4.78841E-05	4.78841E-05	4.78841E-05	4.77287E-05	1.55408E-07	0	0	0	0	0	0	0.000239266	1.49752E-09	1.34776E-08	0.000239266	1.49752E-08	NO
NO2	0	0.000110754	0.000110754	0.000110754	0.000108840	1.91350E-06	0	0	0	0	0	0	0.000551887	3.30268E-08	2.97241E-07	0.000551887	3.30268E-07	NO2
NH3	0	1.17271	1.17271	1.17271	0.0840544	1.08866	2.90618	2.90618	0	0	1.93745	1.93745	2.07537	0.206829	1.86146	2.07537	2.06829	NH3

Process Streams		307	309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	325		Process Streams
Property	**Units**																		**Units**	**Property**
Temperature	℃	20.0000*	108*	112.778*	121.523	113.716	113.769	127.543	127.611			127.543	130.115	104.872	48.7470	48.7470	48.8889*	48.6910	℃	Temperature
Pressure	bar	4.13685*	9.70702	8.67281	7.63859	2.39982*	5.84719	2.31016	6.10228	6.10228	6.10228	2.31016	2.31016	1.96543	5.24044	5.24044	1.82753	1.79306	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	100	0	0	0			0	19.2039	100	0	0	42.3994	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	61.0831	26.0583	26.0583	26.0583	28.8869	26.0127	25.7862	25.7862	25.7862	19.1376	25.7862	25.7862	28.3404	18.0495	18.0495	28.3404	18.0495	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1021.420	1136.03	1134.10	1130.38	2.17931	1124.16	1067.02	1067.04			1067.02	9.32789	1.78997	988.420	988.420	4.59255	988.395	kg/m^3	Mass Density
Molar Flow	kmol/h	0.255161	21371.0	21371.0	21371.0	339.564	21031.4	79238.3	79238.3	0	0	52825.5	52825.5	7312.40	421.002	3789.01	7312.40	4210.02	kmol/h	Molar Flow
Mass Flow	kg/h	15.58600	556892	556892	556892	9808.95	547083	2.04326E+06	2.04326E+06	0	0	1.36217E+06	1.36217E+06	207236	7598.87	68389.9	207236	75988.7	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	6.04488	506288	506288	506288	8044.43	498244	1.87719E+06	1.87719E+06	0	0	1.25146E+06	1.25146E+06	173234	9973.71	89763.4	173234	99737.1	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	0.01527880	566.920	566.920	566.920	11.1652	555.754	2056.85	2056.85	0	0	1371.23	1371.23	235.125	7.60988	68.4889	235.125	76.0988	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.022390	1.13711	1.13517	1.13145	0.997785	1.12522	1.06803	1.06805			1.06803		0.978911	0.989354	0.989354		0.989329		Specific Gravity
Mass Enthalpy	kJ/kg	-4445.34	-11001.1	-10983.0	-10949.3	-10440.2	-10957.9	-10819.1	-10818.6	-10818.6		-10819.1	-10503.6	-10557.6	-15741.5	-15741.5	-11500.7	-15742.1	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	26.81740	0.793000	0.734002	0.642577	0.0170309	0.705350	0.509977	0.509959			0.509977		0.0165419	0.548086	0.548086		0.548234	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.2355	0.3944	0.3947	0.3948	0.0247	0.3985	0.4153	0.4153			0.4153		0.0240	0.6335	0.6335		0.6334	W/(m*℃)	Thermal Cond uctivity
Surface Tension	dyne/cm	48.9361	88.2210	87.8667	86.9593		86.8087	46.4196?	46.4011?			46.4196?			68.0583	68.0583		68.0693	dyne/cm	Surface Tension

Process Streams	330	332	333	334	400	401	402	403	404	405	406	407	408	409	410	Process Streams
	Hot Semi-Lean Amine	Cold Rich Amine to Lean / Rich Exchanger	Process Water to Absorbers	Lean Amine to E-102 Inlet	CO2	1st Stage Suction	Hot 1st Stage Discharge	Cooled 1st Stage Discharge	Cold 1st Stage Discharge	2nd Stage Suction	Hot 2nd Stage Discharge	Cooled 2nd Stage Discharge	Cold 2nd Stage Discharge	Dryer Inlet	3rd Stage Suction	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	4.10161E-07	0.000204316	1.04054E-08*	0	0.00703418	0.00703424	0.00703424	0.00703424	0.00703424	0.00747761	0.00747761	0.00747761	0.00747761	0.00751327	0.00752665	Oxygen
Nitrogen	8.71618E-07	0.000641523	9.25780E-09*	0	0.0220896	0.0220898	0.0220898	0.0220898	0.0220898	0.0234821	0.0234821	0.0234821	0.0234821	0.0235942	0.0236362	Nitrogen
Water	79.0389	78.7083	99.9138*	80.5160	6.53832	6.53752	6.53752	6.53752	6.53752	0.658028	0.658028	0.658028	0.658028	0.188668	0.0110000	Water
Carbon Dioxide	6.03259	6.59730	0.0588102*	3.63314	93.4320	93.4328	93.4328	93.4328	93.4328	99.3105	99.3105	99.3105	99.3105	99.7797	99.9573	Carbon Dioxide
Sulfur Dioxide	3.00188E-08	1.02893E-07	8.07619E-08*	0	3.25367E-06	3.25370E-06	3.25370E-06	3.25370E-06	3.25370E-06	3.44125E-06	3.44125E-06	3.44125E-06	3.44125E-06	3.45190E-06	3.45804E-06	Sulfur Dioxide
MEA	14.9282	14.6932	0.0247119*	15.8506	7.95992E-08	7.95734E-08	7.95734E-08	7.95734E-08	7.95734E-08	2.81680E-09	2.81680E-09	2.81680E-09	2.81680E-09	4.54389E-10	4.55197E-10	MEA
Argon	2.77144E-08	1.43827E-05	8.26903E-10*	0	0.000495175	0.000495179	0.000495179	0.000495179	0.000495179	0.000526390	0.000526390	0.000526390	0.000526390	0.000528900	0.000529842	Argon
NO	2.46261E-11	7.46719E-09	8.14342E-13*	0	2.57010E-07	2.57012E-07	2.57012E-07	2.57012E-07	2.57012E-07	2.73211E-07	2.73211E-07	2.73211E-07	2.73211E-07	2.74514E-07	2.75002E-07	NO
NO2	1.97766E-10	1.12648E-08	4.78076E-09*	0	3.86443E-07	3.86446E-07	3.86446E-07	3.86446E-07	3.86446E-07	3.97825E-07	3.97825E-07	3.97825E-07	3.97825E-07	3.95625E-07	3.96329E-07	NO2
NH3	0.000303946	0.000322211	0.00268616*	0.000215357	1.34106E-05	1.34106E-05	1.34106E-05	1.34106E-05	1.34106E-05	1.00720E-05	1.00720E-05	1.00720E-05	1.00720E-05	8.93896E-06	8.95487E-06	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	8.62627E-05	0.174657	2.24473E-08*	0	0.218227	0.218227	0.218227	0.218227	0.218227	0.218226	0.218226	0.218226	0.218226	0.218225	0.218225	Oxygen
Nitrogen	0.000183314	0.548399	1.99717E-08*	0	0.685302	0.685302	0.685302	0.685302	0.685302	0.685300	0.685300	0.685300	0.685300	0.685299	0.685299	Nitrogen
Water	16623.0	67283.0	215.542*	63799.5	202.843	202.817	202.817	202.817	202.817	19.2038	19.2038	19.2038	19.2038	5.47990	0.318930	Water
Carbon Dioxide	1268.74	5639.63	0.126870*	2878.84	2898.62	2898.62	2898.62	2898.62	2898.62	2898.27	2898.27	2898.27	2898.27	2898.13	2898.13	Carbon Dioxide
Sulfur Dioxide	6.31338E-06	8.79572E-05	1.74226E-07*	0	0.000100941	0.000100941	0.000100941	0.000100941	0.000100941	0.000100429	0.000100429	0.000100429	0.000100429	0.000100261	0.000100261	Sulfur Dioxide
MEA	3139.61	12560.3	0.0533104*	12559.8	2.46947E-06	2.46865E-06	2.46865E-06	2.46865E-06	2.46865E-06	8.22051E-08	8.22051E-08	8.22051E-08	8.22051E-08	1.31978E-08	1.31978E-08	MEA
Argon	5.82872E-06	0.0122949	1.78386E-09*	0	0.0153622	0.0153622	0.0153622	0.0153622	0.0153622	0.0153621	0.0153621	0.0153621	0.0153621	0.0153621	0.0153621	Argon
NO	5.17922E-09	6.38324E-06	1.75676E-12*	0	7.97343E-06	7.97343E-06	7.97343E-06	7.97343E-06	7.97343E-06	7.97336E-06	7.97336E-06	7.97336E-06	7.97336E-06	7.97333E-06	7.97333E-06	NO
NO2	4.15929E-08	9.62959E-06	1.03134E-08*	0	1.19889E-05	1.19889E-05	1.19889E-05	1.19889E-05	1.19889E-05	1.16101E-05	1.16101E-05	1.16101E-05	1.16101E-05	1.14910E-05	1.14910E-05	NO2
NH3	0.0639241	0.275438	0.00579480*	0.170645	0.000416047	0.000416044	0.000416044	0.000416044	0.000416044	0.000293941	0.000293941	0.000293941	0.000293941	0.000259635	0.000259635	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	5.04549E-07	0.000250893	1.84556E-08*	0	0.00532047	0.00532049	0.00532049	0.00532049	0.00532049	0.00545868	0.00545868	0.00545868	0.00545868	0.00546949	0.00547348	Oxygen
Nitrogen	9.38658E-07	0.000689655	1.43750E-08*	0	0.0146270	0.0146271	0.0146271	0.0146271	0.0146271	0.0150070	0.0150070	0.0150070	0.0150070	0.0150368	0.0150477	Nitrogen
Water	54.7390	54.4146	99.7703*	56.2517	2.78426	2.78391	2.78391	2.78391	2.78391	0.270444	0.270444	0.270444	0.270444	0.0773255	0.00450362	Water
Carbon Dioxide	10.2062	11.1421	0.143461*	6.20071	97.1953	97.1957	97.1957	97.1957	97.1957	99.7086	99.7086	99.7086	99.7086	99.9017	99.9745	Carbon Dioxide
Sulfur Dioxide	7.39302E-08	2.52961E-07	2.86783E-07*	0	4.92708E-06	4.92709E-06	4.92709E-06	4.92709E-06	4.92709E-06	5.02944E-06	5.02944E-06	5.02944E-06	5.02944E-06	5.03101E-06	5.03468E-06	Sulfur Dioxide
MEA	35.0545	34.4422	0.0836684*	37.5474	1.14930E-07	1.14892E-07	1.14892E-07	1.14892E-07	1.14892E-07	3.92525E-09	3.92525E-09	3.92525E-09	3.92525E-09	6.31441E-10	6.31901E-10	MEA
Argon	4.25613E-08	2.20490E-05	1.83098E-09*	0	0.000467581	0.000467582	0.000467582	0.000467582	0.000467582	0.000479726	0.000479726	0.000479726	0.000479726	0.000480677	0.000481027	Argon
NO	2.84067E-11	8.59845E-09	1.35441E-12*	0	1.82290E-07	1.82291E-07	1.82291E-07	1.82291E-07	1.82291E-07	1.87025E-07	1.87025E-07	1.87025E-07	1.87025E-07	1.87395E-07	1.87531E-07	NO
NO2	3.49764E-10	1.98878E-08	1.21911E-08*	0	4.20241E-07	4.20242E-07	4.20242E-07	4.20242E-07	4.20242E-07	4.17535E-07	4.17535E-07	4.17535E-07	4.17535E-07	4.14074E-07	4.14376E-07	NO2
NH3	0.000198994	0.000210582	0.00253568*	0.000142233	5.39857E-06	5.39854E-06	5.39854E-06	5.39854E-06	5.39854E-06	3.91324E-06	3.91324E-06	3.91324E-06	3.91324E-06	3.46337E-06	3.46590E-06	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0.00276030	5.58882	7.18288E-07*	0	6.98300	6.98300	6.98300	6.98300	6.98300	6.98296	6.98296	6.98296	6.98296	6.98294	6.98294	Oxygen
Nitrogen	0.00513524	15.3625	5.59474E-07*	0	19.1976	19.1976	19.1976	19.1976	19.1976	19.1976	19.1976	19.1976	19.1976	19.1976	19.1976	Nitrogen
Water	299468	1.21212E+06	3883.05*	1.14937E+06	3654.28	3653.80	3653.80	3653.80	3653.80	345.962	345.962	345.962	345.962	98.7220	5.74562	Water
Carbon Dioxide	55836.6	248197	5.58349*	126696	127567	127567	127567	127567	127567	127551	127551	127551	127551	127545	127545	Carbon Dioxide
Sulfur Dioxide	0.000404459	0.00563487	1.11616E-05*	0	0.00646668	0.00646668	0.00646668	0.00646668	0.00646668	0.00643386	0.00643386	0.00643386	0.00643386	0.00642313	0.00642313	Sulfur Dioxide
MEA	191777	767223	3.25636*	767190	0.000150843	0.000150793	0.000150793	0.000150793	0.000150793	5.02134E-06	5.02134E-06	5.02134E-06	5.02134E-06	8.06165E-07	8.06165E-07	MEA
Argon	0.000232846	0.491157	7.12617E-08*	0	0.613689	0.613689	0.613689	0.613689	0.613689	0.613685	0.613685	0.613685	0.613685	0.613683	0.613683	Argon
NO	1.55408E-07	0.000191536	5.27136E-11*	0	0.000239251	0.000239251	0.000239251	0.000239251	0.000239251	0.000239249	0.000239249	0.000239249	0.000239249	0.000239248	0.000239248	NO
NO2	1.91350E-06	0.000443014	4.74474E-07*	0	0.000551557	0.000551557	0.000551557	0.000551557	0.000551557	0.000534128	0.000534128	0.000534128	0.000534128	0.000528651	0.000528651	NO2
NH3	1.08866	4.69086	0.0986884*	2.90618	0.00708550	0.00708544	0.00708544	0.00708544	0.00708544	0.00500597	0.00500597	0.00500597	0.00500597	0.00442171	0.00442171	NH3

Process Streams		330	332	333	334	400	401	402	403	404	405	406	407	408	409	410		Process Streams
Property	**Units**																**Units**	**Property**
Temperature	℃	113.716	53.4987	47.2376*	58.7658	48.7012	48.7012	176.667*	129.444*	26*	25.8867	176.667*	129.444*	26*	25.9261	25.9261	℃	Temperature
Pressure	bar	2.39982	10.7412	4.13685*	4.72333	1.79306	1.79306	6.03551	5.75972	5.41498	5.34604	23.1075	22.8317	22.4870	22.4181	22.4181	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	99.9991	100	100	100	94.0633	100	100	100	99.5254	100	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0127	26.0583	18.0412	25.7862	42.3055	42.3057	42.3057	42.3057	42.3057	43.8338	43.8338	43.8338	43.8338	43.9558	44.0019	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1124.14	1151.99	988.904	1099.87	2.85806	2.85805	6.88501	7.37041	10.0902	9.71145	27.9168	31.3459	45.7894	45.5572	45.5944	kg/m^3	Mass Density
Molar Flow	kmol/h	21031.4	85483.9	215.728	79238.3	3102.38	3102.35	3102.35	3102.35	3102.35	2918.39	2918.39	2918.39	2918.39	2904.53	2899.37	kmol/h	Molar Flow
Mass Flow	kg/h	547083	2.22757E+06	3891.99*	2.04326E+06	131248	131247	131247	131247	131247	127924	127924	127924	127924	127671	127578	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	498244	2.02515E+06	5110.69	1.87719E+06	73496.7	73496.1	73496.1	73496.1	73496.1	69137.9	69137.9	69137.9	69137.9	68809.5	68687.3	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	555.754	2267.68	3.89702	2056.85	159.027	159.026	159.026	159.026	159.026	155.696	155.696	155.696	155.696	155.441	155.348	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.12520	1.15307	0.989839	1.10091		1.46129	1.46129	1.46129		1.51407	1.51407	1.51407		1.51828	1.51988		Specific Gravity
Mass Enthalpy	kJ/kg	-10958.4	-11194.4	-15753.3	-11071.7	-9045.10	-9045.08	-8924.50	-8971.65	-9130.16	-8956.04	-8823.38	-8871.30	-8978.42	-8965.08	-8961.76	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.705427	2.57968	0.563550	1.85375		0.0161454	0.0216019	0.0197044		0.0152834	0.0220095	0.0201805		0.0159386	0.0159403	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3985	0.3817	0.632525?	0.4053		0.0187	0.0287	0.0251		0.0172	0.0296	0.0261		0.0189	0.0189	W/(m*℃)	Thermal Conducti vity
Surface Tension	dyne/cm	87.6007	92.9823	68.3735	57.9268												dyne/cm	Surface Tension

Process Streams	411	412	413	414	415	416	417	501	502	503	504	505	506	509	510	511	Process Streams
	Hot 3rd Stage Discharge	Cooled 3rd Stage Discharge	Cold 3rd Stage Discharge	CO2 Product	Inter-stage Liquid	Liquefied CO2	Dryer Water	SCW Supply to E-101	SCW Return From E-101	SCW Supply to E-104	SCW Return From E-104	SCW Supply to E-102	SCW Return From E-102	SCW Supply to E-111	SCW Return From E-111	LP Steam from E-112	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0.00752665	0.00752665	0.00752665	0.00752665	9.41796E-07	0.00752665	0*	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	0.0236362	0.0236362	0.0236362	0.0236362	1.46808E-06	0.0236362	0*	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	0.0110000	0.0110000	0.0110000	0.0110000	99.7532	0.0110000	100*	100*	100	100*	100	100*	100	100*	100	100	Water
Carbon Dioxide	99.9573	99.9573	99.9573	99.9573	0.246748	99.9573	0*	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	3.45804E-06	3.45804E-06	3.45804E-06	3.45804E-06	3.43669E-07	3.45804E-06	0*	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	4.55197E-10	4.55197E-10	4.55197E-10	4.55197E-10	1.24120E-06	4.55197E-10	0*	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.000529842	0.000529842	0.000529842	0.000529842	7.18473E-08	0.000529842	0*	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	2.75002E-07	2.75002E-07	2.75002E-07	2.75002E-07	5.10678E-11	2.75002E-07	0*	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	3.96329E-07	3.96329E-07	3.96329E-07	3.96329E-07	2.51704E-07	3.96329E-07	0*	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	8.95487E-06	8.95487E-06	8.95487E-06	8.95487E-06	7.89279E-05	8.95487E-06	0*	0*	0	0*	0	0*	0	0*	0	0	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0.218225	0.218225	0.218225	0.218225	1.86311E-06	0.218225	0*	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	0.685299	0.685299	0.685299	0.685299	2.90423E-06	0.685299	0*	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	0.318930	0.318930	0.318930	0.318930	197.337	0.318930	5*	253439*	253439	253439*	253439	45264.4*	45264.4	267730*	267730	147.981	Water
Carbon Dioxide	2898.13	2898.13	2898.13	2898.13	0.488129	2898.13	0*	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0.000100261	0.000100261	0.000100261	0.000100261	6.79864E-07	0.000100261	0*	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	1.31978E-08	1.31978E-08	1.31978E-08	1.31978E-08	2.45540E-06	1.31978E-08	0*	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.0153621	0.0153621	0.0153621	0.0153621	1.42132E-07	0.0153621	0*	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	7.97333E-06	7.97333E-06	7.97333E-06	7.97333E-06	1.01025E-10	7.97333E-06	0*	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	1.14910E-05	1.14910E-05	1.14910E-05	1.14910E-05	4.97934E-07	1.14910E-05	0*	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	0.000259635	0.000259635	0.000259635	0.000259635	0.000156139	0.000259635	0*	0*	0	0*	0	0*	0	0*	0	0	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0.00547348	0.00547348	0.00547348	0.00547348	1.66689E-06	0.00547348	0*	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	0.0150477	0.0150477	0.0150477	0.0150477	2.27473E-06	0.0150477	0*	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	0.00450362	0.00450362	0.00450362	0.00450362	99.3993	0.00450362	100*	100*	100	100*	100	100*	100	100*	100	100	Water
Carbon Dioxide	99.9745	99.9745	99.9745	99.9745	0.600641	99.9745	0*	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	5.03468E-06	5.03468E-06	5.03468E-06	5.03468E-06	1.21778E-06	5.03468E-06	0*	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	6.31901E-10	6.31901E-10	6.31901E-10	6.31901E-10	4.19351E-06	6.31901E-10	0*	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.000481027	0.000481027	0.000481027	0.000481027	1.58753E-07	0.000481027	0*	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	1.87531E-07	1.87531E-07	1.87531E-07	1.87531E-07	8.47563E-11	1.87531E-07	0*	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	4.14376E-07	4.14376E-07	4.14376E-07	4.14376E-07	6.40494E-07	4.14376E-07	0*	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	3.46590E-06	3.46590E-06	3.46590E-06	3.46590E-06	7.43488E-05	3.46590E-06	0*	0*	0	0*	0	0*	0	0*	0	0	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	6.98294	6.98294	6.98294	6.98294	5.96173E-05	6.98294	0*	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	19.1976	19.1976	19.1976	19.1976	8.13573E-05	19.1976	0*	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	5.74562	5.74562	5.74562	5.74562	3555.08	5.74562	9.29764E+01*	4.56577E+06*	4.56577E+06	4.56577E+06*	4.56577E+06	815451*	815451	4.82324E+06*	4.82324E+06	2665.92	Water
Carbon Dioxide	127545	127545	127545	127545	21.4823	127545	0*	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0.00642313	0.00642313	0.00642313	0.00642313	4.35546E-05	0.00642313	0*	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	8.06165E-07	8.06165E-07	8.06165E-07	8.06165E-07	0.000149984	8.06165E-07	0*	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.613683	0.613683	0.613683	0.613683	5.67790E-06	0.613683	0*	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	0.000239248	0.000239248	0.000239248	0.000239248	3.03137E-09	0.000239248	0*	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	0.000528651	0.000528651	0.000528651	0.000528651	2.29077E-05	0.000528651	0*	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	0.00442171	0.00442171	0.00442171	0.00442171	0.00265914	0.00442171	0*	0*	0	0*	0	0*	0	0*	0	0	NH3

Process Streams		411	412	413	414	415	416	417	501	502	503	504	505	506	509	510	511		Process Streams
Property	**Units**																	**Units**	**Property**
Temperature	℃	176.667*	129.444*	28*	48.2023	25.8867	27.9889	25.9261*	11*	21	11*	21	11*	21*	11*	21*	125.835	℃	Temperature
Pressure	bar	93.5826	93.3068	92.9620	201.000*	5.34604	92.8931	22.4181*	1.9999*	1.31042	1.9999*	1.31042	1.9999*	1.31042	1.9999*	0.965686	2.37913	bar	Pressure
Mole Fraction Vapor	%	100	100	0	100	0	0	0	0	0	0	0	0	0	0	0	100*	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	44.0019	44.0019	44.0019	44.0019	18.0794	44.0019	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	123.168	148.590	722.629?	778.531	997.558	722.520	996.48	1000.00	997.602	1000.00	997.602	1000.00	997.602	1000.00	997.597	1.31446	kg/m^3	Mass Density
Molar Flow	kmol/h	2899.37	2899.37	2899.37	2899.37	197.825	2899.37	5	253439	253439	253439	253439	45264.4	45264.4	267730	267730	147.981	kmol/h	Molar Flow
Mass Flow	kg/h	127578	127578	127578	127578	3576.57	127578	9.29764E+01	4.56577E+06	4.56577E+06	4.56577E+06	4.56577E+06	815451	815451	4.82324E+06	4.82324E+06	2665.92	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	68687.3	68687.3	68687.3	68687.3	4686.57	68687.3	1.22266E+02	6.00408E+06	6.00408E+06	6.00408E+06	6.00408E+06	1.07233E+06	1.07233E+06	6.34265E+06	6.34265E+06	3505.74	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	155.348	155.348	155.348	155.348	3.58474	155.348	0.09	4570.26	4570.26	4570.26	4570.26	816.254	816.254	4827.98	4827.98	2.66855	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.51988	1.51988	0.723312?	1.51988	0.998501	0.723203?	0.99742	1.00095	0.998544	1.00095	0.998544	1.00095	0.998544	1.00095	0.998540	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-8844.38	-8902.60	-9167.60	-9147.65	-15823.4	-9167.60	-15861.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-13240.4	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0242104	0.0230638	0.0609531	0.0692270	0.865915	0.0609671	0.87930	1.29092	0.987185	1.29092	0.987185	1.29092	0.987185	1.29092	0.987115	0.0106144	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0342	0.0319	0.107258?	0.0909	0.6021	0.1073	0.6076	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.0270	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm			0?		72.3391?	0?	72.6316	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192		dyne/cm	Surface Tension

Process Streams	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	Process Streams
	LP Condensate from E-109	LP Steam from E-114	LP Steam to E-109	SCW Supply to E-113	SCW Return From E-113	SCW Supply to E-115	SCW Return From E-115	Condenstate to E-112	Condensate to E-114	Condensate to E-116	SCW Supply to E-117	SCW Return From E-117	LP Steam from E-116	LP Steam to E-110	LP Condensate from E-110	Vent Steam	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100	100	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	472.535	146.600	472.184	28097.7*	28097.7	18508.6*	18508.6	147.981*	146.600*	177.604*	45663.5*	45663.5	177.604	11015.5*	11015.5	306.121	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100	100	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	8512.84	2641.03	8506.53	506188*	506188	333438*	333438	2665.92*	2641.03*	3199.58*	822641*	822641	3199.58	198447*	198447	5514.86	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3

Process Streams		512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527		Process Streams
Property	**Units**																	**Units**	**Property**
Temperature	℃	125.835	125.835	125.835	16*	26*	16*	26*	98.8889*	98.8889*	98.8889*	16*	26*	125.835	135*	133.594	146.435	℃	Temperature
Pressure	bar	2.37913	2.37913	2.37913	1.9999*	1.31042	1.9999*	1.31042	2.37913*	2.37913*	2.37913*	1.9999*	1.31042	2.37913	2.9999*	2.9999	2.3499*	bar	Pressure
Mole Fraction Vapor	%	0*	100	100	0	0	0	0	0	0	0	0	0	100	100	0*	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	938.857	1.31446	1.31446	998.879	996.185	998.879	996.185	959.505	959.505	959.505	998.879	996.185	1.31446	1.62556	932.265	1.23159	kg/m^3	Mass Density
Molar Flow	kmol/h	472.535	146.600	472.184	28097.7	28097.7	18508.6	18508.6	147.981	146.600	177.604	45663.5	45663.5	177.604	11015.5	11015.5	306.121	kmol/h	Molar Flow
Mass Flow	kg/h	8512.84	2641.03	8506.53	506188	506188	333438	333438	2665.92	2641.03	3199.58	822641	822641	3199.58	198447*	198447	5514.86	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	11194.6	3473.01	11186.3	665648	665648	438477	438477	3505.74	3473.01	4207.51	1.08179E+06	1.08179E+06	4207.51	260961	260961	7252.15	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	8.52122	2.64363	8.51490	506.686	506.686	333.766	333.766	2.66855	2.64363	3.20273	823.450	823.450	3.20273	198.642	198.642	5.52029	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.939745	0.622268	0.622268	0.999823	0.997127	0.999823	0.997127	0.960412	0.960412	0.960412	0.999823	0.997127	0.622268	0.622268	0.933146	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-15448.2	-13240.4	-13240.4	-15904.0	-15862.9	-15904.0	-15862.9	-15561.8	-15561.8	-15561.8	-15904.0	-15862.9	-13240.4	-13224.7	-15390.4	-13200.2	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.219521	0.0106144	0.0106144	1.12405	0.874153	1.12405	0.874153	0.279294	0.279294	0.279294	1.12405	0.874153	0.0106144	0.0110023	0.206890	0.0114855	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.6847	0.0270	0.0270	0.5931	0.6077	0.5931	0.6077	0.6758	0.6758	0.6758	0.5931	0.6077	0.0270	0.0278	0.6856	0.0287	W/(m*°C)	Thermal Conductivity
Surface Tension	dyne/cm	53.1489			74.6291	72.6168	74.6291	72.6168	58.4280	58.4280	58.4280	74.6291	72.6168			51.6045		dyne/cm	Surface Tension

Process Streams	001	002	003	004	005	006	007	008	009	010	100	101	102	103	Process Streams
	Flue Gas From CCPP	Flue Gas From Common Fogger	Process Water to Foggers	Process Water to Common Fogger	Process Water to Abs. 1 Fogger	Abs 1. Flue Gas Blower Discharge	Process Water to Absorbers	Process Water to Abs. 2 Fogger	Abs 2. Flue Gas Blower Discharge	Softened Water	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 1)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 1)	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	12.8084*	12.4336	1.00873E-08	1.00873E-08	1.00873E-08	12.4336	1.00873E-08*	1.00873E-08	12.4336	0	12.3515	0.000214102	0.000214102	13.1597	Oxygen
Nitrogen	74.7787*	72.5907	8.97434E-09	8.97434E-09	8.97434E-09	72.5907	8.97434E-09*	8.97434E-09	72.5907	0	72.1113	0.000671827	0.000671827	76.8340	Nitrogen
Water	7.74143*	10.4385	99.9163	99.9163	99.9163	10.4385	99.9163*	99.9163	10.4385	100	11.0294	99.3931	99.3931	8.54853	Water
Carbon Dioxide	3.81568*	3.70570	0.0570861	0.0570861	0.0570861	3.70570	0.0570861*	0.0570861	3.70570	0	3.68161	0.150800	0.150800	0.578188	Carbon Dioxide
Sulfur Dioxide	9.86294E-06*	9.57664E-06	7.83447E-08	7.83447E-08	7.83447E-08	9.57664E-06	7.83447E-08*	7.83447E-08	9.57664E-06	0	9.51392E-06	0	0	5.42419E-10	Sulfur Dioxide
MEA	0*	0.000701788	0.0239842	0.0239842	0.0239842	0.000701788	0.0239842*	0.0239842	0.000701788	0	0.000855530	0.455022	0.455022	0.000301589	MEA
Argon	0.854973*	0.829956	8.01637E-10	8.01637E-10	8.01637E-10	0.829956	8.01637E-10*	8.01637E-10	0.829956	0	0.824476	1.50791E-05	1.50791E-05	0.878463	Argon
NO	0.000316434*	0.000307175	7.89452E-13	7.89452E-13	7.89452E-13	0.000307175	7.89452E-13*	7.89452E-13	0.000307175	0	0.000305146	7.82469E-09	7.82469E-09	0.000325125	NO
NO2	5.15967E-05*	5.00871E-05	4.64336E-09	4.64336E-09	4.64336E-09	5.00871E-05	4.64336E-09*	4.64336E-09	5.00871E-05	0	4.97564E-05	1.18385E-08	1.18385E-08	5.30018E-05	NO2
NH3	0.000396083*	0.000461063	0.00261683	0.00261683	0.00261683	0.000461063	0.00261683*	0.00261683	0.000461063	0	0.000475299	0.000219179	0.000219179	0.000408706	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	11405.2*	11405.2	3.32250E-07	2.70743E-07	3.07532E-08	5702.58	9.19251E-08*	3.07532E-08	5702.58	0	5702.58	0.159636	0.00894710	11404.4	Oxygen
Nitrogen	66586.2*	66586.2	2.95592E-07	2.40872E-07	2.73601E-08	33293.1	8.17828E-08*	2.73601E-08	33293.1	0	33293.1	0.500920	0.0280750	66585.5	Nitrogen
Water	6893.30*	9575.06	3290.99	2681.76	304.616	4787.53	910.534*	304.616	4787.53	231.576	5092.15	74108.4	4153.54	7408.28	Water
Carbon Dioxide	3397.64*	3399.18	1.88027	1.53220	0.174039	1699.59	0.520224*	0.174039	1699.59	0	1699.76	112.438	6.30179	501.066	Carbon Dioxide
Sulfur Dioxide	0.00878239*	0.00878449	2.58048E-06	2.10278E-06	2.38850E-07	0.00439224	7.13953E-07*	2.38850E-07	0.00439224	0	0.00439248	0	0	4.70068E-07	Sulfur Dioxide
MEA	0*	0.643738	0.789980	0.643738	0.0731209	0.321869	0.218567*	0.0731209	0.321869	0	0.394990	339.269	19.0149	0.261362	MEA
Argon	761.305*	761.305	2.64039E-08	2.15160E-08	2.44396E-09	380.652	7.30529E-09*	2.44396E-09	380.652	0	380.652	0.0112431	0.000630139	761.289	Argon
NO	0.281766*	0.281766	2.60026E-11	2.11889E-11	2.40681E-12	0.140883	7.19425E-12*	2.40681E-12	0.140883	0	0.140883	5.83416E-06	3.26986E-07	0.281758	NO
NO2	0.0459440*	0.0459441	1.52941E-07	1.24628E-07	1.41563E-08	0.0229720	4.23148E-08*	1.41563E-08	0.0229720	0	0.0229721	8.82692E-06	4.94721E-07	0.0459322	NO2
NH3	0.352690*	0.422926	0.0861919	0.0702359	0.00797796	0.211463	0.0238471*	0.00797796	0.211463	0	0.219441	0.163422	0.00915927	0.354191	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	14.3999*	14.1299	1.78921E-08	1.78921E-08	1.78921E-08	14.1299	1.78921E-08*	1.78921E-08	14.1299	0	14.0700	0.000375386	0.000375386	15.1035	Oxygen
Nitrogen	73.5995*	72.2197	1.39355E-08	1.39355E-08	1.39355E-08	72.2197	1.39355E-08*	1.39355E-08	72.2197	0	71.9134	0.00103121	0.00103121	77.2001	Nitrogen
Water	4.89997*	6.67864	99.7771	99.7771	99.7771	6.67864	99.7771*	99.7771	6.67864	100	7.07346	98.1118	98.1118	5.52371	Water
Carbon Dioxide	5.89996*	5.79196	0.139261	0.139261	0.139261	5.79196	0.139261*	0.139261	5.79196	0	5.76799	0.363641	0.363641	0.912670	Carbon Dioxide
Sulfur Dioxide	2.21998E-05*	2.17889E-05	2.78212E-07	2.78212E-07	2.78212E-07	2.17889E-05	2.78212E-07*	2.78212E-07	2.17889E-05	0	2.16977E-05	0	0	1.24637E-09	Sulfur Dioxide
MEA	0*	0.00152243	0.0812082	0.0812082	0.0812082	0.00152243	0.0812082*	0.0812082	0.00152243	0	0.00186036	1.52292	1.52292	0.000660747	MEA
Argon	1.19999*	1.17750	1.77511E-09	1.77511E-09	1.77511E-09	1.17750	1.77511E-09*	1.77511E-09	1.17750	0	1.17250	3.30060E-05	3.30060E-05	1.25868	Argon
NO	0.000333598*	0.000327344	1.31307E-12	1.31307E-12	1.31307E-12	0.000327344	1.31307E-12*	1.31307E-12	0.000327344	0	0.000325955	1.28647E-08	1.28647E-08	0.000349911	NO
NO2	8.33994E-05*	8.18361E-05	1.18412E-08	1.18412E-08	1.18412E-08	8.18361E-05	1.18412E-08*	1.18412E-08	8.18361E-05	0	8.14891E-05	2.98423E-08	2.98423E-08	8.74579E-05	NO2
NH3	0.000236998*	0.000278867	0.00247034	0.00247034	0.00247034	0.000278867	0.00247034*	0.00247034	0.000278867	0	0.000288161	0.000204527	0.000204527	0.000249653	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	364951*	364951	1.06316E-05	8.66346E-06	9.84065E-07	182476	2.94149E-06*	9.84065E-07	182476	0	182476	5.10817	0.286297	364926	Oxygen
Nitrogen	1.86531E+06*	1.86531E+06	8.28054E-06	6.74764E-06	7.66451E-07	932653	2.29102E-06*	7.66451E-07	932653	0	932653	14.0325	0.786476	1.86529E+06	Nitrogen
Water	124185*	172497	59288.1	48312.7	5487.74	86248.7	16403.5*	5487.74	86248.7	4171.91	91736.4	1.33508E+06	74827.1	133462	Water
Carbon Dioxide	149529*	149596	82.7499	67.4311	7.65937	74798.0	22.8948*	7.65937	74798.0	0	74805.7	4948.34	277.339	22051.7	Carbon Dioxide
Sulfur Dioxide	0.562633*	0.562768	0.000165315	0.000134712	1.53017E-05	0.281384	4.57385E-05*	1.53017E-05	0.281384	0	0.281399	0	0	3.01144E-05	Sulfur Dioxide
MEA	0*	39.3215	48.2544	39.3215	4.46645	19.6608	13.3508*	4.46645	19.6608	0	24.1272	20723.6	1161.49	15.9648	MEA
Argon	30412.6*	30412.6	1.05478E-06	8.59521E-07	9.76313E-08	15206.3	2.91832E-07*	9.76313E-08	15206.3	0	15206.3	0.449139	0.0251728	30412.0	Argon
NO	8.45470*	8.45470	7.80235E-10	6.35797E-10	7.22190E-11	4.22735	2.15871E-10*	7.22190E-11	4.22735	0	4.22735	0.000175060	9.81158E-06	8.45446	NO
NO2	2.11367*	2.11368	7.03611E-06	5.73358E-06	6.51266E-07	1.05684	1.94671E-06*	6.51266E-07	1.05684	0	1.05684	0.000406087	2.27599E-05	2.11313	NO2
NH3	6.00649*	7.20264	1.46789	1.19615	0.135869	3.60132	0.406129*	0.135869	3.60132	0	3.73719	2.78316	0.155987	6.03205	NH3

Process Streams		001	002	003	004	005	006	007	008	009	010	100	101	102	103	Process Streams	
Property	**Units**															**Units**	**Property**
Temperature	℃	90*	47.0834	48.6174	48.6174	48.6173	59.6195	46.4459*	48.6173	59.6195	20.0000	50.1573	53.1358	53.1358	42.9986	℃	Temperature
Pressure	bar	1.0017*	1.0017	138*	138	138	1.08857	4.13685*	138	1.08857	4.13685	1.08857	4.48079	4.48079	1.01273	bar	Pressure
Mole Fraction Vapor	%	100	100	0	0	0	100	0	0	100	0	100	0	0	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	28.4622	28.1573	18.0404	18.0404	18.0404	28.1573	18.0404	18.0404	28.1573	18.0153	28.0905	18.2505	18.2505	27.8806	kg/kmol	Molecular Weight
Mass Density	kg/m^3	0.944399	1.06001	990.203	990.203	990.203	1.10845	989.227	990.203	1.10845	997.903	1.13834	987.623	987.623	1.07471	kg/m^3	Mass Density
Molar Flow	kmol/h	89044.3	91728.3	3293.75	2684.01	304.871	45864.1	911.297	304.871	45864.1	231.576	46169.0	74560.9	4178.90	43330.7	kmol/h	Molar Flow
Mass Flow	kg/h	2.53440E+06*	2.58282E+06	59420.6	48420.6	5500	1.29141E+06	16440.2*	5500	1.29141E+06	4171.91	1.29691E+06	1.36078E+06	76267.2	1.20809E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	2.10950E+06	2.17308E+06	78030.3	63585.3	7222.53	1.08654E+06	21589.0	7222.53	1.08654E+06	5486.15	1.09376E+06	1.76638E+06	99000.0	1.02652E+06	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	2962.14	3010.62	59.4969	48.4828	5.50706	1505.31	16.4613	5.50706	1505.31	4.17602	1510.82	1362.76	76.3786	1408.08	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.983118	0.972585	0.991139	0.991139	0.991139	0.972585	0.990162	0.991139	0.972585	0.998846	0.970277	0.988557	0.988557	0.963026		Specific Gravity
Mass Enthalpy	kJ/kg	-1117.26	-1391.32	-15736.3	-15736.3	-15736.3	-1377.97	-15757.2	-15736.3	-1377.97	-15885.0	-1438.86	-15552.1	-15552.1	-804.331	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0205100	0.0186164	0.564032	0.564032	0.564033	0.0191570	0.571712	0.564033	0.0191570	1.01302	0.0187300	0.522996	0.522996	0.0186184	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0293	0.0265	0.6342	0.634 2	0.6342	0.0274	0.631690?	0.6342	0.0274	0.5991	0.0267	0.6285	0.6285	0.0266	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm			68.1058	68.1058	68.1058		68.5295	68.1058		73.8205		66.9806	66.9806		dyne/cm	Surface Tension

Process Streams	104	105	106	107	108	109	110	111	200	201	202	203	204	Process Streams
	Lean Amine (Abs. 1)	Cooled Semi-Lean Amine (Abs. 1)	Rich Amine (Abs. 1)	Process Water to Upper Bed (Abs. 1)	Cooled Wash Water to Lower Bed (Abs. 1)	Cooled Wash Water (Abs. 1)	Cooled Wash Water to Upper Bed (Abs. 1)	Combined Wash Water to Upper Bed (Abs. 1)	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 2)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 2)	Lean Amine (Abs. 2)	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	2.03887E-05	4.09355E-07	0.000204302	1.00873E-08	0.000214102	0.000214102	0.000214102	0.000171284	12.3515	0.000214102	0.000214102	13.1597	2.03887E-05	Oxygen
Nitrogen	6.39773E-05	8.69854E-07	0.000641464	8.97434E-09	0.000671827	0.000671827	0.000671827	0.000537464	72.1113	0.000671827	0.000671827	76.8340	6.39773E-05	Nitrogen
Water	82.3414	78.9990	78.6680	99.9163	99.3931	99.3931	99.3931	99.4977	11.0294	99.3931	99.3931	8.54853	82.3414	Water
Carbon Dioxide	3.30108	6.04490	6.61087	0.0570861	0.150800	0.150800	0.150800	0.132057	3.68161	0.150800	0.150800	0.578188	3.30108	Carbon Dioxide
Sulfur Dioxide	2.35290E-10	2.99841E-08	1.02902E-07	7.83447E-08	0	0	0	1.56689E-08	9.51392E-06	0	0	5.42419E-10	2.35290E-10	Sulfur Dioxide
MEA	14.3573	14.9558	14.7200	0.0239842	0.455022	0.455022	0.455022	0.368815	0.000855530	0.455022	0.455022	0.000301589	14.3573	MEA
Argon	1.43596E-06	2.76605E-08	1.43819E-05	8.01637E-10	1.50791E-05	1.50791E-05	1.50791E-05	1.20634E-05	0.824476	1.50791E-05	1.50791E-05	0.878463	1.43596E-06	Argon
NO	7.45138E-10	2.45771E-11	7.46666E-09	7.89452E-13	7.82469E-09	7.82469E-09	7.82469E-09	6.25991E-09	0.000305146	7.82469E-09	7.82469E-09	0.000325125	7.45138E-10	NO
NO2	1.14131E-09	1.97407E-10	1.12650E-08	4.64336E-09	1.18385E-08	1.18385E-08	1.18385E-08	1.03995E-08	4.97564E-05	1.18385E-08	1.18385E-08	5.30018E-05	1.14131E-09	NO2
NH3	0.000222485	0.000302942	0.000321162	0.00261683	0.000219179	0.000219179	0.000219179	0.000698710	0.000475299	0.000219179	0.000219179	0.000408706	0.000222485	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	0.00894712	4.29752E-05	0.108975	3.02618E-08	0.157067	0.159636	0.00256922	0.00256925	5702.58	0.159636	0.00894710	11404.4	0.00894712	Oxygen
Nitrogen	0.0280750	9.13196E-05	0.342159	2.69230E-08	0.492858	0.500920	0.00806193	0.00806195	33293.1	0.500920	0.0280750	66585.5	0.0280750	Nitrogen
Water	36133.7	8293.52	41961.7	299.749	72915.6	74108.4	1192.72	1492.47	5092.15	74108.4	4153.54	7408.28	36133.7	Water
Carbon Dioxide	1448.60	634.610	3526.26	0.171258	110.628	112.438	1.80960	1.98086	1699.76	112.438	6.30179	501.066	1448.60	Carbon Dioxide
Sulfur Dioxide	1.03252E-07	3.14781E-06	5.48884E-05	2.35034E-07	0	0	0	2.35034E-07	0.00439248	0	0	4.70068E-07	1.03252E-07	Sulfur Dioxide
MEA	6300.36	1570.10	7851.68	0.0719527	333.808	339.269	5.46027	5.53222	0.394990	339.269	19.0149	0.261362	6300.36	MEA
Argon	0.000630140	2.90388E-06	0.00767137	2.40491E-09	0.0110621	0.0112431	0.000180949	0.000180951	380.652	0.0112431	0.000630139	761.289	0.000630140	Argon
NO	3.26987E-07	2.58017E-09	3.98274E-06	2.36836E-12	5.74027E-06	5.83416E-06	9.38963E-08	9.38987E-08	0.140883	5.83416E-06	3.26986E-07	0.281758	3.26987E-07	NO
NO2	5.00840E-07	2.07243E-08	6.00881E-06	1.39301E-08	8.68486E-06	8.82692E-06	1.42062E-07	1.55993E-07	0.0229721	8.82692E-06	4.94721E-07	0.0459322	5.00840E-07	NO2
NH3	0.0976328	0.0318037	0.171309	0.00785050	0.160792	0.163422	0.00263015	0.0104806	0.219441	0.163422	0.00915927	0.354191	0.0976328	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	2.60374E-05	5.03266E-07	0.000250732	1.78921E-08	0.000375386	0.000375386	0.000375386	0.000301006	14.0700	0.000375386	0.000375386	15.1035	2.60374E-05	Oxygen
Nitrogen	7.15265E-05	9.36215E-07	0.000689193	1.39355E-08	0.00103121	0.00103121	0.00103121	0.000826876	71.9134	0.00103121	0.00103121	77.2001	7.15265E-05	Nitrogen
Water	59.2018	54.6797	54.3552	99.7771	98.1118	98.1118	98.1118	98.4418	7.07346	98.1118	98.1118	5.52371	59.2018	Water
Carbon Dioxide	5.79799	10.2211	11.1586	0.139261	0.363641	0.363641	0.363641	0.319179	5.76799	0.363641	0.363641	0.912670	5.79799	Carbon Dioxide
Sulfur Dioxide	6.01577E-10	7.38017E-08	2.52837E-07	2.78212E-07	0	0	0	5.51287E-08	2.16977E-05	0	0	1.24637E-09	6.01577E-10	Sulfur Dioxide
MEA	35	35.0990	34.4850	0.0812082	1.52292	1.52292	1.52292	1.23724	0.00186036	1.52292	1.52292	0.000660747	35	MEA
Argon	2.28936E-06	4.24540E-08	2.20351E-05	1.77511E-09	3.30060E-05	3.30060E-05	3.30060E-05	2.64661E-05	1.17250	3.30060E-05	3.30060E-05	1.25868	2.28936E-06	Argon
NO	8.92322E-10	2.83338E-11	8.59287E-09	1.31307E-12	1.28647E-08	1.28647E-08	1.28647E-08	1.03158E-08	0.000325955	1.28647E-08	1.28647E-08	0.000349911	8.92322E-10	NO
NO2	2.09551E-09	3.48928E-10	1.98767E-08	1.18412E-08	2.98423E-08	2.98423E-08	2.98423E-08	2.62753E-08	8.14891E-05	2.98423E-08	2.98423E-08	8.74579E-05	2.09551E-09	NO2
NH3	0.000151219	0.000198222	0.000209776	0.00247034	0.000204527	0.000204527	0.000204527	0.000653507	0.000288161	0.000204527	0.000204527	0.000249653	0.000151219	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	0.286297	0.00137515	3.48708	9.68343E-07	5.02596	5.10817	0.0822120	0.0822130	182476	5.10817	0.286297	364926	0.286297	Oxygen
Nitrogen	0.786476	0.00255817	9.58503	7.54205E-07	13.8066	14.0325	0.225842	0.225843	932653	14.0325	0.786476	1.86529E+06	0.786476	Nitrogen
Water	650958	149410	755952	5400.06	1.31360E+06	1.33508E+06	21487.1	26887.2	91736.4	1.33508E+06	74827.1	133462	650958	Water
Carbon Dioxide	63752.3	27928.8	155189	7.53700	4868.70	4948.34	79.6397	87.1767	74805.7	4948.34	277.339	22051.7	63752.3	Carbon Dioxide
Sulfur Dioxide	6.61469E-06	0.000201660	0.00351636	1.50572E-05	0	0	0	1.50572E-05	0.281399	0	0	3.01144E-05	6.61469E-06	Sulfur Dioxide
MEA	384846	95906.7	479605	4.39509	20390.0	20723.6	333.530	337.925	24.1272	20723.6	1161.49	15.9648	384846	MEA
Argon	0.0251728	0.000116004	0.306456	9.60714E-08	0.441910	0.449139	0.00722854	0.00722863	15206.3	0.449139	0.0251728	30412.0	0.0251728	Argon
NO	9.81161E-06	7.74210E-08	0.000119506	7.10651E-11	0.000172243	0.000175060	2.81746E-06	2.81753E-06	4.22735	0.000175060	9.81158E-06	8.45446	9.81161E-06	NO
NO2	2.30414E-05	9.53432E-07	0.000276438	6.40860E-07	0.000399551	0.000406087	6.53565E-06	7.17651E-06	1.05684	0.000406087	2.27599E-05	2.11313	2.30414E-05	NO2
NH3	1.66274	0.541633	2.91748	0.133698	2.73836	2.78316	0.0447928	0.178491	3.73719	2.78316	0.155987	6.03205	1.66274	NH3

Process Streams		104	105	106	107	108	109	110	111	200	201	202	203	204	Process Streams	
Property	**Units**														**Units**	**Property**
Temperature	℃	55.0223	58.8758	53.3439	46.4461	20.0000	20.0000	20.0000	25.3983	50.1573	53.1358	53.1358	42.9986	55.0223	℃	Temperatu re
Pressure	bar	3.68912	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	1.08857	4.48079	4.48079	1.01273	3.68912	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	100	0	0	100	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	25.0567	26.0277	26.0734	18.0404	18.2505	18.2505	18.2505	18.2085	28.0905	18.2505	18.2505	27.8806	25.0567	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1088.37	1142.83	1152.26	989.227	999.804	999.804	999.804	997.937	1.13834	987.623	987.623	1.07471	1088.37	kg/m^3	Mass Density
Molar Flow	kmol/h	43882.8	10498.3	53340.3	300	73360.9	74560.9	1200	1500	46169.0	74560.9	4178.90	43330.7	43882.8	kmol/h	Molar Flow
Mass Flow	kg/h	1.09956E+06	273246	1.39076E+06	5412.13	1.33888E+06	1.36078E+06	21900.7	27312.8	1.29691E+06	1.36078E+06	76267.2	1.20809E+06	1.09956E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	1.03960E+06	248709	1.26366E+06	7107.13	1.73795E+06	1.76638E+06	28428.5	35535.7	1.09376E+06	1.76638E+06	99000.0	1.02652E+06	1.03960E+06	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	1106.49	277.584	1415.84	5.41908	1340.83	1362.76	21.9326	27.3517	1510.82	1362.76	76.3786	1408.08	1106.49	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.08940	1.14391	1.15334	0.990162	1.00075	1.00075	1.00075	0.998880	0.970277	0.988557	0.988557	0.963026	1.08940		Specific Gravity
Mass Enthalpy	kJ/kg	-11399.9	-11148.9	-11189.9	-15757.2	-15689.1	-15689.1	-15689.1	-15702.5	-1438.86	-15552.1	-15552.1	-804.331	-11399.9	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	1.72388	2.17395	2.59849	0.571710	1.04927	1.04927	1.04927	0.911176	0.0187300	0.522996	0.522996	0.0186184	1.72388	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.4173	0.3874	0.3813	0.6317	0.5881	0.5881	0.5881	0.5975	0.0267	0.6285	0.6285	0.0266	0.4173	W/(m*℃)	Thermal Conducti vity
Surface Tension	dyne/cm	59.2253	92.8370	95.5904	68.5295	73.3767	73.3767	73.3767	72.4157		66.9806	66.9806		59.2253	dyne/cm	Surface Tension

Process Streams	**205**	**206**	**207**	**208**	**209**	**210**	**211**	**300**	**302**	**303**	**304**	**305**	**306**	**307**	**Process Streams**
	Cooled Semi-Lean Amine (Abs. 2)	**Rich Amine (Abs. 2)**	**Process Water to Upper Bed (Abs. 2)**	**Cooled Wash Water to Lower Bed (Abs. 2)**	**Cooled Wash Water (Abs. 2)**	**Cooled Wash Water to Upper Bed (Abs. 2)**	**Combined Wash Water to Upper Bed (Abs. 2)**	**Combined Cold Rich Amine**	**Hot Rich Amine**	**Stripper Bottoms to E-108 Inlet**	**Rich Amine to E-103**	**Lean Amine**	**Filtered Lean Amine**	**Fresh Amine**	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	4.09355E-07	0.000204302	1.00873E-08	0.000214102	0.000214102	0.000214102	0.000171284	0.000204302	0.000204302	0	0.000204302	2.03887E-05	2.03887E-05	0	Oxygen
Nitrogen	8.69854E-07	0.000641464	8.97434E-09	0.000671827	0.000671827	0.000671827	0.000537464	0.000641464	0.000641464	0	0.000641464	6.39773E-05	6.39773E-05	0	Nitrogen
Water	78.9990	78.6680	99.9163	99.3931	99.3931	99.3931	99.4977	78.6680	78.6680	80.4728	78.6680	82.3414	82.3414	0	Water
Carbon Dioxide	6.04490	6.61087	0.0570861	0.150800	0.150800	0.150800	0.132057	6.61087	6.61087	3.64688	6.61087	3.30108	3.30108	0	Carbon Dioxide
Sulfur Dioxide	2.99841E-08	1.02902E-07	7.83447E-08	0	0	0	1.56689E-08	1.02902E-07	1.02902E-07	0	1.02902E-07	2.35290E-10	2.35290E-10	0	Sulfur Dioxide
MEA	14.9558	14.7200	0.0239842	0.455022	0.455022	0.455022	0.368815	14.7200	14.7200	15.8801	14.7200	14.3573	14.3573	100	MEA
Argon	2.76605E-08	1.43819E-05	8.01637E-10	1.50791E-05	1.50791E-05	1.50791E-05	1.20634E-05	1.43819E-05	1.43819E-05	0	1.43819E-05	1.43596E-06	1.43596E-06	0	Argon
NO	2.45771E-11	7.46666E-09	7.89452E-13	7.82469E-09	7.82469E-09	7.82469E-09	6.25991E-09	7.46666E-09	7.46666E-09	0	7.46666E-09	7.45138E-10	7.45138E-10	0	NO
NO2	1.97407E-10	1.12650E-08	4.64336E-09	1.18385E-08	1.18385E-08	1.18385E-08	1.03995E-08	1.12650E-08	1.12650E-08	0	1.12650E-08	1.14131E-09	1.14131E-09	0	NO2
NH3	0.000302942	0.000321162	0.00261683	0.000219179	0.000219179	0.000219179	0.000698710	0.000321162	0.000321162	0.000214993	0.000321162	0.000222485	0.000222485	0	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	4.29752E-05	0.108975	3.02618E-08	0.157067	0.159636	0.00256922	0.00256925	0.217951	0.174360	0	0.0435901	0.0143154	0.00357885	0	Oxygen
Nitrogen	9.13196E-05	0.342159	2.69230E-08	0.492858	0.500920	0.00806193	0.00806195	0.684317	0.547454	0	0.136863	0.0449200	0.0112300	0	Nitrogen
Water	8293.52	41961.7	299.749	72915.6	74108.4	1192.72	1492.47	83923.4	67138.7	63649.0	16784.7	57813.9	14453.5	0	Water
Carbon Dioxide	634.610	3526.26	0.171258	110.628	112.438	1.80960	1.98086	7052.51	5642.01	2884.45	1410.50	2317.77	579.442	0	Carbon Dioxide
Sulfur Dioxide	3.14781E-06	5.48884E-05	2.35034E-07	0	0	0	2.35034E-07	0.000109777	8.78214E-05	0	2.19553E-05	1.65203E-07	4.13007E-08	0	Sulfur Dioxide
MEA	1570.10	7851.68	0.0719527	333.808	339.269	5.46027	5.53222	15703.3	12562.7	12560.1	3140.67	10080.6	2520.15	2.49009	MEA
Argon	2.90388E-06	0.00767137	2.40491E-09	0.0110621	0.0112431	0.000180949	0.000180951	0.0153427	0.0122742	0	0.00306854	0.00100822	0.000252056	0	Argon
NO	2.58017E-09	3.98274E-06	2.36836E-12	5.74027E-06	5.83416E-06	9.38963E-08	9.38987E-08	7.96547E-06	6.37237E-06	0	1.59309E-06	5.23180E-07	1.30795E-07	0	NO
NO2	2.07243E-08	6.00881E-06	1.39301E-08	8.68486E-06	8.82692E-06	1.42062E-07	1.55993E-07	1.20176E-05	9.61408E-06	0	2.40352E-06	8.01344E-07	2.00336E-07	0	NO2
NH3	0.0318037	0.171309	0.00785050	0.160792	0.163422	0.00263015	0.0104806	0.342617	0.274094	0.170046	0.0685235	0.156212	0.0390531	0	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	5.03266E-07	0.000250732	1.78921E-08	0.000375386	0.000375386	0.000375386	0.000301006	0.000250732	0.000250732	0	0.000250732	2.60374E-05	2.60374E-05	0	Oxygen
Nitrogen	9.36215E-07	0.000689193	1.39355E-08	0.00103121	0.00103121	0.00103121	0.000826876	0.000689193	0.000689193	0	0.000689193	7.15265E-05	7.15265E-05	0	Nitrogen
Water	54.6797	54.3552	99.7771	98.1118	98.1118	98.1118	98.4418	54.3552	54.3552	56.1862	54.3552	59.2018	59.2018	0	Water
Carbon Dioxide	10.2211	11.1586	0.139261	0.363641	0.363641	0.363641	0.319179	11.1586	11.1586	6.22024	11.1586	5.79799	5.79799	0	Carbon Dioxide
Sulfur Dioxide	7.38017E-08	2.52837E-07	2.78212E-07	0	0	0	5.51287E-08	2.52837E-07	2.52837E-07	0	2.52837E-07	6.01577E-10	6.01577E-10	0	Sulfur Dioxide
MEA	35.0990	34.4850	0.0812082	1.52292	1.52292	1.52292	1.23724	34.4850	34.4850	37.5935	34.4850	35	35	100	MEA
Argon	4.24540E-08	2.20351E-05	1.77511E-09	3.30060E-05	3.30060E-05	3.30060E-05	2.64661E-05	2.20351E-05	2.20351E-05	0	2.20351E-05	2.28936E-06	2.28936E-06	0	Argon
NO	2.83338E-11	8.59287E-09	1.31307E-12	1.28647E-08	1.28647E-08	1.28647E-08	1.03158E-08	8.59287E-09	8.59287E-09	0	8.59287E-09	8.92322E-10	8.92322E-10	0	NO
NO2	3.48928E-10	1.98767E-08	1.18412E-08	2.98423E-08	2.98423E-08	2.98423E-08	2.62753E-08	1.98767E-08	1.98767E-08	0	1.98767E-08	2.09551E-09	2.09551E-09	0	NO2
NH3	0.000198222	0.000209776	0.00247034	0.000204527	0.000204527	0.000204527	0.000653507	0.000209776	0.000209776	0.000141903	0.000209776	0.000151219	0.000151219	0	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	0.00137515	3.48708	9.68343E-07	5.02596	5.10817	0.0822120	0.0822130	6.97416	5.57933	0	1.39483	0.458075	0.114519	0	Oxygen
Nitrogen	0.00255817	9.58503	7.54205E-07	13.8066	14.0325	0.225842	0.225843	19.1700	15.3360	0	3.83401	1.25836	0.314590	0	Nitrogen
Water	149410	755952	5400.06	1.31360E+06	1.33508E+06	21487.1	26887.2	1.51190E+06	1.20952E+06	1.14665E+06	302381	1.04153E+06	260383	0	Water
Carbon Dioxide	27928.8	155189	7.53700	4868.70	4948.34	79.6397	87.1767	310378	248302	126943	62075.5	102004	25500.9	0	Carbon Dioxide
Sulfur Dioxide	0.000201660	0.00351636	1.50572E-05	0	0	0	1.50572E-05	0.00703271	0.00562617	0	0.00140654	1.05835E-05	2.64588E-06	0	Sulfur Dioxide
MEA	95906.7	479605	4.39509	20390.0	20723.6	333.530	337.925	959209	767367	767212	191842	615753	153938	152.102	MEA
Argon	0.000116004	0.306456	9.60714E-08	0.441910	0.449139	0.00722854	0.00722863	0.612911	0.490329	0	0.122582	0.0402765	0.0100691	0	Argon
NO	7.74210E-08	0.000119506	7.10651E-11	0.000172243	0.000175060	2.81746E-06	2.81753E-06	0.000239013	0.000191210	0	4.78025E-05	1.56986E-05	3.92464E-06	0	NO
NO2	9.53432E-07	0.000276438	6.40860E-07	0.000399551	0.000406087	6.53565E-06	7.17651E-06	0.000552876	0.000442301	0	0.000110575	3.68662E-05	9.21656E-06	0	NO2
NH3	0.541633	2.91748	0.133698	2.73836	2.78316	0.0447928	0.178491	5.83495	4.66796	2.89597	1.16699	2.66038	0.665095	0	NH3

Process Streams		**205**	**206**	**207**	**208**	**209**	**210**	**211**	**300**	**302**	**303**	**304**	**305**	**306**	**307**	**Process Streams**	
Property	**Units**															**Units**	**Property**
Temperature	℃	58.8758	53.3439	46.4461	20.0000	20.0000	20.0000	25.3983	53.4896	117*	126.351	53.4896	55.0223	55.0223	20.0000*	℃	Temperature
Pressure	bar	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	10.7412	9.70702	5.41280	10.7412	3.68912	3.68912	8.6049*	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0277	26.0734	18.0404	18.2505	18.2505	18.2505	18.2085	26.0734	26.0734	25.8025	26.0734	25.0567	25.0567	61.0831	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1142.83	1152.26	989.227	999.804	999.804	999.804	997.937	1152.33	1132.75	1068.27	1152.33	1088.37	1088.37	993.667	kg/m^3	Mass Density
Molar Flow	kmol/h	10498.3	53340.3	300	73360.9	74560.9	1200	1500	106680	85344.4	79093.8	21336.1	70212.4	17553.1	2.49009	kmol/h	Molar Flow
Mass Flow	kg/h	273246	1.39076E+06	5412.13	1.33888E+06	1.36078E+06	21900.7	27312.8	2.78152E+06	2.22522E+06	2.04081E+06	556304	1.75929E+06	439824	152.102	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	248709	1.26366E+06	7107.13	1.73795E+06	1.76638E+06	28428.5	35535.7	2.52731E+06	2.02185E+06	1.87377E+06	505462	1.66336E+06	415841	58.9913	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	277.584	1415.84	5.41908	1340.83	1362.76	21.9326	27.3517	2831.68	2265.34	2054.46	566.336	1770.39	442.598	0.149104	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.14391	1.15334	0.990162	1.00075	1.00075	1.00075	0.998880	1.15342	1.13382	1.06928	1.15342	1.08940	1.08940	0.994606		Specific Gravity
Mass Enthalpy	kJ/kg	-11148.9	-11189.9	-15757.2	-15689.1	-15689.1	-15689.1	-15702.5	-11188.6	-10960.9	-10817.3	-11188.6	-11399.9	-11399.9	-4324.37	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	2.17395	2.59849	0.571710	1.04927	1.04927	1.04927	0.911176	2.59253	0.689861	0.520015	2.59253	1.72388	1.72388	7.17196	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3874	0.3813	0.6317	0.5881	0.5881	0.5881	0.5975	0.3814	0.3945	0.4150	0.3814	0.4173	0.4173	0.2403	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm	92.8370	95.5904	68.5295	73.3767	73.3767	73.3767	72.4157	93.0610	87.1491	46.6093	93.0610	59.2253	59.2253	45.6798	dyne/cm	Surface Tension

Process Streams	309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	325	330	Process Streams
	Rich Amine to E-107	Rich Amine to E-109	Rich Amine to V-101	Flash Gas	Hot Semi-Lean Amine	Stripper Bottoms	Stripper Bottoms to E-107	Reclaimer Feed	Reclaimer Product	Stripper Reboiler Inlet	Stripper Reboiler Discharge	Stripper Overhead	Stripper Reflux	Reflux Purge	Cooled Stripper Overhead	Stripper Overhead Liquid	Hot Semi-Lean Amine	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0.000204302	0.000204302	0.000204302	0.0128108	4.09351E-07	0	0	0	0	0	0	0.00298592	2.19422E-07	2.19422E-07	0.00298592	2.19422E-07	4.09351E-07	Oxygen
Nitrogen	0.000641464	0.000641464	0.000641464	0.0402487	8.69846E-07	0	0	0	0	0	0	0.00937631	3.65882E-07	3.65882E-07	0.00937631	3.65882E-07	8.69846E-07	Nitrogen
Water	78.6680	78.6680	78.6680	58.2029	78.9990	80.4728	80.4728	80.4728	80.7711	80.4728	80.4728	60.2360	99.8826	99.8826	60.2360	99.8826	78.9990	Water
Carbon Dioxide	6.61087	6.61087	6.61087	41.6046	6.04490	3.64688	3.64688	3.64688	3.66040	3.64688	3.64688	39.7346	0.0880845	0.0880845	39.7346	0.0880845	6.04490	Carbon Dioxide
Sulfur Dioxide	1.02902E-07	1.02902E-07	1.02902E-07	4.61139E-06	2.99837E-08	0	0	0	0	0	0	1.42233E-06	7.10243E-08	7.10243E-08	1.42233E-06	7.10243E-08	2.99837E-08	Sulfur Dioxide
MEA	14.7200	14.7200	14.7200	0.137153	14.9558	15.8801	15.8801	15.8801	15.5683	15.8801	15.8801	0.0151863	0.0263988	0.0263988	0.0151863	0.0263988	14.9558	MEA
Argon	1.43819E-05	1.43819E-05	1.43819E-05	0.000901892	2.76603E-08	0	0	0	0	0	0	0.000210198	1.63891E-08	1.63891E-08	0.000210198	1.63891E-08	2.76603E-08	Argon
NO	7.46666E-09	7.46666E-09	7.46666E-09	4.67603E-07	2.45769E-11	0	0	0	0	0	0	1.09099E-07	1.18469E-11	1.18469E-11	1.09099E-07	1.18469E-11	2.45769E-11	NO
NO2	1.12650E-08	1.12650E-08	1.12650E-08	6.95566E-07	1.97405E-10	0	0	0	0	0	0	1.64147E-07	1.70429E-10	1.70429E-10	1.64147E-07	1.70429E-10	1.97405E-10	NO2
NH3	0.000321162	0.000321162	0.000321162	0.00144795	0.000302938	0.000214993	0.000214993	0.000214993	0.000215790	0.000214993	0.000214993	0.00165885	0.00287376	0.00287376	0.00165885	0.00287376	0.000302938	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0.0435901	0.0435901	0.0435901	0.0435042	8.59494E-05	0	0	0	0	0	0	0.217866	9.20999E-07	8.28899E-06	0.217866	9.20999E-06	8.59494E-05	Oxygen
Nitrogen	0.136863	0.136863	0.136863	0.136681	0.000182637	0	0	0	0	0	0	0.684136	1.53575E-06	1.38217E-05	0.684136	1.53575E-05	0.000182637	Nitrogen
Water	16784.7	16784.7	16784.7	197.651	16587.0	64084.8	63649.0	435.776	435.776	42723.2	42723.2	4395.08	419.245	3773.21	4395.08	4192.45	16587.0	Water
Carbon Dioxide	1410.50	1410.50	1410.50	141.285	1269.22	2904.20	2884.45	19.7486	19.7486	1936.14	1936.14	2899.21	0.369724	3.32752	2899.21	3.69724	1269.22	Carbon Dioxide
Sulfur Dioxide	2.19553E-05	2.19553E-05	2.19553E-05	1.56598E-05	6.29553E-06	0	0	0	0	0	0	0.000103779	2.98116E-07	2.68304E-06	0.000103779	2.98116E-06	6.29553E-06	Sulfur Dioxide
MEA	3140.67	3140.67	3140.67	0.465757	3140.20	12646.1	12560.1	85.9937	83.9939	8430.76	8430.76	1.10806	0.110806	0.997253	1.10806	1.10806	3140.20	MEA
Argon	0.00306854	0.00306854	0.00306854	0.00306274	5.80769E-06	0	0	0	0	0	0	0.0153370	6.87911E-08	6.19120E-07	0.0153370	6.87911E-07	5.80769E-06	Argon
NO	1.59309E-06	1.59309E-06	1.59309E-06	1.58793E-06	5.16029E-09	0	0	0	0	0	0	7.96036E-06	4.97259E-11	4.47533E-10	7.96036E-06	4.97259E-10	5.16029E-09	NO
NO2	2.40352E-06	2.40352E-06	2.40352E-06	2.36207E-06	4.14481E-08	0	0	0	0	0	0	1.19769E-05	7.15355E-10	6.43819E-09	1.19769E-05	7.15355E-09	4.14481E-08	NO2
NH3	0.0685235	0.0685235	0.0685235	0.00491708	0.0636064	0.171210	0.170046	0.00116423	0.00116423	0.114140	0.114140	0.121037	0.0120623	0.108560	0.121037	0.120623	0.0636064	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0.000250732	0.000250732	0.000250732	0.0141868	5.03261E-07	0	0	0	0	0	0	0.00337000	3.89000E-07	3.89000E-07	0.00337000	3.89000E-07	5.03261E-07	Oxygen
Nitrogen	0.000689193	0.000689193	0.000689193	0.0390206	9.36206E-07	0	0	0	0	0	0	0.00926436	5.67860E-07	5.67860E-07	0.00926436	5.67860E-07	9.36206E-07	Nitrogen
Water	54.3552	54.3552	54.3552	36.2878	54.6796	56.1862	56.1862	56.1862	56.6817	56.1862	56.1862	38.2749	99.6932	99.6932	38.2749	99.6932	54.6796	Water
Carbon Dioxide	11.1586	11.1586	11.1586	63.3669	10.2211	6.22024	6.22024	6.22024	6.27510	6.22024	6.22024	61.6784	0.214773	0.214773	61.6784	0.214773	10.2211	Carbon Dioxide
Sulfur Dioxide	2.52837E-07	2.52837E-07	2.52837E-07	1.02240E-05	7.38008E-08	0	0	0	0	0	0	3.21389E-06	2.52089E-07	2.52089E-07	3.21389E-06	2.52089E-07	7.38008E-08	Sulfur Dioxide
MEA	34.4850	34.4850	34.4850	0.289935	35.0990	37.5935	37.5935	37.5935	37.0431	37.5935	37.5935	0.0327184	0.0893387	0.0893387	0.0327184	0.0893387	35.0990	MEA
Argon	2.20351E-05	2.20351E-05	2.20351E-05	0.00124688	4.24536E-08	0	0	0	0	0	0	0.000296171	3.62730E-08	3.62730E-08	0.000296171	3.62730E-08	4.24536E-08	Argon
NO	8.59287E-09	8.59287E-09	8.59287E-09	4.85581E-07	2.83335E-11	0	0	0	0	0	0	1.15465E-07	1.96947E-11	1.96947E-11	1.15465E-07	1.96947E-11	2.83335E-11	NO
NO2	1.98767E-08	1.98767E-08	1.98767E-08	1.10745E-06	3.48924E-10	0	0	0	0	0	0	2.66355E-07	4.34398E-10	4.34398E-10	2.66355E-07	4.34398E-10	3.48924E-10	NO2
NH3	0.000209776	0.000209776	0.000209776	0.000853405	0.000198219	0.000141903	0.000141903	0.000141903	0.000143154	0.000141903	0.000141903	0.000996442	0.00271152	0.00271152	0.000996442	0.00271152	0.000198219	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	1.39483	1.39483	1.39483	1.39208	0.00275028	0	0	0	0	0	0	6.97144	2.94709E-05	0.000265238	6.97144	0.000294709	0.00275028	Oxygen
Nitrogen	3.83401	3.83401	3.83401	3.82889	0.00511629	0	0	0	0	0	0	19.1650	4.30215E-05	0.000387193	19.1650	0.000430215	0.00511629	Nitrogen
Water	302381	302381	302381	3560.74	298820	1.15451E+06	1.14665E+06	7850.63	7850.63	769670	769670	79178.6	7552.82	67975.4	79178.6	75528.2	298820	Water
Carbon Dioxide	62075.5	62075.5	62075.5	6217.88	55857.6	127813	126943	869.125	869.125	85208.3	85208.3	127593	16.2714	146.442	127593	162.714	55857.6	Carbon Dioxide
Sulfur Dioxide	0.00140654	0.00140654	0.00140654	0.00100323	0.000403315	0	0	0	0	0	0	0.00664850	1.90984E-05	0.000171886	0.00664850	0.000190984	0.000403315	Sulfur Dioxide
MEA	191842	191842	191842	28.4499	191813	772465	767212	5252.76	5130.61	514977	514977	67.6838	6.76836	60.9153	67.6838	67.6836	191813	MEA
Argon	0.122582	0.122582	0.122582	0.122350	0.000232005	0	0	0	0	0	0	0.612682	2.74807E-06	2.47326E-05	0.612682	2.74807E-05	0.000232005	Argon
NO	4.78025E-05	4.78025E-05	4.78025E-05	4.76477E-05	1.54840E-07	0	0	0	0	0	0	0.000238859	1.49208E-09	1.34287E-08	0.000238859	1.49208E-08	1.54840E-07	NO
NO2	0.000110575	0.000110575	0.000110575	0.000108668	1.90684E-06	0	0	0	0	0	0	0.000551002	3.29103E-08	2.96192E-07	0.000551002	3.29103E-07	1.90684E-06	NO2
NH3	1.16699	1.16699	1.16699	0.0837404	1.08325	2.91580	2.89597	0.0198274	0.0198274	1.94387	1.94387	2.06132	0.205427	1.84884	2.06132	2.05427	1.08325	NH3

Process Streams		309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	325	330	Process Streams	
Property	**Units**																		**Units**	**Property**
Temperature	℃	108*	112.778*	121.526	113.709	113.762	127.540	127.608	127.608	169.974	127.540	129.980	104.851	48.7469	48.7469	48.8889*	48.6909	113.709	℃	Temperature
Pressure	bar	9.70702	8.67281	7.63859	2.39982*	5.84719	2.31016	6.10228	6.10228	2.3499	2.31016	2.31016	1.96543	5.24044	5.24044	1.82753	1.79306	2.39982	bar	Pressure
Mole Fraction Vapor	%	0	0	0	100	0	0	0	0	100*	0	17.9797	100	0	0	42.4467	0	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0734	26.0734	26.0734	28.8951	26.0278	25.8025	25.8025	25.8025	25.6717	25.8025	25.8025	28.3519	18.0495	18.0495	28.3519	18.0495	26.0278	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1136.42	1134.49	1130.77	2.17996	1124.54	1067.51	1067.53	1067.53	1.66311	1067.51	9.96644	1.79079	988.420	988.420	4.58931	988.395	1124.52	kg/m^3	Mass Density
Molar Flow	kmol/h	21336.1	21336.1	21336.1	339.590	20996.5	79635.3	79093.8	541.520	539.520	53090.2	53090.2	7296.43	419.738	3777.64	7296.43	4197.38	20996.5	kmol/h	Molar Flow
Mass Flow	kg/h	556304	556304	556304	9812.50	546492	2.05479E+06	2.04081E+06	13972.5	13850.4	1.36986E+06	1.36986E+06	206868	7576.07	68184.6	206868	75760.7	546492	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	505462	505462	505462	8045.04	497417	1.88660E+06	1.87377E+06	12828.8	12781.5	1.25773E+06	1.25773E+06	172856	9943.78	89494.0	172856	99437.8	497417	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	566.336	566.336	566.336	11.1699	555.166	2068.52	2054.46	14.0660	13.9462	1379.02	1379.02	234.727	7.58704	68.2833	234.727	75.8704	555.166	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.13749	1.13556	1.13184	0.998070	1.12560	1.06852	1.06854	1.06854	0.886729	1.06852		0.979307	0.989354	0.989354		0.989329	1.12558		Specific Gravity
Mass Enthalpy	kJ/kg	-10995.3	-10977.2	-10943.5	-10438.9	-10952.1	-10812.9	-10812.4	-10812.4	-9100.06	-10812.9	-10517.3	-10555.7	-15741.5	-15741.5	-11497.7	-15742.1	-10952.6	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.795671	0.736405	0.644543	0.0170327	0.707635	0.511379	0.511360	0.511360	0.0149774	0.511379		0.0165440	0.548088	0.548088		0.548236	0.707712	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3941	0.3944	0.3944	0.0247	0.3982	0.4149	0.4149	0.4149	0.0325	0.4149		0.0240	0.6335	0.6335		0.6334	0.3982	W/(m*℃)	Th ermal Conductivity
Surface Tension	dyne/cm	88.3099	87.9568	87.0508		86.8984	46.4059	46.3874	46.3874		46.4059			68.0584	68.0584		68.0693	87.6911	dyne/cm	Surface Tension

Process Streams	332	333	334	400	401	402	403	404	405	406	407	408	409	410	411	Process Streams
	Cold Rich Amine to Lean / Rich Exchanger	Process Water to Absorbers	Lean Amine to E-102 Inlet	CO2	1st Stage Suction	Hot 1st Stage Discharge	Cooled 1st Stage Discharge	Cold 1st Stage Discharge	2nd Stage Suction	Hot 2nd Stage Discharge	Cooled 2nd Stage Discharge	Cold 2nd Stage Discharge	Dryer Inlet	3rd Stage Suction	Hot 3rd Stage Discharge	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	0.000204302	1.00873E-08*	0	0.00702977	0.00702983	0.00702983	0.00702983	0.00702983	0.00747291	0.00747291	0.00747291	0.00747291	0.00750856	0.00752192	0.00752192	Oxygen
Nitrogen	0.000641464	8.97434E-09*	0	0.0220751	0.0220753	0.0220753	0.0220753	0.0220753	0.0234668	0.0234668	0.0234668	0.0234668	0.0235787	0.0236207	0.0236207	Nitrogen
Water	78.6680	99.9163*	80.4728	6.53828	6.53748	6.53748	6.53748	6.53748	0.658027	0.658027	0.658027	0.658027	0.188667	0.0110000	0.0110000	Water
Carbon Dioxide	6.61087	0.0570861*	3.64688	93.4321	93.4329	93.4329	93.4329	93.4329	99.3105	99.3105	99.3105	99.3105	99.7797	99.9573	99.9573	Carbon Dioxide
Sulfur Dioxide	1.02902E-07	7.83447E-08*	0	3.25254E-06	3.25257E-06	3.25257E-06	3.25257E-06	3.25257E-06	3.44005E-06	3.44005E-06	3.44005E-06	3.44005E-06	3.45070E-06	3.45684E-06	3.45684E-06	Sulfur Dioxide
MEA	14.7200	0.0239842*	15.8801	7.96099E-08	7.95840E-08	7.95840E-08	7.95840E-08	7.95840E-08	2.81700E-09	2.81700E-09	2.81700E-09	2.81700E-09	4.54423E-10	4.55231E-10	4.55231E-10	MEA
Argon	1.43819E-05	8.01637E-10*	0	0.000494870	0.000494874	0.000494874	0.000494874	0.000494874	0.000526066	0.000526066	0.000526066	0.000526066	0.000528575	0.000529515	0.000529515	Argon
NO	7.46666E-09	7.89452E-13*	0	2.56848E-07	2.56850E-07	2.56850E-07	2.56850E-07	2.56850E-07	2.73038E-07	2.73038E-07	2.73038E-07	2.73038E-07	2.74340E-07	2.74829E-07	2.74829E-07	NO
NO2	1.12650E-08	4.64336E-09*	0	3.86238E-07	3.86241E-07	3.86241E-07	3.86241E-07	3.86241E-07	3.97611E-07	3.97611E-07	3.97611E-07	3.97611E-07	3.95412E-07	3.96116E-07	3.96116E-07	NO2
NH3	0.000321162	0.00261683*	0.000214993	1.33580E-05	1.33580E-05	1.33580E-05	1.33580E-05	1.33580E-05	1.00477E-05	1.00477E-05	1.00477E-05	1.00477E-05	8.91735E-06	8.93322E-06	8.93322E-06	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	0.174360	3.14014E-08*	0	0.217856	0.217856	0.217856	0.217856	0.217856	0.217855	0.217855	0.217855	0.217855	0.217854	0.217854	0.217854	Oxygen
Nitrogen	0.547454	2.79368E-08*	0	0.684121	0.684121	0.684121	0.684121	0.684121	0.684119	0.684119	0.684119	0.684119	0.684118	0.684118	0.684118	Nitrogen
Water	67138.7	311.036*	63649.0	202.625	202.598	202.598	202.598	202.598	19.1832	19.1832	19.1832	19.1832	5.47403	0.318588	0.318588	Water
Carbon Dioxide	5642.01	0.177707*	2884.45	2895.51	2895.51	2895.51	2895.51	2895.51	2895.16	2895.16	2895.16	2895.16	2895.02	2895.02	2895.02	Carbon Dioxide
Sulfur Dioxide	8.78214E-05	2.43885E-07*	0	0.000100798	0.000100798	0.000100798	0.000100798	0.000100798	0.000100287	0.000100287	0.000100287	0.000100287	0.000100119	0.000100119	0.000100119	Sulfur Dioxide
MEA	12562.7	0.0746621*	12560.1	2.46716E-06	2.46633E-06	2.46633E-06	2.46633E-06	2.46633E-06	8.21231E-08	8.21231E-08	8.21231E-08	8.21231E-08	1.31847E-08	1.31847E-08	1.31847E-08	MEA
Argon	0.0122742	2.49547E-09*	0	0.0153363	0.0153363	0.0153363	0.0153363	0.0153363	0.0153362	0.0153362	0.0153362	0.0153362	0.0153362	0.0153362	0.0153362	Argon
NO	6.37237E-06	2.45754E-12*	0	7.95986E-06	7.95986E-06	7.95986E-06	7.95986E-06	7.95986E-06	7.95979E-06	7.95979E-06	7.95979E-06	7.95979E-06	7.95976E-06	7.95976E-06	7.95976E-06	NO
NO2	9.61408E-06	1.44546E-08*	0	1.19697E-05	1.19697E-05	1.19697E-05	1.19697E-05	1.19697E-05	1.15914E-05	1.15914E-05	1.15914E-05	1.15914E-05	1.14725E-05	1.14725E-05	1.14725E-05	NO2
NH3	0.274094	0.00814611*	0.170046	0.000413973	0.000413969	0.000413969	0.000413969	0.000413969	0.000292917	0.000292917	0.000292917	0.000292917	0.000258730	0.000258730	0.000258730	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	0.000250732	1.78921E-08*	0	0.00531713	0.00531715	0.00531715	0.00531715	0.00531715	0.00545525	0.00545525	0.00545525	0.00545525	0.00546606	0.00547004	0.00547004	Oxygen
Nitrogen	0.000689193	1.39355E-08*	0	0.0146175	0.0146175	0.0146175	0.0146175	0.0146175	0.0149972	0.0149972	0.0149972	0.0149972	0.0150269	0.0150379	0.0150379	Nitrogen
Water	54.3552	99.7771*	56.1862	2.78424	2.78389	2.78389	2.78389	2.78389	0.270443	0.270443	0.270443	0.270443	0.0773254	0.00450362	0.00450362	Water
Carbon Dioxide	11.1586	0.139261*	6.22024	97.1953	97.1957	97.1957	97.1957	97.1957	99.7086	99.7086	99.7086	99.7086	99.9017	99.9745	99.9745	Carbon Dioxide
Sulfur Dioxide	2.52837E-07	2.78212E-07*	0	4.92537E-06	4.92539E-06	4.92539E-06	4.92539E-06	4.92539E-06	5.02769E-06	5.02769E-06	5.02769E-06	5.02769E-06	5.02926E-06	5.03293E-06	5.03293E-06	Sulfur Dioxide
MEA	34.4850	0.0812082*	37.5935	1.14945E-07	1.14907E-07	1.14907E-07	1.14907E-07	1.14907E-07	3.92554E-09	3.92554E-09	3.92554E-09	3.92554E-09	6.31488E-10	6.31948E-10	6.31948E-10	MEA
Argon	2.20351E-05	1.77511E-09*	0	0.000467293	0.000467294	0.000467294	0.000467294	0.000467294	0.000479431	0.000479431	0.000479431	0.000479431	0.000480381	0.000480731	0.000480731	Argon
NO	8.59287E-09	1.31307E-12*	0	1.82175E-07	1.82176E-07	1.82176E-07	1.82176E-07	1.82176E-07	1.86907E-07	1.86907E-07	1.86907E-07	1.86907E-07	1.87277E-07	1.87413E-07	1.87413E-07	NO
NO2	1.98767E-08	1.18412E-08*	0	4.20017E-07	4.20019E-07	4.20019E-07	4.20019E-07	4.20019E-07	4.17310E-07	4.17310E-07	4.17310E-07	4.17310E-07	4.13851E-07	4.14152E-07	4.14152E-07	NO2
NH3	0.000209776	0.00247034*	0.000141903	5.37741E-06	5.37738E-06	5.37738E-06	5.37738E-06	5.37738E-06	3.90378E-06	3.90378E-06	3.90378E-06	3.90378E-06	3.45500E-06	3.45752E-06	3.45752E-06	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	5.57933	1.00481E-06*	0	6.97114	6.97114	6.97114	6.97114	6.97114	6.97110	6.97110	6.97110	6.97110	6.97108	6.97108	6.97108	Oxygen
Nitrogen	15.3360	7.82605E-07*	0	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	19.1645	Nitrogen
Water	1.20952E+06	5603.40*	1.14665E+06	3650.34	3649.86	3649.86	3649.86	3649.86	345.591	345.591	345.591	345.591	98.6161	5.73946	5.73946	Water
Carbon Dioxide	248302	7.82080*	126943	127430	127430	127430	127430	127430	127415	127415	127415	127415	127409	127409	127409	Carbon Dioxide
Sulfur Dioxide	0.00562617	1.56242E-05*	0	0.00645751	0.00645751	0.00645751	0.00645751	0.00645751	0.00642474	0.00642474	0.00642474	0.00642474	0.00641402	0.00641402	0.00641402	Sulfur Dioxide
MEA	767367	4.56059*	767212	0.000150701	0.000150651	0.000150651	0.000150651	0.000150651	5.01633E-06	5.01633E-06	5.01633E-06	5.01633E-06	8.05362E-07	8.05362E-07	8.05362E-07	MEA
Argon	0.490329	9.96890E-08*	0	0.612654	0.612654	0.612654	0.612654	0.612654	0.612650	0.612650	0.612650	0.612650	0.612649	0.612649	0.612649	Argon
NO	0.000191210	7.37411E-11*	0	0.000238844	0.000238844	0.000238844	0.000238844	0.000238844	0.000238842	0.000238842	0.000238842	0.000238842	0.000238841	0.000238841	0.000238841	NO
NO2	0.000442301	6.64992E-07*	0	0.000550673	0.000550672	0.000550672	0.000550672	0.000550672	0.000533268	0.000533268	0.000533268	0.000533268	0.000527800	0.000527800	0.000527800	NO2
NH3	4.66796	0.138732*	2.89597	0.00705017	0.00705011	0.00705011	0.00705011	0.00705011	0.00498852	0.00498852	0.00498852	0.00498852	0.00440630	0.00440630	0.00440630	NH3

Process Streams		332	333	334	400	401	402	403	404	405	406	407	408	409	410	411	Process Streams	
Property	**Units**																**Units**	**Property**
Temperature	℃	53.4896	46.4461*	58.7365	48.7010	48.7010	176.667*	129.444*	26*	25.8867	176.667*	129.444*	26*	25.9261	25.9261	176.667*	℃	Temperature
Pressure	bar	10.7412	4.13685*	4.72333	1.79306	1.79306	6.03552	5.75973	5.41499	5.34604	23.1076	22.8318	22.4870	22.4181	22.4181	93.5828	bar	Pressure
Mole Fraction Vapor	%	0	0	0	99.9991	100	100	100	94.0633	100	100	100	99.5254	100	100	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0734	18.0404	25.8025	42.3055	42.3057	42.3057	42.3057	42.3057	43.8338	43.8338	43.8338	43.8338	43.9558	44.0019	44.0019	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1152.33	989.227	1100.29	2.85806	2.85805	6.88502	7.37042	10.0902	9.71146	27.9169	31.3460	45.7895	45.5574	45.5945	123.168	kg/m^3	Mass Density
Molar Flow	kmol/h	85344.4	311.297	79093.8	3099.06	3099.03	3099.03	3099.03	3099.03	2915.26	2915.26	2915.26	2915.26	2901.42	2896.26	2896.26	kmol/h	Molar Flow
Mass Flow	kg/h	2.22522E+06	5615.92*	2.04081E+06	131107	131107	131107	131107	131107	127787	127787	127787	127787	127534	127441	127441	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	2.02185E+06	7374.75	1.87377E+06	73418.0	73417.4	73417.4	73417.4	73417.4	69063.9	69063.9	69063.9	69063.9	68735.8	68613.7	68613.7	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	2265.34	5.62313	2054.46	158.856	158.856	158.856	158.856	158.856	155.529	155.529	155.529	155.529	155.275	155.182	155.182	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.15342	0.990162	1.10133		1.46129	1.46129	1.46129		1.51407	1.51407	1.51407		1.51828	1.51988	1.51988		Specific Gravity
Mass Enthalpy	kJ/kg	-11188.6	-15757.1	-11065.5	-9045.10	-9045.08	-8924.50	-8971.65	-9130.16	-8956.04	-8823.38	-8871.30	-8978.43	-8965.08	-8961.76	-8844.38	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	2.59253	0.571710	1.86287		0.0161454	0.0216019	0.0197044		0.0152834	0.0220095	0.0201805		0.0159386	0.0159403	0.0242104	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3814	0.6317	0.4050		0.0187	0.0287	0.0251		0.0172	0.0296	0.0261		0.0189	0.0189	0.0342	W/(m*℃)	Thermal Conductivit y
Surface Tension	dyne/cm	93.0610	68.5295	57.9132													dyne/cm	Surface Tension

Process Streams		412	413	414	415	416	417	501	502	503	504	505	506	509	510	511	512	513	Process Streams	
		Cooled 3rd Stage Discharge	Cold 3rd Stage Discharge	CO2 Product	Inter-stage Liquid	Liquefied CO2	Dryer Water	SCW Supply to E-101	SCW Return From E-101	SCW Supply to E-104	SCW Return From E-104	SCW Supply to E-102	SCW Return From E-102	SCW Supply to E-111	SCW Return From E-111	LP Steam from E-112	LP Condensate from E-109	LP Steam from E-114		
Mole Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**	
Oxygen		0.00752192	0.00752192	0.00752192	9.41207E-07	0.00752192	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Oxygen	
Nitrogen		0.0236207	0.0236207	0.0236207	1.46712E-06	0.0236207	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Nitrogen	
Water		0.0110000	0.0110000	0.0110000	99.7532	0.0110000	100*	100*	100	100*	100	100*	100	100*	100	100	100	100	Water	
Carbon Dioxide		99.9573	99.9573	99.9573	0.246748	99.9573	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Carbon Dioxide	
Sulfur Dioxide		3.45684E-06	3.45684E-06	3.45684E-06	3.43550E-07	3.45684E-06	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Sulfur Dioxide	
MEA		4.55231E-10	4.55231E-10	4.55231E-10	1.24129E-06	4.55231E-10	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	MEA	
Argon		0.000529515	0.000529515	0.000529515	7.18032E-08	0.000529515	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Argon	
NO		2.74829E-07	2.74829E-07	2.74829E-07	5.10357E-11	2.74829E-07	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO	
NO2		3.96116E-07	3.96116E-07	3.96116E-07	2.51569E-07	3.96116E-07	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO2	
NH3		8.93322E-06	8.93322E-06	8.93322E-06	7.87373E-05	8.93322E-06	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NH3	
Molar Flow		kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**	
Oxygen		0.217854	0.217854	0.217854	1.86006E-06	0.217854	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Oxygen	
Nitrogen		0.684118	0.684118	0.684118	2.89939E-06	0.684118	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Nitrogen	
Water		0.318588	0.318588	0.318588	197.137	0.318588	5*	255336*	255336	255336*	255336	34919.3*	34919.3	266937*	266937	147.823	472.152	146.443	Water	
Carbon Dioxide		2895.02	2895.02	2895.02	0.487635	2895.02	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Carbon Dioxide	
Sulfur Dioxide		0.000100119	0.000100119	0.000100119	6.78940E-07	0.000100119	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Sulfur Dioxide	
MEA		1.31847E-08	1.31847E-08	1.31847E-08	2.45310E-06	1.31847E-08	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	MEA	
Argon		0.0153362	0.0153362	0.0153362	1.41901E-07	0.0153362	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Argon	
NO		7.95976E-06	7.95976E-06	7.95976E-06	1.00859E-10	7.95976E-06	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO	
NO2		1.14725E-05	1.14725E-05	1.14725E-05	4.97162E-07	1.14725E-05	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO2	
NH3		0.000258730	0.000258730	0.000258730	0.000155604	0.000258730	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NH3	
Mass Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**	
Oxygen		0.00547004	0.00547004	0.00547004	1.66584E-06	0.00547004	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Oxygen	
Nitrogen		0.0150379	0.0150379	0.0150379	2.27325E-06	0.0150379	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Nitrogen	
Water		0.00450362	0.00450362	0.00450362	99.3993	0.00450362	100*	100*	100	100*	100	100*	100	100*	100	100	100	100	Water	
Carbon Dioxide		99.9745	99.9745	99.9745	0.600642	99.9745	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Carbon Dioxide	
Sulfur Dioxide		5.03293E-06	5.03293E-06	5.03293E-06	1.21736E-06	5.03293E-06	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Sulfur Dioxide	
MEA		6.31948E-10	6.31948E-10	6.31948E-10	4.19382E-06	6.31948E-10	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	MEA	
Argon		0.000480731	0.000480731	0.000480731	1.58655E-07	0.000480731	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Argon	
NO		1.87413E-07	1.87413E-07	1.87413E-07	8.47030E-11	1.87413E-07	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO	
NO2		4.14152E-07	4.14152E-07	4.14152E-07	6.40150E-07	4.14152E-07	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO2	
NH3		3.45752E-06	3.45752E-06	3.45752E-06	7.41693E-05	3.45752E-06	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NH3	
Mass Flow		kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**	
Oxygen		6.97108	6.97108	6.97108	5.95196E-05	6.97108	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Oxygen	
Nitrogen		19.1645	19.1645	19.1645	8.12219E-05	19.1645	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Nitrogen	
Water		5.73946	5.73946	5.73946	3551.48	5.73946	9.28767E+01*	4.59995E+06*	4.59995E+06	4.59995E+06*	4.59995E+06	629082*	629082	4.80895E+06*	4.80895E+06	2663.07	8505.95	2638.20	Water	
Carbon Dioxide		127409	127409	127409	21.4606	127409	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Carbon Dioxide	
Sulfur Dioxide		0.00641402	0.00641402	0.00641402	4.34955E-05	0.00641402	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Sulfur Dioxide	
MEA		8.05362E-07	8.05362E-07	8.05362E-07	0.000149843	8.05362E-07	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	MEA	
Argon		0.612649	0.612649	0.612649	5.66866E-06	0.612649	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	Argon	
NO		0.000238841	0.000238841	0.000238841	3.02639E-09	0.000238841	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO	
NO2		0.000527800	0.000527800	0.000527800	2.28722E-05	0.000527800	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NO2	
NH3		0.00440630	0.00440630	0.00440630	0.00265002	0.00440630	0*	0*	0	0*	0	0*	0	0*	0	0	0	0	NH3	
Process Streams		**412**	**413**	**414**	**415**	**416**	**417**	**501**	**502**	**503**	**504**	**505**	**506**	**509**	**510**	**511**	**512**	**513**	**Process Streams**	
Property	**Units**																		**Units**	**Property**
Temperature	℃	129.444*	28*	48.2022	25.8867	27.9889	25.9261*	11*	21	11*	21	11*	21*	11*	21*	125.835	125.835	125.835	℃	Temperature
Pressure	bar	93.3070	92.9622	201.000*	5.34604	92.8933	22.4181*	1.9999*	0.965686	1.9999*	0.965686	1.9999*	1.31042	1.9999*	0.965686	2.37913	2.37913	2.37913	bar	Pressure
Mole Fraction Vapor	%	100	0	100	0	0	0	0	0	0	0	0	0	0	0	100*	0*	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	44.0019	44.0019	44.0019	18.0794	44.0019	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	148.590	722.630?	778.532	997.558	722.521	996.48	1000.00	997.597	1000.00	997.597	1000.00	997.602	1000.00	997.597	1.31446	938.857	1.31446	kg/m^3	Mass Density
Molar Flow	kmol/h	2896.26	2896.26	2896.26	197.625	2896.26	5	255336	255336	255336	255336	34919.3	34919.3	266937	266937	147.823	472.152	146.443	kmol/h	Molar Flow
Mass Flow	kg/h	127441	127441	127441	3572.94	127441	9.28767E+01	4.59995E+06	4.59995E+06	4.59995E+06	4.59995E+06	629082	629082	4.80895E+06	4.80895E+06	2663.07	8505.95	2638.20	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	68613.7	68613.7	68613.7	4681.82	68613.7	1.22135E+02	6.04902E+06	6.04902E+06	6.04902E+06	6.04902E+06	827254	827254	6.32386E+06	6.32386E+06	3501.99	11185.5	3469.29	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	155.182	155.182	155.182	3.58111	155.182	0.09	4604.47	4604.47	4604.47	4604.47	629.701	629.701	4813.68	4813.68	2.66569	8.51432	2.64080	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.51988	0.723313?	1.51988	0.998501	0.723204?	0.99742	1.00095	0.998540	1.00095	0.998540	1.00095	0.998544	1.00095	0.998540	0.622268	0.939745	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-8902.60	-9167.60	-9147.65	-15823.4	-9167.60	-15861.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-13240.4	-15448.2	-13240.4	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0230638	0.0609532	0.0692271	0.865915	0.0609671	0.87930	1.29092	0.987115	1.29092	0.987115	1.29092	0.987185	1.29092	0.987115	0.0106144	0.219521	0.0106144	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0319	0.1073	0.0909	0.6021	0.1073	0.6076	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.0270	0.6847	0.0270	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm		0.0000		72.3391	0.0000	72.6316	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192		53.1489		dyne/cm	Surface Tension

Process Streams	**514**	**515**	**516**	**517**	**518**	**519**	**520**	**521**	**522**	**523**	**524**	**525**	**526**	**527**	**Process Streams**
	LP Steam to E-109	**SCW Supply to E-113**	**SCW Return From E-113**	**SCW Supply to E-115**	**SCW Return From E-115**	**Condenstate to E-112**	**Condenstate to E-114**	**Condenstate to E-116**	**SCW Supply to E-117**	**SCW Return From E-117**	**LP Steam from E-116**	**LP Steam to E-110**	**LP Condensate from E-110**	**Vent Steam**	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	471.679	28067.5*	28067.5	18488.8*	18488.8	147.823*	146.443*	177.413*	45614.6*	45614.6	177.413	10380.1*	10380.1	288.503	Water
Carbon Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	8497.42	505645*	505645	333081*	333081	2663.07*	2638.20*	3196.15*	821760*	821760	3196.15	187000*	187000	5197.47	Water
Carbon Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3

Process Streams		**514**	**515**	**516**	**517**	**518**	**519**	**520**	**521**	**522**	**523**	**524**	**525**	**526**	**527**	**Process Streams**	
Property	**Units**															**Units**	**Property**
Temperature	℃	125.835	16*	26*	16*	26*	98.8889*	98.8889*	98.8889*	16*	26*	125.835	135*	133.594	146.435	℃	Temperature
Pressure	bar	2.37913	1.9999*	1.31042	1.9999*	1.31042	2.37913*	2.37913*	2.37913*	1.9999*	1.31042	2.37913	2.9999*	2.9999	2.3499*	bar	Pressure
Mole Fraction Vapor	%	100	0	0	0	0	0	0	0	0	0	100	100	0*	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1.31446	998.879	996.185	998.879	996.185	959.505	959.505	959.505	998.879	996.185	1.31446	1.62556	932.265	1.23159	kg/m^3	Mass Density
Molar Flow	kmol/h	471.679	28067.5	28067.5	18488.8	18488.8	147.823	146.443	177.413	45614.6	45614.6	177.413	10380.1	10380.1	288.503	kmol/h	Molar Flow
Mass Flow	kg/h	8497.42	505645	505645	333081	333081	2663.07	2638.20	3196.15	821760	821760	3196.15	187000*	187000	5197.47	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	11174.3	664932	664932	438008	438008	3501.99	3469.29	4203.00	1.08063E+06	1.08063E+06	4203.00	245909	245909	6834.77	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	8.50579	506.142	506.142	333.409	333.409	2.66569	2.64080	3.19930	822.569	822.569	3.19930	187.184	187.184	5.20258	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.622268	0.999823	0.997127	0.999823	0.997127	0.960412	0.960412	0.960412	0.999823	0.997127	0.622268	0.622268	0.933146	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-13240.4	-15904.0	-15862.9	-15904.0	-15862.9	-15561.8	-15561.8	-15561.8	-15904.0	-15862.9	-13240.4	-13224.7	-15390.4	-13200.2	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0106144	1.12405	0.874153	1.12405	0.874153	0.279294	0.279294	0.279294	1.12405	0.874153	0.0106144	0.0110023	0.206890	0.0114855	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0270	0.5931	0.6077	0.5931	0.6077	0.6758	0.6758	0.6758	0.5931	0.6077	0.0270	0.0278	0.6856	0.0287	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm		74.6291	72.6168	74.6291	72.6168	58.4280	58.4280	58.4280	74.6291	72.6168			51.6045		dyne/cm	Surface Tension

Process Streams	001	002	003	004	005	006	007	008	009	010	100	101	102	103	Process Streams
	Flue Gas From CCPP	Flue Gas From Common Fogger	Process Water to Foggers	Process Water to Common Fogger	Process Water to Abs. 1 Fogger	Abs 1. Flue Gas Blower Discharge	Process Water to Absorbers	Process Water to Abs. 2 Fogger	Abs 2. Flue Gas Blower Discharge	Softened Water	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 1)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 1)	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	12.5495*	12.2421	9.79466E-09	9.79466E-09	9.79466E-09	12.2421	9.79466E-09	9.79466E-09	12.2421	0	12.1586	0.000206160	0.000206160	12.8898	Oxygen
Nitrogen	73.3905*	71.5929	8.78164E-09	8.78164E-09	8.78164E-09	71.5929	8.78164E-09	8.78164E-09	71.5929	0	71.1044	0.000652141	0.000652141	75.3812	Nitrogen
Water	9.41850*	11.6351	99.9151	99.9151	99.9151	11.6351	99.9151	99.9151	11.6351	100	12.2375	99.3082	99.3082	10.2755	Water
Carbon Dioxide	3.79120*	3.69975	0.0576852	0.0576852	0.0576852	3.69975	0.0576852	0.0576852	3.69975	0	3.67490	0.170016	0.170016	0.579779	Carbon Dioxide
Sulfur Dioxide	9.93210E-06*	9.69066E-06	7.49449E-08	7.49449E-08	7.49449E-08	9.69066E-06	7.49449E-08	7.49449E-08	9.69066E-06	0	9.62505E-06	1.02631E-07	1.02631E-07	1.00913E-05	Sulfur Dioxide
MEA	0*	0.000608395	0.0248384	0.0248384	0.0248384	0.000608395	0.0248384	0.0248384	0.000608395	0	0.000773726	0.520705	0.520705	0.000445242	MEA
Argon	0.849489*	0.828681	7.87137E-10	7.87137E-10	7.87137E-10	0.828681	7.87137E-10	7.87137E-10	0.828681	0	0.823027	1.46786E-05	1.46786E-05	0.872522	Argon
NO	0.000317608*	0.000309829	7.85873E-13	7.85873E-13	7.85873E-13	0.000309829	7.85873E-13	7.85873E-13	0.000309829	0	0.000307715	7.72594E-09	7.72594E-09	0.000326217	NO
NO2	7.92960E-05*	7.73539E-05	6.77183E-09	6.77183E-09	6.77183E-09	7.73539E-05	6.77183E-09	6.77183E-09	7.73539E-05	0	7.68261E-05	1.74949E-08	1.74949E-08	8.14275E-05	NO2
NH3	0.000396864*	0.000446394	0.00241901	0.00241901	0.00241901	0.000446394	0.00241901	0.00241901	0.000446394	0	0.000459854	0.000190453	0.000190453	0.000406759	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	10304.2*	10304.2	2.58574E-07	2.01934E-07	2.83200E-08	5152.09	1.24179E-07	2.83200E-08	5152.09	0	5152.09	0.153435	0.00782513	5152.00	Oxygen
Nitrogen	60259.8*	60259.8	2.31831E-07	1.81049E-07	2.53910E-08	30129.9	1.11336E-07	2.53910E-08	30129.9	0	30129.9	0.485357	0.0247531	30129.6	Nitrogen
Water	7733.38*	9793.30	2637.71	2059.92	288.892	4896.65	1266.75	288.892	4896.65	202.180	5185.54	73910.3	3769.41	4107.09	Water
Carbon Dioxide	3112.90*	3114.09	1.52286	1.18928	0.166789	1557.04	0.731348	0.166789	1557.04	0	1557.21	126.535	6.45324	231.736	Carbon Dioxide
Sulfur Dioxide	0.00815509*	0.00815664	1.97851E-06	1.54512E-06	2.16694E-07	0.00407832	9.50171E-07	2.16694E-07	0.00407832	0	0.00407854	7.63833E-05	3.89553E-06	0.00403347	Sulfur Dioxide
MEA	0*	0.512086	0.655720	0.512086	0.0718170	0.256043	0.314908	0.0718170	0.256043	0	0.327860	387.536	19.7642	0.177962	MEA
Argon	697.502*	697.502	2.07800E-08	1.62282E-08	2.27591E-09	348.751	9.97954E-09	2.27591E-09	348.751	0	348.751	0.0109246	0.000557149	348.744	Argon
NO	0.260783*	0.260783	2.07466E-11	1.62021E-11	2.27225E-12	0.130392	9.96351E-12	2.27225E-12	0.130392	0	0.130392	5.75004E-06	2.93251E-07	0.130388	NO
NO2	0.0651087*	0.0651088	1.78773E-07	1.39613E-07	1.95799E-08	0.0325544	8.58550E-08	1.95799E-08	0.0325544	0	0.0325544	1.30206E-05	6.64047E-07	0.0325463	NO2
NH3	0.325858*	0.375731	0.0638607	0.0498721	0.00699426	0.187865	0.0306689	0.00699426	0.187865	0	0.194860	0.141745	0.00722897	0.162580	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	14.1999*	13.9760	1.73726E-08	1.73726E-08	1.73726E-08	13.9760	1.73726E-08	1.73726E-08	13.9760	0	13.9145	0.000360803	0.000360803	14.8919	Oxygen
Nitrogen	72.6995*	71.5533	1.36358E-08	1.36358E-08	1.36358E-08	71.5533	1.36358E-08	1.36358E-08	71.5533	0	71.2383	0.000999173	0.000999173	76.2430	Nitrogen
Water	5.99996*	7.47836	99.7729	99.7729	99.7729	7.47836	99.7729	99.7729	7.47836	100	7.88470	97.8496	97.8496	6.68368	Water
Carbon Dioxide	5.89996*	5.80916	0.140718	0.140718	0.140718	5.80916	0.140718	0.140718	5.80916	0	5.78420	0.409232	0.409232	0.921255	Carbon Dioxide
Sulfur Dioxide	2.24998E-05*	2.21493E-05	2.66131E-07	2.66131E-07	2.66131E-07	2.21493E-05	2.66131E-07	2.66131E-07	2.21493E-05	0	2.20530E-05	3.59604E-07	3.59604E-07	2.33417E-05	Sulfur Dioxide
MEA	0*	0.00132587	0.0840978	0.0840978	0.0840978	0.00132587	0.0840978	0.0840978	0.00132587	0	0.00169028	1.73959	1.73959	0.000981947	MEA
Argon	1.19999*	1.18107	1.74295E-09	1.74295E-09	1.74295E-09	1.18107	1.74295E-09	1.74295E-09	1.18107	0	1.17587	3.20709E-05	3.20709E-05	1.25847	Argon
NO	0.000336998*	0.000331685	1.30708E-12	1.30708E-12	1.30708E-12	0.000331685	1.30708E-12	1.30708E-12	0.000331685	0	0.000330224	1.26793E-08	1.26793E-08	0.000353417	NO
NO2	0.000128999*	0.000126966	1.72686E-08	1.72686E-08	1.72686E-08	0.000126966	1.72686E-08	1.72686E-08	0.000126966	0	0.000126407	4.40204E-08	4.40204E-08	0.000135255	NO2
NH3	0.000238998*	0.000271232	0.00228353	0.00228353	0.00228353	0.000271232	0.00228353	0.00228353	0.000271232	0	0.000280091	0.000177398	0.000177398	0.000250113	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	329722*	329722	8.27406E-06	6.46165E-06	9.06206E-07	164861	3.97359E-06	9.06206E-07	164861	0	164861	4.90972	0.250395	164858	Oxygen
Nitrogen	1.68808E+06*	1.68808E+06	6.49437E-06	5.07179E-06	7.11288E-07	844041	3.11890E-06	7.11288E-07	844041	0	844041	13.5965	0.693419	844032	Nitrogen
Water	139319*	176429	47519.0	37110.1	5204.47	88214.5	22820.9	5204.47	88214.5	3642.33	93419.0	1.33152E+06	67906.9	73990.3	Water
Carbon Dioxide	136997*	137049	67.0203	52.3396	7.34032	68524.7	32.1863	7.34032	68524.7	0	68532.0	5568.73	284.004	10198.6	Carbon Dioxide
Sulfur Dioxide	0.522446*	0.522545	0.000126751	9.89863E-05	1.38822E-05	0.261273	6.08716E-05	1.38822E-05	0.261273	0	0.261286	0.00489340	0.000249562	0.258399	Sulfur Dioxide
MEA	0*	31.2798	40.0534	31.2798	4.38680	15.6399	19.2355	4.38680	15.6399	0	20.0267	23671.9	1207.26	10.8704	MEA
Argon	27863.8*	27863.8	8.30121E-07	6.48285E-07	9.09180E-08	13931.9	3.98663E-07	9.09180E-08	13931.9	0	13931.9	0.436414	0.0222570	13931.6	Argon
NO	7.82508*	7.82508	6.22526E-10	4.86163E-10	6.81814E-11	3.91254	2.98966E-10	6.81814E-11	3.91254	0	3.91254	0.000172536	8.79931E-06	3.91243	NO
NO2	2.99536*	2.99536	8.22453E-06	6.42297E-06	9.00782E-07	1.49768	3.94980E-06	9.00782E-07	1.49768	0	1.49768	0.000599019	3.05498E-05	1.49731	NO2
NH3	5.54954*	6.39889	1.08758	0.849348	0.119116	3.19944	0.522307	0.119116	3.19944	0	3.31856	2.41399	0.123113	2.76883	NH3

Process Streams		001	002	003	004	005	006	007	008	009	010	100	101	102	103	Process Streams	
Property	**Units**															**Units**	**Property**
Temperature	℃	85*	49.2778	48.6255	48.6255	48.6254	61.8714	46.4539	48.6254	61.8714	20.0000	52.0985	55.3962	55.3962	46.5841	℃	Temperature
Pressure	bar	1.0017*	1.0017	138*	138	138	1.08857	4.13685*	138	1.08857	4.13685	1.08857	4.48079	4.48079	1.01273	bar	Pressure
Mole Fraction Vapor	%	100	100	0	0	0	100	0	0	100	0	100	0	0	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	28.2797	28.0289	18.0409	18.0409	18.0409	28.0289	18.0409	18.0409	28.0289	18.0153	27.9607	18.2838	18.2838	27.6968	kg/kmol	Molecular Weight
Mass Density	kg/m^3	0.951534	1.04804	990.205	990.205	990.205	1.09602	989.229	990.205	1.09602	997.903	1.12637	986.801	986.801	1.05570	kg/m^3	Mass Density
Molar Flow	kmol/h	82108.4	84170.1	2639.95	2061.68	289.137	42085.0	1267.83	289.137	42085.0	202.180	42374.2	74425.2	3795.66	39969.7	kmol/h	Molar Flow
Mass Flow	kg/h	2.32200E+06*	2.35919E+06	47627.2	37194.6*	5216.31	1.17960E+06	23343.4	5216.31	1.17960E+06	3642.33	1.18481E+06	1.36078E+06	69399.3	1.10703E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	1.94518E+06	1.99403E+06	62541.6	48842.0	6849.79	997013	30035.4	6849.79	997013	4789.73	1.00386E+06	1.76317E+06	89921.0	946899	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	2709.46	2746.70	47.6884	37.2424	5.22302	1373.35	22.9022	5.22302	1373.35	3.64591	1378.57	1362.84	69.5043	1288.07	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.976812	0.968149	0.991141	0.991141	0.991141	0.968149	0.990164	0.991141	0.968149	0.998846	0.965795	0.987734	0.987734	0.956677		Specific Gravity
Mass Enthalpy	kJ/kg	-1269.64	-1497.71	-15735.9	-15735.9	-15735.9	-1484.20	-15756.7	-15735.9	-1484.20	-15885.0	-1546.95	-15515.2	-15515.2	-956.808	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0202531	0.0186674	0.563976	0.563976	0.563977	0.0192098	0.571655	0.563977	0.0192098	1.01302	0.0187686	0.505559	0.505559	0.0187141	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0290	0.0266	0.6342	0.634 2	0.6342	0.0275	0.6317	0.6342	0.0275	0.5991	0.0268	0.6291	0.6291	0.0267	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm			68.1036	68.1036	68.1036		68.5273	68.1036		73.8205		66.5042	66.5042		dyne/cm	Surface Tension

Process Streams		104	105	106	107	108	109	110	111	200	201	202	203	204	Process Streams	
		Lean Amine (Abs. 1)	Cooled Semi-Lean Amine (Abs. 1)	Rich Amine (Abs. 1)	Process Water to Upper Bed (Abs. 1)	Cooled Wash Water to Lower Bed (Abs. 1)	Cooled Wash Water (Abs. 1)	Cooled Wash Water to Upper Bed (Abs. 1)	Combined Wash Water to Upper Bed (Abs. 1)	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 2)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 2)	Lean Amine (Abs. 2)		
Mole Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**	
Oxygen		1.94394E-05	4.09154E-07	0.000198362	9.79466E-09	0.000206160	0.000206160	0.000206160	0.000164930	12.1586	0.000206160	0.000206160	12.8898	1.94394E-05	Oxygen	
Nitrogen		6.14921E-05	8.76929E-07	0.000627346	8.78164E-09	0.000652141	0.000652141	0.000652141	0.000521715	71.1044	0.000652141	0.000652141	75.3812	6.14921E-05	Nitrogen	
Water		82.4057	78.9860	78.6727	99.9151	99.3082	99.3082	99.3082	99.4296	12.2375	99.3082	99.3082	10.2755	82.4057	Water	
Carbon Dioxide		3.24734	6.03129	6.57340	0.0576852	0.170016	0.170016	0.170016	0.147550	3.67490	0.170016	0.170016	0.579779	3.24734	Carbon Dioxide	
Sulfur Dioxide		1.02990E-08	2.93751E-08	9.91719E-08	7.49449E-08	1.02631E-07	1.02631E-07	1.02631E-07	9.70937E-08	9.62505E-06	1.02631E-07	1.02631E-07	1.00913E-05	1.02990E-08	Sulfur Dioxide	
MEA		14.3466	14.9824	14.7528	0.0248384	0.520705	0.520705	0.520705	0.421532	0.000773726	0.520705	0.520705	0.000445242	14.3466	MEA	
Argon		1.38408E-06	2.79491E-08	1.41229E-05	7.87137E-10	1.46786E-05	1.46786E-05	1.46786E-05	1.17430E-05	0.823027	1.46786E-05	1.46786E-05	0.872522	1.38408E-06	Argon	
NO		7.28504E-10	2.52085E-11	7.43319E-09	7.85873E-13	7.72594E-09	7.72594E-09	7.72594E-09	6.18091E-09	0.000307715	7.72594E-09	7.72594E-09	0.000326217	7.28504E-10	NO	
NO2		1.70581E-09	3.03185E-10	1.68366E-08	6.77183E-09	1.74949E-08	1.74949E-08	1.74949E-08	1.53503E-08	7.68261E-05	1.74949E-08	1.74949E-08	8.14275E-05	1.70581E-09	NO2	
NH3		0.000208783	0.000276320	0.000292817	0.00241901	0.000190453	0.000190453	0.000190453	0.000636165	0.000459854	0.000190453	0.000190453	0.000406759	0.000208783	NH3	
Molar Flow		kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**	
Oxygen		0.00782516	3.92876E-05	0.0967313	2.93840E-08	0.150961	0.153435	0.002474	0.002474	5152.09	0.153435	0.00782513	5152.00	0.00782516	Oxygen	
Nitrogen		0.0247531	8.42039E-05	0.305926	2.63449E-08	0.477532	0.485357	0.007826	0.007826	30129.9	0.485357	0.0247531	30129.6	0.0247531	Nitrogen	
Water		33171.7	7584.34	38364.9	299.745	72718.6	73910.3	1191.7	1491.4	5185.54	73910.3	3769.41	4107.09	33171.7	Water	
Carbon Dioxide		1307.19	579.132	3205.53	0.173055	124.495	126.535	2.040	2.213	1557.21	126.535	6.45324	231.736	1307.19	Carbon Dioxide	
Sulfur Dioxide		4.14578E-06	2.82064E-06	4.83613E-05	2.24835E-07	7.51517E-05	7.63833E-05	1.23157E-06	1.45641E-06	0.00407854	7.63833E-05	3.89553E-06	0.00403347	4.14578E-06	Sulfur Dioxide	
MEA		5775.12	1438.63	7194.21	0.0745151	381.287	387.536	6.248	6.323	0.327860	387.536	19.7642	0.177962	5775.12	MEA	
Argon		0.000557152	2.68371E-06	0.00688705	2.36141E-09	0.0107484	0.0109246	0.0001761	0.0001761	348.751	0.0109246	0.000557149	348.744	0.000557152	Argon	
NO		2.93253E-07	2.42055E-09	3.62481E-06	2.35762E-12	5.65733E-06	5.75004E-06	9.27112E-08	9.27136E-08	0.130392	5.75004E-06	2.93251E-07	0.130388	2.93253E-07	NO	
NO2		6.86659E-07	2.91122E-08	8.21040E-06	2.03155E-08	1.28107E-05	1.30206E-05	2.09939E-07	2.30254E-07	0.0325544	1.30206E-05	6.64047E-07	0.0325463	6.86659E-07	NO2	
NH3		0.0840440	0.0265326	0.142793	0.00725703	0.139460	0.141745	0.002285	0.009542	0.194860	0.141745	0.00722897	0.162580	0.0840440	NH3	
Mass Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**	
Oxygen		2.48435E-05	5.02866E-07	0.000243400	1.73726E-08	0.000360803	0.000360803	0.000360803	0.000289415	13.9145	0.000360803	0.000360803	14.8919	2.48435E-05	Oxygen	
Nitrogen		6.87990E-05	9.43543E-07	0.000673911	1.36358E-08	0.000999173	0.000999173	0.000999173	0.000801470	71.2383	0.000999173	0.000999173	76.2430	6.87990E-05	Nitrogen	
Water		59.2919	54.6541	54.3494	99.7729	97.8496	97.8496	97.8496	98.2302	7.88470	97.8496	97.8496	6.68368	59.2919	Water	
Carbon Dioxide		5.70783	10.1950	11.0934	0.140718	0.409232	0.409232	0.409232	0.356101	5.78420	0.409232	0.409232	0.921255	5.70783	Carbon Dioxide	
Sulfur Dioxide		2.63515E-08	7.22810E-08	2.43630E-07	2.66131E-07	3.59604E-07	3.59604E-07	3.59604E-07	3.41108E-07	2.20530E-05	3.59604E-07	3.59604E-07	2.33417E-05	2.63515E-08	Sulfur Dioxide	
MEA		35	35.1507	34.5560	0.0840978	1.73959	1.73959	1.73959	1.41202	0.00169028	1.73959	1.73959	0.000981947	35	MEA	
Argon		2.20828E-06	4.28838E-08	2.16346E-05	1.74295E-09	3.20709E-05	3.20709E-05	3.20709E-05	2.57254E-05	1.17587	3.20709E-05	3.20709E-05	1.25847	2.20828E-06	Argon	
NO		8.73049E-10	2.90528E-11	8.55292E-09	1.30708E-12	1.26793E-08	1.26793E-08	1.26793E-08	1.01707E-08	0.000330224	1.26793E-08	1.26793E-08	0.000353417	8.73049E-10	NO	
NO2		3.13428E-09	5.35733E-10	2.97026E-08	1.72686E-08	4.40204E-08	4.40204E-08	4.40204E-08	3.87270E-08	0.000126407	4.40204E-08	4.40204E-08	0.000135255	3.13428E-09	NO2	
NH3		0.000142011	0.000180747	0.000191229	0.00228353	0.000177398	0.000177398	0.000177398	0.000594136	0.000280091	0.000177398	0.000177398	0.000250113	0.000142011	NH3	
Mass Flow		kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**	
Oxygen		0.250396	0.00125715	3.09529	9.40252E-07	4.83056	4.90972	0.07916	0.07916	164861	4.90972	0.250395	164858	0.250396	Oxygen	
Nitrogen		0.693419	0.00235884	8.57003	7.38010E-07	13.3773	13.5965	0.2192	0.2192	844041	13.5965	0.693419	844032	0.693419	Nitrogen	
Water		597598	136634	691154	5399.99	1.31005E+06	1.33152E+06	2.14688E+04	2.68688E+04	93419.0	1.33152E+06	67906.9	73990.3	597598	Water	
Carbon Dioxide		57528.8	25487.3	141074	7.61609	5478.95	5568.73	89.79	97.40	68532.0	5568.73	284.004	10198.6	57528.8	Carbon Dioxide	
Sulfur Dioxide		0.000265594	0.000180701	0.00309821	1.44038E-05	0.00481450	0.00489340	0.00007890	0.00009330	0.261286	0.00489340	0.000249562	0.258399	0.000265594	Sulfur Dioxide	
MEA		352762	87875.9	439444	4.55161	23290.2	23671.9	381.7	386.2	20.0267	23671.9	1207.26	10.8704	352762	MEA	
Argon		0.0222571	0.000107209	0.275124	9.43337E-08	0.429377	0.436414	0.007037	0.007037	13931.9	0.436414	0.0222570	13931.6	0.0222571	Argon	
NO		8.79939E-06	7.26314E-08	0.000108766	7.07429E-11	0.000169754	0.000172536	0.000002782	0.000002782	3.91254	0.000172536	8.79931E-06	3.91243	8.79939E-06	NO	
NO2		3.15901E-05	1.33932E-06	0.000377724	9.34624E-07	0.000589361	0.000599019	0.000009658	0.000010593	1.49768	0.000599019	3.05498E-05	1.49731	3.15901E-05	NO2	
NH3		1.43131	0.451864	2.43183	0.123591	2.37507	2.41399	0.03892	0.16251	3.31856	2.41399	0.123113	2.76883	1.43131	NH3	
Process Streams		**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**200**	**201**	**202**	**203**	**204**	**Process Streams**	
Property	**Units**														**Units**	**Property**
Temperature	℃	58.4696	61.211	55.3047	46.4540	26	26.0000	26	30.1718	52.0985	55.3962	55.3962	46.5841	58.4696	℃	Temperature
Pressure	bar	3.68912	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	1.08857	4.48079	4.48079	1.01273	3.68912	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	100	0	0	100	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	25.0382	26.0357	26.0778	18.0409	18.2838	18.2838	18.2838	18.2353	27.9607	18.2838	18.2838	27.6968	25.0382	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1085.91	1142.18	1151.43	989.229	998.34	998.340	998.34	996.640	1.12637	986.801	986.801	1.05570	1085.91	kg/m^3	Mass Density
Molar Flow	kmol/h	40254.2	9602.13	48765.2	300	73225.2	74425.2	1200.0	1500.0	42374.2	74425.2	3795.66	39969.7	40254.2	kmol/h	Molar Flow
Mass Flow	kg/h	1.00789E+06	249998	1.27169E+06	5412.28	1.33884E+06	1.36078E+06	2.19406E+04	2.73529E+04	1.18481E+06	1.36078E+06	69399.3	1.10703E+06	1.00789E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	953639	227479	1.15527E+06	7107.13	1.73474E+06	1.76317E+06	2.84285E+04	3.55357E+04	1.00386E+06	1.76317E+06	89921.0	946899	953639	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	1014.05	253.949	1294.42	5.41924	1340.86	1362.84	21.97	27.39	1378.57	1362.84	69.5043	1288.07	1014.05	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.08694	1.14325	1.15252	0.990164	0.999284	0.999284	0.999284	0.997582	0.965795	0.987734	0.987734	0.956677	1.08694		Specific Gravity
Mass Enthalpy	kJ/kg	-11392.3	-11136.3	-11178.5	-15756.7	-15637.2	-15637.2	-15637.2	-15660.9	-1546.95	-15515.2	-15515.2	-956.808	-11392.3	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	1.57094	2.04854	2.46135	0.571653	0.909174	0.909174	0.909174	0.818804	0.0187686	0.505559	0.505559	0.0187141	1.57094	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.4195	0.38822	0.3823	0.6317	0.5949	0.5949	0.5949	0.6026	0.0268	0.6291	0.6291	0.0267	0.4195	W/(m*℃)	Thermal Conduct ivity
Surface Tension	dyne/cm	58.7098	92.6636	95.4097	68.5273	72.1981?	72.1981	72.1981?	71.2709?		66.5042	66.5042		58.7098	dyne/cm	Surface Tension

Process Streams		205	206	207	208	209	210	211	300	302	303	304	305	306	307	Process Streams	
		Cooled Semi-Lean Amine (Abs. 2)	Rich Amine (Abs. 2)	Process Water to Upper Bed (Abs. 2)	Cooled Wash Water to Lower Bed (Abs. 2)	Cooled Wash Water (Abs. 2)	Cooled Wash Water to Upper Bed (Abs. 2)	Combined Wash Water to Upper Bed (Abs. 2)	Combined Cold Rich Amine	Hot Rich Amine	Stripper Bottoms to E-108 Inlet	Rich Amine to E-103	Lean Amine	Filtered Lean Amine	Fresh Amine		
Mole Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**	
Oxygen		4.09154E-07	0.000198362	9.79466E-09	0.000206160	0.000206160	0.000206160	0.000164930	0.000198362	0.000198362	0	0.000198362	1.94394E-05	1.94394E-05	0	Oxygen	
Nitrogen		8.76929E-07	0.000627346	8.78164E-09	0.000652141	0.000652141	0.000652141	0.000521715	0.000627346	0.000627346	0	0.000627346	6.14921E-05	6.14921E-05	0	Nitrogen	
Water		78.9860	78.6727	99.9151	99.3082	99.3082	99.3082	99.4296	78.6727	78.6727	80.4612	78.6727	82.4057	82.4057	0	Water	
Carbon Dioxide		6.03129	6.57340	0.0576852	0.170016	0.170016	0.170016	0.147550	6.57340	6.57340	3.60148	6.57340	3.24734	3.24734	0	Carbon Dioxide	
Sulfur Dioxide		2.93751E-08	9.91719E-08	7.49449E-08	1.02631E-07	1.02631E-07	1.02631E-07	9.70937E-08	9.91719E-08	9.91719E-08	0	9.91719E-08	1.02990E-08	1.02990E-08	0	Sulfur Dioxide	
MEA		14.9824	14.7528	0.0248384	0.520705	0.520705	0.520705	0.421532	14.7528	14.7528	15.9371	14.7528	14.3466	14.3466	100	MEA	
Argon		2.79491E-08	1.41229E-05	7.87137E-10	1.46786E-05	1.46786E-05	1.46786E-05	1.17430E-05	1.41229E-05	1.41229E-05	0	1.41229E-05	1.38408E-06	1.38408E-06	0	Argon	
NO		2.52085E-11	7.43319E-09	7.85873E-13	7.72594E-09	7.72594E-09	7.72594E-09	6.18091E-09	7.43319E-09	7.43319E-09	0	7.43319E-09	7.28504E-10	7.28504E-10	0	NO	
NO2		3.03185E-10	1.68366E-08	6.77183E-09	1.74949E-08	1.74949E-08	1.74949E-08	1.53503E-08	1.68366E-08	1.68366E-08	0	1.68366E-08	1.70581E-09	1.70581E-09	0	NO2	
NH3		0.000276320	0.000292817	0.00241901	0.000190453	0.000190453	0.000190453	0.000636165	0.000292817	0.000292817	0.000190351	0.000292817	0.000208783	0.000208783	0	NH3	
Molar Flow		kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**	
Oxygen		3.92876E-05	0.0967313	2.93840E-08	0.150961	0.153435	0.002474	0.002474	0.193463	0.154770	0	0.0386925	0.0125203	0.00313006	0	Oxygen	
Nitrogen		8.42039E-05	0.305926	2.63449E-08	0.477532	0.485357	0.007826	0.007826	0.611852	0.489482	0	0.122370	0.0396050	0.00990125	0	Nitrogen	
Water		7584.34	38364.9	299.745	72718.6	73910.3	1191.7	1491.4	76729.7	61383.8	58111.3	15345.9	53074.8	13268.7	0	Water	
Carbon Dioxide		579.132	3205.53	0.173055	124.495	126.535	2.040	2.213	6411.06	5128.85	2601.09	1282.21	2091.50	522.876	0	Carbon Dioxide	
Sulfur Dioxide		2.82064E-06	4.83613E-05	2.24835E-07	7.51517E-05	7.63833E-05	1.23157E-06	1.45641E-06	9.67227E-05	7.73781E-05	0	1.93445E-05	6.63324E-06	1.65831E-06	0	Sulfur Dioxide	
MEA		1438.63	7194.21	0.0745151	381.287	387.536	6.248	6.323	14388.4	11510.7	11510.2	2877.68	9240.19	2310.05	0.353151	MEA	
Argon		2.68371E-06	0.00688705	2.36141E-09	0.0107484	0.0109246	0.0001761	0.0001761	0.0137741	0.0110193	0	0.00275482	0.000891443	0.000222861	0	Argon	
NO		2.42055E-09	3.62481E-06	2.35762E-12	5.65733E-06	5.75004E-06	9.27112E-08	9.27136E-08	7.24961E-06	5.79969E-06	0	1.44992E-06	4.69205E-07	1.17301E-07	0	NO	
NO2		2.91122E-08	8.21040E-06	2.03155E-08	1.28107E-05	1.30206E-05	2.09939E-07	2.30254E-07	1.64208E-05	1.31366E-05	0	3.28416E-06	1.09866E-06	2.74664E-07	0	NO2	
NH3		0.0265326	0.142793	0.00725703	0.139460	0.141745	0.002285	0.009542	0.285585	0.228468	0.137477	0.0571171	0.134470	0.0336176	0	NH3	
Mass Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**	
Oxygen		5.02866E-07	0.000243400	1.73726E-08	0.000360803	0.000360803	0.000360803	0.000289415	0.000243400	0.000243400	0	0.000243400	2.48435E-05	2.48435E-05	0	Oxygen	
Nitrogen		9.43543E-07	0.000673911	1.36358E-08	0.000999173	0.000999173	0.000999173	0.000801470	0.000673911	0.000673911	0	0.000673911	6.87990E-05	6.87990E-05	0	Nitrogen	
Water		54.6541	54.3494	99.7729	97.8496	97.8496	97.8496	98.2302	54.3494	54.3494	56.1503	54.3494	59.2919	59.2919	0	Water	
Carbon Dioxide		10.1950	11.0934	0.140718	0.409232	0.409232	0.409232	0.356101	11.0934	11.0934	6.13977	11.0934	5.70783	5.70783	0	Carbon Dioxide	
Sulfur Dioxide		7.22810E-08	2.43630E-07	2.66131E-07	3.59604E-07	3.59604E-07	3.59604E-07	3.41108E-07	2.43630E-07	2.43630E-07	0	2.43630E-07	2.63515E-08	2.63515E-08	0	Sulfur Dioxide	
MEA		35.1507	34.5560	0.0840978	1.73959	1.73959	1.73959	1.41202	34.5560	34.5560	37.7098	34.5560	35	35	100	MEA	
Argon		4.28838E-08	2.16346E-05	1.74295E-09	3.20709E-05	3.20709E-05	3.20709E-05	2.57254E-05	2.16346E-05	2.16346E-05	0	2.16346E-05	2.20828E-06	2.20828E-06	0	Argon	
NO		2.90528E-11	8.55292E-09	1.30708E-12	1.26793E-08	1.26793E-08	1.26793E-08	1.01707E-08	8.55292E-09	8.55292E-09	0	8.55292E-09	8.73049E-10	8.73049E-10	0	NO	
NO2		5.35733E-10	2.97026E-08	1.72686E-08	4.40204E-08	4.40204E-08	4.40204E-08	3.87270E-08	2.97026E-08	2.97026E-08	0	2.97026E-08	3.13428E-09	3.13428E-09	0	NO2	
NH3		0.000180747	0.000191229	0.00228353	0.000177398	0.000177398	0.000177398	0.000594136	0.000191229	0.000191229	0.000125576	0.000191229	0.000142011	0.000142011	0	NH3	
Mass Flow		kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**	
Oxygen		0.00125715	3.09529	9.40252E-07	4.83056	4.90972	0.07916	0.07916	6.19057	4.95246	0	1.23811	0.400633	0.100158	0	Oxygen	
Nitrogen		0.00235884	8.57003	7.38010E-07	13.3773	13.5965	0.2192	0.2192	17.1401	13.7120	0	3.42801	1.10947	0.277368	0	Nitrogen	
Water		136634	691154	5399.99	1.31005E+06	1.33152E+06	2.14688E+04	2.68688E+04	1.38231E+06	1.10585E+06	1.04689E+06	276462	956157	239039	0	Water	
Carbon Dioxide		25487.3	141074	7.61609	5478.95	5568.73	89.79	97.40	282147	225718	114473	56429.5	92046.0	23011.5	0	Carbon Dioxide	
Sulfur Dioxide		0.000180701	0.00309821	1.44038E-05	0.00481450	0.00489340	0.00007890	0.00009330	0.00619642	0.00495714	0	0.00123928	0.000424951	0.000106238	0	Sulfur Dioxide	
MEA		87875.9	439444	4.55161	23290.2	23671.9	381.7	386.2	878889	703111	703078	175778	564419	141105	21.5716	MEA	
Argon		0.000107209	0.275124	9.43337E-08	0.429377	0.436414	0.007037	0.007037	0.550248	0.440198	0	0.110050	0.0356114	0.00890284	0	Argon	
NO		7.26314E-08	0.000108766	7.07429E-11	0.000169754	0.000172536	0.000002782	0.000002782	0.000217533	0.000174026	0	4.35065E-05	1.40790E-05	3.51975E-06	0	NO	
NO2		1.33932E-06	0.000377724	9.34624E-07	0.000589361	0.000599019	0.000009658	0.000010593	0.000755447	0.000604358	0	0.000151089	5.05442E-05	1.26360E-05	0	NO2	
NH3		0.451864	2.43183	0.123591	2.37507	2.41399	0.03892	0.16251	4.86367	3.89094	2.34130	0.972734	2.29010	0.572525	0	NH3	
Process Streams		**205**	**206**	**207**	**208**	**209**	**210**	**211**	**300**	**302**	**303**	**304**	**305**	**306**	**307**	**Process Streams**	
Property	**Units**															**Units**	**Property**
Temperature	℃	61.211	55.3047	46.4540	26	26.0000	26	30.1718	55.4506	117*	126.486	55.4506	58.4696	58.4696	20.0000	℃	Temperature
Pressure	bar	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	10.7412	9.70702	5.41280	10.7412	3.68912	3.68912	4.13685	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0357	26.0778	18.0409	18.2838	18.2838	18.2838	18.2353	26.0778	26.0778	25.8152	26.0778	25.0382	25.0382	61.0831	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1142.18	1151.43	989.229	998.34	998.340	998.34	996.640	1151.50	1132.22	1067.22	1151.50	1085.91	1085.91	1021.42	kg/m^3	Mass Density
Molar Flow	kmol/h	9602.13	48765.2	300	73225.2	74425.2	1200.0	1500.0	97530.3	78024.3	72222.7	19506.1	64406.7	16101.7	0.353151	kmol/h	Molar Flow
Mass Flow	kg/h	249998	1.27169E+06	5412.28	1.33884E+06	1.36078E+06	2.19406E+04	2.73529E+04	2.54337E+06	2.03470E+06	1.86444E+06	508675	1.61263E+06	403157	21.5716	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	227479	1.15527E+06	7107.13	1.73474E+06	1.76317E+06	2.84285E+04	3.55357E+04	2.31054E+06	1.84843E+06	1.71099E+06	462107	1.52582E+06	381456	8.36631	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	253.949	1294.42	5.41924	1340.86	1362.84	21.97	27.39	2588.84	2071.07	1876.54	517.768	1622.48	405.621	0.0211464	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.14325	1.15252	0.990164	0.999284	0.999284	0.999284	0.997582	1.15259	1.13329	1.06823	1.15259	1.08694	1.08694	1.02239		Specific Gravity
Mass Enthalpy	kJ/kg	-11136.3	-11178.5	-15756.7	-15637.2	-15637.2	-15637.2	-15660.9	-11177.3	-10956.3	-10807.4	-11177.3	-11392.3	-11392.3	-4445.34	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	2.04854	2.46135	0.571653	0.909174	0.909174	0.909174	0.818804	2.45591	0.689788	0.518855	2.45591	1.57094	1.57094	26.8174	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3882	0.3823	0.6317	0.5949	0.5949	0.5949	0.6026	0.3823	0.3946	0.4151	0.3823	0.4195	0.4195	0.2355	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm	92.6636	95.4097	68.5273	72.1981?	72.1981	72.1981?	71.2709?	92.8998	87.0839	46.5956	92.8998	58.7098	58.7098	48.9361	dyne/cm	Surface Tension

Process Streams	309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	325	330	Process Streams
	Rich Amine to E-107	Rich Amine to E-109	Rich Amine to V-101	Flash Gas	Hot Semi-Lean Amine	Stripper Bottoms	Stripper Bottoms to E-107	Reclaimer Feed	Reclaimer Product	Stripper Reboiler Inlet	Stripper Reboiler Discharge	Stripper Overhead	Stripper Reflux	Reflux Purge	Cooled Stripper Overhead	Stripper Overhead Liquid	Hot Semi-Lean Amine	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0.000198362	0.000198362	0.000198362	0.0127944	4.09154E-07	0	0	0	0	0	0	0.00285148	2.12922E-07	2.12922E-07	0.00285148	2.12922E-07	4.09154E-07	Oxygen
Nitrogen	0.000627346	0.000627346	0.000627346	0.0404907	8.76928E-07	0	0	0	0	0	0	0.00901936	3.57631E-07	3.57631E-07	0.00901936	3.57631E-07	8.76928E-07	Nitrogen
Water	78.6727	78.6727	78.6727	58.7343	78.9860	80.4612	80.4612	80.4612	95.7155	80.4612	80.4612	60.8657	99.8812	99.8812	60.8657	99.8812	78.9860	Water
Carbon Dioxide	6.57340	6.57340	6.57340	41.0691	6.03129	3.60148	3.60148	3.60148	4.28427	3.60148	3.60148	39.1048	0.0887872	0.0887872	39.1048	0.0887872	6.03129	Carbon Dioxide
Sulfur Dioxide	9.91719E-08	9.91719E-08	9.91719E-08	4.54047E-06	2.93751E-08	0	0	0	0	0	0	1.34698E-06	6.82892E-08	6.82892E-08	1.34698E-06	6.82892E-08	2.93751E-08	Sulfur Dioxide
MEA	14.7528	14.7528	14.7528	0.141059	14.9824	15.9371	15.9371	15.9371	0	15.9371	15.9371	0.0158995	0.0273178	0.0273178	0.0158995	0.0273178	14.9824	MEA
Argon	1.41229E-05	1.41229E-05	1.41229E-05	0.000911010	2.79490E-08	0	0	0	0	0	0	0.000203022	1.60848E-08	1.60848E-08	0.000203022	1.60848E-08	2.79490E-08	Argon
NO	7.43319E-09	7.43319E-09	7.43319E-09	4.78816E-07	2.52085E-11	0	0	0	0	0	0	1.06825E-07	1.17871E-11	1.17871E-11	1.06825E-07	1.17871E-11	2.52085E-11	NO
NO2	1.68366E-08	1.68366E-08	1.68366E-08	1.06889E-06	3.03185E-10	0	0	0	0	0	0	2.41283E-07	2.54548E-10	2.54548E-10	2.41283E-07	2.54548E-10	3.03185E-10	NO2
NH3	0.000292817	0.000292817	0.000292817	0.00134263	0.000276319	0.000190351	0.000190351	0.000190351	0.000226439	0.000190351	0.000190351	0.00155578	0.00266401	0.00266401	0.00155578	0.00266401	0.000276319	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0.0386925	0.0386925	0.0386925	0.0386140	7.85750E-05	0	0	0	0	0	0	0.193385	8.40445E-07	7.56401E-06	0.193385	8.40445E-06	7.85750E-05	Oxygen
Nitrogen	0.122370	0.122370	0.122370	0.122202	0.000168408	0	0	0	0	0	0	0.611685	1.41164E-06	1.27047E-05	0.611685	1.41164E-05	0.000168408	Nitrogen
Water	15345.9	15345.9	15345.9	177.262	15168.7	58111.3	58111.3	0	0	38740.8	38740.8	4127.86	394.250	3548.25	4127.86	3942.50	15168.7	Water
Carbon Dioxide	1282.21	1282.21	1282.21	123.948	1158.26	2601.09	2601.09	0	0	1734.06	1734.06	2652.06	0.350460	3.15414	2652.06	3.50460	1158.26	Carbon Dioxide
Sulfur Dioxide	1.93445E-05	1.93445E-05	1.93445E-05	1.37033E-05	5.64127E-06	0	0	0	0	0	0	9.13509E-05	2.69550E-07	2.42595E-06	9.13509E-05	2.69550E-06	5.64127E-06	Sulfur Dioxide
MEA	2877.68	2877.68	2877.68	0.425719	2877.26	11510.2	11510.2	0	0	7673.46	7673.46	1.07829	0.107829	0.970458	1.07829	1.07829	2877.26	MEA
Argon	0.00275482	0.00275482	0.00275482	0.00274945	5.36741E-06	0	0	0	0	0	0	0.0137688	6.34897E-08	5.71407E-07	0.0137688	6.34897E-07	5.36741E-06	Argon
NO	1.44992E-06	1.44992E-06	1.44992E-06	1.44508E-06	4.84110E-09	0	0	0	0	0	0	7.24482E-06	4.65258E-11	4.18732E-10	7.24482E-06	4.65258E-10	4.84110E-09	NO
NO2	3.28416E-06	3.28416E-06	3.28416E-06	3.22594E-06	5.82243E-08	0	0	0	0	0	0	1.63636E-05	1.00475E-09	9.04274E-09	1.63636E-05	1.00475E-08	5.82243E-08	NO2
NH3	0.0571171	0.0571171	0.0571171	0.00405210	0.0530650	0.137477	0.137477	0	0	0.0916512	0.0916512	0.105512	0.0105153	0.0946380	0.105512	0.105153	0.0530650	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0.000243400	0.000243400	0.000243400	0.0142364	5.02866E-07	0	0	0	0	0	0	0.00323692	3.77464E-07	3.77464E-07	0.00323692	3.77464E-07	5.02866E-07	Oxygen
Nitrogen	0.000673911	0.000673911	0.000673911	0.0394428	9.43542E-07	0	0	0	0	0	0	0.00896335	5.55037E-07	5.55037E-07	0.00896335	5.55037E-07	9.43542E-07	Nitrogen
Water	54.3494	54.3494	54.3494	36.7942	54.6541	56.1503	56.1503	56.1503	90.1431	56.1503	56.1503	38.8993	99.6886	99.6886	38.8993	99.6886	54.6541	Water
Carbon Dioxide	11.0934	11.0934	11.0934	62.8504	10.1950	6.13977	6.13977	6.13977	9.85672	6.13977	6.13977	61.0528	0.216480	0.216480	61.0528	0.216480	10.1950	Carbon Dioxide
Sulfur Dioxide	2.43630E-07	2.43630E-07	2.43630E-07	1.01149E-05	7.22809E-08	0	0	0	0	0	0	3.06127E-06	2.42373E-07	2.42373E-07	3.06127E-06	2.42373E-07	7.22809E-08	Sulfur Dioxide
MEA	34.5560	34.5560	34.5560	0.299618	35.1507	37.7098	37.7098	37.7098	0	37.7098	37.7098	0.0344534	0.0924459	0.0924459	0.0344534	0.0924459	35.1507	MEA
Argon	2.16346E-05	2.16346E-05	2.16346E-05	0.00126551	4.28838E-08	0	0	0	0	0	0	0.000287718	3.55984E-08	3.55984E-08	0.000287718	3.55984E-08	4.28838E-08	Argon
NO	8.55292E-09	8.55292E-09	8.55292E-09	4.99603E-07	2.90528E-11	0	0	0	0	0	0	1.13714E-07	1.95946E-11	1.95946E-11	1.13714E-07	1.95946E-11	2.90528E-11	NO
NO2	2.97026E-08	2.97026E-08	2.97026E-08	1.70997E-06	5.35733E-10	0	0	0	0	0	0	3.93790E-07	6.48784E-10	6.48784E-10	3.93790E-07	6.48784E-10	5.35733E-10	NO2
NH3	0.000191229	0.000191229	0.000191229	0.000795118	0.000180747	0.000125576	0.000125576	0.000125576	0.000201599	0.000125576	0.000125576	0.000939952	0.00251353	0.00251353	0.000939952	0.00251353	0.000180747	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	1.23811	1.23811	1.23811	1.23560	0.00251431	0	0	0	0	0	0	6.18808	2.68932E-05	0.000242039	6.18808	0.000268932	0.00251431	Oxygen
Nitrogen	3.42801	3.42801	3.42801	3.42329	0.00471767	0	0	0	0	0	0	17.1354	3.95448E-05	0.000355903	17.1354	0.000395448	0.00471767	Nitrogen
Water	276462	276462	276462	3193.42	273268	1.04689E+06	1.04689E+06	0	0	697927	697927	74364.5	7102.53	63922.7	74364.5	71025.3	273268	Water
Carbon Dioxide	56429.5	56429.5	56429.5	5454.87	50974.6	114473	114473	0	0	76315.1	76315.1	116716	15.4236	138.812	116716	154.236	50974.6	Carbon Dioxide
Sulfur Dioxide	0.00123928	0.00123928	0.00123928	0.000877883	0.000361401	0	0	0	0	0	0	0.00585229	1.72684E-05	0.000155416	0.00585229	0.000172684	0.000361401	Sulfur Dioxide
MEA	175778	175778	175778	26.0042	175752	703078	703078	0	0	468719	468719	65.8652	6.58650	59.2785	65.8652	65.8650	175752	MEA
Argon	0.110050	0.110050	0.110050	0.109835	0.000214417	0	0	0	0	0	0	0.550036	2.53629E-06	2.28266E-05	0.550036	2.53629E-05	0.000214417	Argon
NO	4.35065E-05	4.35065E-05	4.35065E-05	4.33612E-05	1.45263E-07	0	0	0	0	0	0	0.000217389	1.39606E-09	1.25645E-08	0.000217389	1.39606E-08	1.45263E-07	NO
NO2	0.000151089	0.000151089	0.000151089	0.000148411	2.67864E-06	0	0	0	0	0	0	0.000752815	4.62240E-08	4.16016E-07	0.000752815	4.62240E-07	2.67864E-06	NO2
NH3	0.972734	0.972734	0.972734	0.0690093	0.903725	2.34130	2.34130	0	0	1.56087	1.56087	1.79692	0.179082	1.61173	1.79692	1.79082	0.903725	NH3

Process Streams		309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	325	330	Process Streams	
Property	**Units**																		**Units**	**Property**
Temperature	℃	108*	112.778*	121.600	113.998	114.052	127.675	127.743			127.675	130.233	105.163	48.7488	48.7488	48.8889*	48.6928	113.998	℃	Temperature
Pressure	bar	9.70702	8.67281	7.63859	2.39982*	5.84719	2.31016	6.10228	6.10228	6.10228	2.31016	2.31016	1.96543	5.24044	5.24044	1.82753	1.79306	2.39982	bar	Pressure
Mole Fraction Vapor	%	0	0	0	100	0	0	0			0	19.5697	100	0	0	41.7716	0	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0778	26.0778	26.0778	28.7576	26.0356	25.8152	25.8152	25.8152	19.1289	25.8152	25.8152	28.1884	18.0501	18.0501	28.1884	18.0501	26.0356	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1135.90	1133.97	1130.21	2.16808	1124.28	1066.45	1066.47			1066.45	9.16267	1.77910	988.425	988.425	4.63637	988.400	1124.26	kg/m^3	Mass Density
Molar Flow	kmol/h	19506.1	19506.1	19506.1	301.803	19204.3	72222.7	72222.7	0	0	48148.5	48148.5	6781.92	394.719	3552.47	6781.92	3947.19	19204.3	kmol/h	Molar Flow
Mass Flow	kg/h	508675	508675	508675	8679.13	499995	1.86444E+06	1.86444E+06	0	0	1.24296E+06	1.24296E+06	191172	7124.72	64122.4	191172	71247.2	499995	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	462107	462107	462107	7149.84	454957	1.71099E+06	1.71099E+06	0	0	1.14066E+06	1.14066E+06	160667	9351.07	84159.6	160667	93510.7	454957	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	517.768	517.768	517.768	9.86999	507.898	1876.54	1876.54	0	0	1251.03	1251.03	216.657	7.13504	64.2154	216.657	71.3504	507.898	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.13698	1.13504	1.13128	0.993321	1.12535	1.06746	1.06748			1.06746		0.973661	0.989359	0.989359		0.989334	1.12533		Specific Gravity
Mass Enthalpy	kJ/kg	-10990.6	-10972.6	-10938.6	-10460.2	-10946.4	-10803.0	-10802.4	-10802.4		-10803.0	-10482.4	-10582.7	-15741.1	-15741.1	-11540.8	-15741.6	-10946.9	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.795626	0.736343	0.643765	0.0170095	0.705187	0.510247	0.510228			0.510247		0.0165147	0.548094	0.548094		0.548241	0.705264	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3942	0.3945	0.3946	0.0247	0.3982	0.4149	0.4149			0.4149		0.0240	0.6334	0.6334		0.6334	0.3982	W/(m*℃)	Thermal Cond uctivity
Surface Tension	dyne/cm	88.2489	87.8920	86.9700		86.8515	46.3922	46.3737			46.3922			68.0573	68.0573		68.0682	87.6418	dyne/cm	Surface Tension

Process Streams	332	333	334	400	401	402	403	404	405	406	407	408	409	410	411	Process Streams
	Cold Rich Amine to Lean / Rich Exchanger	Process Water to Absorbers	Lean Amine to E-102 Inlet	CO2	1st Stage Suction	Hot 1st Stage Discharge	Cooled 1st Stage Discharge	Cold 1st Stage Discharge	2nd Stage Suction	Hot 2nd Stage Discharge	Cooled 2nd Stage Discharge	Cold 2nd Stage Discharge	Dryer Inlet	3rd Stage Suction	Hot 3rd Stage Discharge	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	0.000198362	9.79466E-09*	0	0.00682169	0.00682175	0.00682175	0.00682175	0.00682175	0.00725176	0.00725176	0.00725176	0.00725176	0.00728635	0.00729932	0.00729932	Oxygen
Nitrogen	0.000627346	8.78164E-09*	0	0.0215778	0.0215779	0.0215779	0.0215779	0.0215779	0.0229382	0.0229382	0.0229382	0.0229382	0.0230476	0.0230887	0.0230887	Nitrogen
Water	78.6727	99.9151*	80.4612	6.53882	6.53804	6.53804	6.53804	6.53804	0.658039	0.658039	0.658039	0.658039	0.188670	0.0110001	0.0110001	Water
Carbon Dioxide	6.57340	0.0576852*	3.60148	93.4323	93.4331	93.4331	93.4331	93.4331	99.3112	99.3112	99.3112	99.3112	99.7805	99.9581	99.9581	Carbon Dioxide
Sulfur Dioxide	9.91719E-08	7.49449E-08*	0	3.12747E-06	3.12750E-06	3.12750E-06	3.12750E-06	3.12750E-06	3.30779E-06	3.30779E-06	3.30779E-06	3.30779E-06	3.31803E-06	3.32393E-06	3.32393E-06	Sulfur Dioxide
MEA	14.7528	0.0248384*	15.9371	8.41497E-08	8.41229E-08	8.41229E-08	8.41229E-08	8.41229E-08	2.97760E-09	2.97760E-09	2.97760E-09	2.97760E-09	4.80323E-10	4.81178E-10	4.81178E-10	MEA
Argon	1.41229E-05	7.87137E-10*	0	0.000485696	0.000485700	0.000485700	0.000485700	0.000485700	0.000516316	0.000516316	0.000516316	0.000516316	0.000518779	0.000519702	0.000519702	Argon
NO	7.43319E-09	7.85873E-13*	0	2.55557E-07	2.55559E-07	2.55559E-07	2.55559E-07	2.55559E-07	2.71668E-07	2.71668E-07	2.71668E-07	2.71668E-07	2.72963E-07	2.73449E-07	2.73449E-07	NO
NO2	1.68366E-08	6.77183E-09*	0	5.76900E-07	5.76904E-07	5.76904E-07	5.76904E-07	5.76904E-07	5.93889E-07	5.93889E-07	5.93889E-07	5.93889E-07	5.90605E-07	5.91656E-07	5.91656E-07	NO2
NH3	0.000292817	0.00241901*	0.000190351	1.26484E-05	1.26484E-05	1.26484E-05	1.26484E-05	1.26484E-05	9.48676E-06	9.48676E-06	9.48676E-06	9.48676E-06	8.41952E-06	8.43450E-06	8.43450E-06	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	0.154770	6.79663E-08*	0	0.193376	0.193376	0.193376	0.193376	0.193376	0.193375	0.193375	0.193375	0.193375	0.193375	0.193375	0.193375	Oxygen
Nitrogen	0.489482	6.09368E-08*	0	0.611671	0.611671	0.611671	0.611671	0.611671	0.611669	0.611669	0.611669	0.611669	0.611669	0.611669	0.611669	Nitrogen
Water	61383.8	693.322*	58111.3	185.358	185.334	185.334	185.334	185.334	17.5473	17.5473	17.5473	17.5473	5.00717	0.291417	0.291417	Water
Carbon Dioxide	5128.85	0.400284*	2601.09	2648.55	2648.55	2648.55	2648.55	2648.55	2648.23	2648.23	2648.23	2648.23	2648.11	2648.11	2648.11	Carbon Dioxide
Sulfur Dioxide	7.73781E-05	5.20051E-07*	0	8.86554E-05	8.86554E-05	8.86554E-05	8.86554E-05	8.86554E-05	8.82054E-05	8.82054E-05	8.82054E-05	8.82054E-05	8.80582E-05	8.80582E-05	8.80582E-05	Sulfur Dioxide
MEA	11510.7	0.172356*	11510.2	2.38542E-06	2.38464E-06	2.38464E-06	2.38464E-06	2.38464E-06	7.94006E-08	7.94006E-08	7.94006E-08	7.94006E-08	1.27475E-08	1.27475E-08	1.27475E-08	MEA
Argon	0.0110193	5.46204E-09*	0	0.0137682	0.0137682	0.0137682	0.0137682	0.0137682	0.0137681	0.0137681	0.0137681	0.0137681	0.0137680	0.0137680	0.0137680	Argon
NO	5.79969E-06	5.45326E-12*	0	7.24435E-06	7.24435E-06	7.24435E-06	7.24435E-06	7.24435E-06	7.24429E-06	7.24429E-06	7.24429E-06	7.24429E-06	7.24426E-06	7.24426E-06	7.24426E-06	NO
NO2	1.31366E-05	4.69905E-08*	0	1.63535E-05	1.63535E-05	1.63535E-05	1.63535E-05	1.63535E-05	1.58366E-05	1.58366E-05	1.58366E-05	1.58366E-05	1.56742E-05	1.56742E-05	1.56742E-05	NO2
NH3	0.228468	0.0167858*	0.137477	0.000358549	0.000358546	0.000358546	0.000358546	0.000358546	0.000252974	0.000252974	0.000252974	0.000252974	0.000223448	0.000223448	0.000223448	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	0.000243400	1.73726E-08*	0	0.00515976	0.00515977	0.00515977	0.00515977	0.00515977	0.00529380	0.00529380	0.00529380	0.00529380	0.00530429	0.00530815	0.00530815	Oxygen
Nitrogen	0.000673911	1.36358E-08*	0	0.0142881	0.0142882	0.0142882	0.0142882	0.0142882	0.0146594	0.0146594	0.0146594	0.0146594	0.0146884	0.0146991	0.0146991	Nitrogen
Water	54.3494	99.7729*	56.1503	2.78448	2.78413	2.78413	2.78413	2.78413	0.270447	0.270447	0.270447	0.270447	0.0773262	0.00450366	0.00450366	Water
Carbon Dioxide	11.0934	0.140718*	6.13977	97.1956	97.1960	97.1960	97.1960	97.1960	99.7091	99.7091	99.7091	99.7091	99.9022	99.9750	99.9750	Carbon Dioxide
Sulfur Dioxide	2.43630E-07	2.66131E-07*	0	4.73598E-06	4.73599E-06	4.73599E-06	4.73599E-06	4.73599E-06	4.83438E-06	4.83438E-06	4.83438E-06	4.83438E-06	4.83588E-06	4.83941E-06	4.83941E-06	Sulfur Dioxide
MEA	34.5560	0.0840978*	37.7098	1.21500E-07	1.21461E-07	1.21461E-07	1.21461E-07	1.21461E-07	4.14932E-09	4.14932E-09	4.14932E-09	4.14932E-09	6.67479E-10	6.67966E-10	6.67966E-10	MEA
Argon	2.16346E-05	1.74295E-09*	0	0.000458630	0.000458632	0.000458632	0.000458632	0.000458632	0.000470544	0.000470544	0.000470544	0.000470544	0.000471477	0.000471820	0.000471820	Argon
NO	8.55292E-09	1.30708E-12*	0	1.81260E-07	1.81260E-07	1.81260E-07	1.81260E-07	1.81260E-07	1.85968E-07	1.85968E-07	1.85968E-07	1.85968E-07	1.86336E-07	1.86472E-07	1.86472E-07	NO
NO2	2.97026E-08	1.72686E-08*	0	6.27355E-07	6.27357E-07	6.27357E-07	6.27357E-07	6.27357E-07	6.23311E-07	6.23311E-07	6.23311E-07	6.23311E-07	6.18144E-07	6.18595E-07	6.18595E-07	NO2
NH3	0.000191229	0.00228353*	0.000125576	5.09176E-06	5.09174E-06	5.09174E-06	5.09174E-06	5.09174E-06	3.68584E-06	3.68584E-06	3.68584E-06	3.68584E-06	3.26211E-06	3.26448E-06	3.26448E-06	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	4.95246	2.17484E-06*	0	6.18782	6.18782	6.18782	6.18782	6.18782	6.18778	6.18778	6.18778	6.18778	6.18776	6.18776	6.18776	Oxygen
Nitrogen	13.7120	1.70705E-06*	0	17.1350	17.1350	17.1350	17.1350	17.1350	17.1349	17.1349	17.1349	17.1349	17.1349	17.1349	17.1349	Nitrogen
Water	1.10585E+06	12490.4*	1.04689E+06	3339.27	3338.84	3338.84	3338.84	3338.84	316.119	316.119	316.119	316.119	90.2055	5.24996	5.24996	Water
Carbon Dioxide	225718	17.6163*	114473	116561	116561	116561	116561	116561	116547	116547	116547	116547	116542	116542	116542	Carbon Dioxide
Sulfur Dioxide	0.00495714	3.33165E-05*	0	0.00567960	0.00567960	0.00567960	0.00567960	0.00567960	0.00565077	0.00565077	0.00565077	0.00565077	0.00564134	0.00564134	0.00564134	Sulfur Dioxide
MEA	703111	10.5281*	703078	0.000145709	0.000145661	0.000145661	0.000145661	0.000145661	4.85003E-06	4.85003E-06	4.85003E-06	4.85003E-06	7.78654E-07	7.78654E-07	7.78654E-07	MEA
Argon	0.440198	2.18197E-07*	0	0.550010	0.550010	0.550010	0.550010	0.550010	0.550007	0.550007	0.550007	0.550007	0.550005	0.550005	0.550005	Argon
NO	0.000174026	1.63631E-10*	0	0.000217375	0.000217375	0.000217375	0.000217375	0.000217375	0.000217373	0.000217373	0.000217373	0.000217373	0.000217372	0.000217372	0.000217372	NO
NO2	0.000604358	2.16182E-06*	0	0.000752353	0.000752352	0.000752352	0.000752352	0.000752352	0.000728572	0.000728572	0.000728572	0.000728572	0.000721102	0.000721102	0.000721102	NO2
NH3	3.89094	0.285871*	2.34130	0.00610627	0.00610622	0.00610622	0.00610622	0.00610622	0.00430827	0.00430827	0.00430827	0.00430827	0.00380544	0.00380544	0.00380544	NH3

Process Streams		332	333	334	400	401	402	403	404	405	406	407	408	409	410	411	Process Streams	
Property	**Units**																**Units**	**Property**
Temperature	℃	55.4506	46.4540*	60.9239	48.7028	48.7028	176.667*	129.444*	26*	25.8867	176.667*	129.444*	26*	25.9261	25.9261	176.667*	℃	Temperature
Pressure	bar	10.7412	4.13685*	4.72333	1.79306	1.79306	6.03542	5.75963	5.41489	5.34594	23.1072	22.8314	22.4867	22.4177	22.4177	93.5814	bar	Pressure
Mole Fraction Vapor	%	0	0	0	99.9992	100	100	100	94.0627	100	100	100	99.5254	100	100	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0778	18.0409	25.8152	42.3055	42.3057	42.3057	42.3057	42.3057	43.8339	43.8339	43.8339	43.8339	43.9559	44.0020	44.0020	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1151.50	989.229	1098.74	2.85804	2.85803	6.88490	7.37028	10.0901	9.71130	27.9165	31.3456	45.7888	45.5567	45.5938	123.167	kg/m^3	Mass Density
Molar Flow	kmol/h	78024.3	693.912	72222.7	2834.73	2834.70	2834.70	2834.70	2834.70	2666.60	2666.60	2666.60	2666.60	2653.93	2649.22	2649.22	kmol/h	Molar Flow
Mass Flow	kg/h	2.03470E+06	12518.8*	1.86444E+06	119925	119924	119924	119924	119924	116887	116887	116887	116887	116656	116571	116571	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	1.84843E+06	16439.1	1.71099E+06	67156.0	67155.4	67155.4	67155.4	67155.4	63172.9	63172.9	63172.9	63172.9	62872.8	62761.1	62761.1	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	2071.07	12.5349	1876.54	145.307	145.306	145.306	145.306	145.306	142.264	142.264	142.264	142.264	142.031	141.946	141.946	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.15259	0.990164	1.09978		1.46129	1.46129	1.46129		1.51407	1.51407	1.51407		1.51829	1.51988	1.51988		Specific Gravity
Mass Enthalpy	kJ/kg	-11177.3	-15756.7	-11048.5	-9045.15	-9045.13	-8924.56	-8971.71	-9130.22	-8956.09	-8823.42	-8871.35	-8978.47	-8965.13	-8961.80	-8844.43	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	2.45591	0.571653	1.76174		0.0161455	0.0216019	0.0197044		0.0152834	0.0220095	0.0201805		0.0159385	0.0159403	0.0242103	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3823	0.6317	0.4059		0.0187	0.0287	0.0251		0.0172	0.0296	0.0261		0.0189	0.0189	0.0342	W/(m*℃)	Thermal Conductivit y
Surface Tension	dyne/cm	92.8998	68.5273	57.5777													dyne/cm	Surface Tension

Process Streams	**412**	**413**	**414**	**415**	**416**	**417**	**501**	**502**	**503**	**504**	**505**	**506**	**509**	**510**	**511**	**512**	**513**	**514**	**Process Streams**
	Cooled 3rd Stage Discharge	**Cold 3rd Stage Discharge**	**CO2 Product**	**Inter-stage Liquid**	**Liquefied CO2**	**Dryer Water**	**SCW Supply to E-101**	**SCW Return From E-101**	**SCW Supply to E-104**	**SCW Return From E-104**	**SCW Supply to E-102**	**SCW Return From E-102**	**SCW Supply to E-111**	**SCW Return From E-111**	**LP Steam from E-112**	**LP Condensate from E-109**	**LP Steam from E-114**	**LP Steam to E-109**	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	0.00729932	0.00729932	0.00729932	9.13336E-07	0.00729932	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Oxygen
Nitrogen	0.0230887	0.0230887	0.0230887	1.43405E-06	0.0230887	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Nitrogen
Water	0.0110001	0.0110001	0.0110001	99.7532	0.0110001	100	100*	100	100*	100	100*	100	100*	100	100	100	100	100	Water
Carbon Dioxide	99.9581	99.9581	99.9581	0.246745	99.9581	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Carbon Dioxide
Sulfur Dioxide	3.32393E-06	3.32393E-06	3.32393E-06	3.30335E-07	3.32393E-06	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Sulfur Dioxide
MEA	4.81178E-10	4.81178E-10	4.81178E-10	1.31203E-06	4.81178E-10	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	MEA
Argon	0.000519702	0.000519702	0.000519702	7.04711E-08	0.000519702	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Argon
NO	2.73449E-07	2.73449E-07	2.73449E-07	5.07785E-11	2.73449E-07	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO
NO2	5.91656E-07	5.91656E-07	5.91656E-07	3.75747E-07	5.91656E-07	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO2
NH3	8.43450E-06	8.43450E-06	8.43450E-06	7.43403E-05	8.43450E-06	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	0.193375	0.193375	0.193375	1.65106E-06	0.193375	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Oxygen
Nitrogen	0.611669	0.611669	0.611669	2.59237E-06	0.611669	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Nitrogen
Water	0.291417	0.291417	0.291417	180.327	0.291417	4.71575	272589*	272589	272589*	272589	19431.1*	19431.1	250893*	250893	135.215	434.843	133.952	431.447	Water
Carbon Dioxide	2648.11	2648.11	2648.11	0.446049	2648.11	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Carbon Dioxide
Sulfur Dioxide	8.80582E-05	8.80582E-05	8.80582E-05	5.97156E-07	8.80582E-05	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Sulfur Dioxide
MEA	1.27475E-08	1.27475E-08	1.27475E-08	2.37180E-06	1.27475E-08	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	MEA
Argon	0.0137680	0.0137680	0.0137680	1.27393E-07	0.0137680	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Argon
NO	7.24426E-06	7.24426E-06	7.24426E-06	9.17938E-11	7.24426E-06	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO
NO2	1.56742E-05	1.56742E-05	1.56742E-05	6.79249E-07	1.56742E-05	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO2
NH3	0.000223448	0.000223448	0.000223448	0.000134387	0.000223448	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	0.00530815	0.00530815	0.00530815	1.61651E-06	0.00530815	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Oxygen
Nitrogen	0.0146991	0.0146991	0.0146991	2.22200E-06	0.0146991	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Nitrogen
Water	0.00450366	0.00450366	0.00450366	99.3993	0.00450366	100	100*	100	100*	100	100*	100	100*	100	100	100	100	100	Water
Carbon Dioxide	99.9750	99.9750	99.9750	0.600635	99.9750	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Carbon Dioxide
Sulfur Dioxide	4.83941E-06	4.83941E-06	4.83941E-06	1.17053E-06	4.83941E-06	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Sulfur Dioxide
MEA	6.67966E-10	6.67966E-10	6.67966E-10	4.43284E-06	6.67966E-10	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	MEA
Argon	0.000471820	0.000471820	0.000471820	1.55712E-07	0.000471820	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Argon
NO	1.86472E-07	1.86472E-07	1.86472E-07	8.42762E-11	1.86472E-07	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO
NO2	6.18595E-07	6.18595E-07	6.18595E-07	9.56139E-07	6.18595E-07	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO2
NH3	3.26448E-06	3.26448E-06	3.26448E-06	7.00273E-05	3.26448E-06	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	6.18776	6.18776	6.18776	5.28321E-05	6.18776	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Oxygen
Nitrogen	17.1349	17.1349	17.1349	7.26210E-05	17.1349	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Nitrogen
Water	5.24996	5.24996	5.24996	3248.64	5.24996	84.9556	4.91078E+06*	4.91E+06	4.91078E+06*	4.91E+06	350057*	350057	4.51991E+06*	4.51991E+06	2435.93	7833.81	2413.17	7772.63	Water
Carbon Dioxide	116542	116542	116542	19.6304	116542	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Carbon Dioxide
Sulfur Dioxide	0.00564134	0.00564134	0.00564134	3.82561E-05	0.00564134	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Sulfur Dioxide
MEA	7.78654E-07	7.78654E-07	7.78654E-07	0.000144877	7.78654E-07	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	MEA
Argon	0.550005	0.550005	0.550005	5.08909E-06	0.550005	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	Argon
NO	0.000217372	0.000217372	0.000217372	2.75437E-09	0.000217372	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO
NO2	0.000721102	0.000721102	0.000721102	3.12492E-05	0.000721102	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NO2
NH3	0.00380544	0.00380544	0.00380544	0.00228868	0.00380544	0	0*	0	0*	0	0*	0	0*	0	0	0	0	0	NH3

Process Streams		**412**	**413**	**414**	**415**	**416**	**417**	**501**	**502**	**503**	**504**	**505**	**506**	**509**	**510**	**511**	**512**	**513**	**514**	**Process Streams**	
Property	**Units**																			**Units**	**Property**
Temperature	℃	129.444*	28*	48.2019	25.8867	27.9889	25.9261	11*	21	11*	21	11*	21*	11*	21*	125.835	125.835	125.835	125.835	℃	Temperature
Pressure	bar	93.3056	92.9609	201.000*	5.34594	92.8919	22.4177	1.9999*	0.965686	1.9999*	0.965686	1.9999*	1.31042	1.9999*	0.965686	2.37913	2.37913	2.37913	2.37913	bar	Pressure
Mole Fraction Vapor	%	100	0	100	0	0	0	0	0	0	0	0	0	0	0	100*	0*	100	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	44.0020	44.0020	44.0020	18.0794	44.0020	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	148.588	722.643?	778.544	997.558	722.534	996.481	1000.00	997.597	1000.00	997.597	1000.00	997.602	1000.00	997.597	1.31446	938.857	1.31446	1.31446	kg/m^3	Mass Density
Molar Flow	kmol/h	2649.22	2649.22	2649.22	180.773	2649.22	4.71575	272589	272589	272589	272589	19431.1	19431.1	250893	250893	135.215	434.843	133.952	431.447	kmol/h	Molar Flow
Mass Flow	kg/h	116571	116571	116571	3268.27	116571	84.9556	4.91E+06	4.91E+06	4.91E+06	4.91E+06	350057	350057	4.51991E+06	4.51991E+06	2435.93	7833.81	2413.17	7772.63	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	62761.1	62761.1	62761.1	4282.59	62761.1	111.718	6.46E+06	6.46E+06	6.46E+06	6.46E+06	460331	460331	5.94377E+06	5.94377E+06	3203.30	10301.6	3173.37	10221.2	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	141.946	141.946	141.946	3.27574	141.946	0.0850392	4915.61	4915.61	4915.61	4915.61	350.401	350.401	4524.35	4524.35	2.43833	7.84152	2.41555	7.78028	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.51988	0.723326?	1.51988	0.998501	0.723217?	0.997422	1.00095	0.998540	1.00095	0.998540	1.00095	0.998544	1.00095	0.998540	0.622268	0.939745	0.622268	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-8902.65	-9167.65	-9147.70	-15823.4	-9167.65	-15861.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-13240.4	-15448.2	-13240.4	-13240.4	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0230637	0.0609552	0.0692290	0.865916	0.0609691	0.879295	1.29092	0.987115	1.29092	0.987115	1.29092	0.987185	1.29092	0.987115	0.0106144	0.219521	0.0106144	0.0106144	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0319	0.1073	0.0909	0.6021	0.1073	0.6076	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.0270	0.6847	0.0270	0.0270	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm		0.0000		72.3392	0.0000	72.6316	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192		53.1489			dyne/cm	Surface Tension

Process Streams	515	516	517	518	519	520	521	522	523	524	525	526	527	Process Streams
	SCW Supply to E-113	SCW Return From E-113	SCW Supply to E-115	SCW Return From E-115	Condenstate to E-112	Condenstate to E-114	Condenstate to E-116	SCW Supply to E-117	SCW Return From E-117	LP Steam from E-116	LP Steam to E-110	LP Condensate from E-110	Vent Steam	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	25674.5*	25674.5	16911.8*	16911.8	135.215*	133.952*	162.281*	41724.4*	41724.4	162.281	10213.6*	10213.6	283.831	Water
Carbon Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	462534*	462534	304670*	304670	2435.93*	2413.17*	2923.53*	751677*	751677	2923.53	184000*	184000	5113.30	Water
Carbon Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3

Process Streams		515	516	517	518	519	520	521	522	523	524	525	526	527	Process Streams	
Property	**Units**														**Units**	**Property**
Temperature	℃	16*	26*	16*	26*	98.8889*	98.8889*	98.8889*	16*	26*	125.835	135*	133.594	146.435	℃	Temperature
Pressure	bar	1.9999*	1.31042	1.9999*	1.31042	2.37913*	2.37913*	2.37913*	1.9999*	1.31042	2.37913	2.9999*	2.9999	2.3499*	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	0	100	100	0*	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	998.879	996.185	998.879	996.185	959.505	959.505	959.505	998.879	996.185	1.31446	1.62556	932.265	1.23159	kg/m^3	Mass Density
Molar Flow	kmol/h	25674.5	25674.5	16911.8	16911.8	135.215	133.952	162.281	41724.4	41724.4	162.281	10213.6	10213.6	283.831	kmol/h	Molar Flow
Mass Flow	kg/h	462534	462534	304670	304670	2435.93	2413.17	2923.53	751677	751677	2923.53	184000*	184000	5113.30	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	608241	608241	400647	400647	3203.30	3173.37	3844.50	988470	988470	3844.50	241964	241964	6724.09	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	462.989	462.989	304.970	304.970	2.43833	2.41555	2.92641	752.417	752.417	2.92641	184.181	184.181	5.11833	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.999823	0.997127	0.999823	0.997127	0.960412	0.960412	0.960412	0.999823	0.997127	0.622268	0.622268	0.933146	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-15904.0	-15862.9	-15904.0	-15862.9	-15561.8	-15561.8	-15561.8	-15904.0	-15862.9	-13240.4	-13224.7	-15390.4	-13200.2	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	1.12405	0.874153	1.12405	0.874153	0.279294	0.279294	0.279294	1.12405	0.874153	0.0106144	0.0110023	0.206890	0.0114855	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.5931	0.6077	0.5931	0.6077	0.6758	0.6758	0.6758	0.5931	0.6077	0.0270	0.0278	0.6856	0.0287	W/(m*℃)	Thermal Conducti vity
Surface Tension	dyne/cm	74.6291	72.6168	74.6291	72.6168	58.4280	58.4280	58.4280	74.6291	72.6168			51.6045		dyne/cm	Surface Tension

Process Streams		001	002	003	004	005	006	007	008	009	010	100	101	102	103		Process Streams
		Flue Gas From CCPP	Flue Gas From Common Fogger	Process Water to Foggers	Process Water to Common Fogger	Process Water to Abs. 1 Fogger	Abs 1. Flue Gas Blower Discharge	Process Water to Absorbers	Process Water to Abs. 2 Fogger	Abs 2. Flue Gas Blower Discharge	Softened Water	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 1)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 1)		
Mole Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mole Fraction**
Oxygen		12.9413*	12.4873	9.84458E-09	9.84458E-09	9.84458E-09	12.4873	9.84458E-09*	9.84458E-09	12.4873	0	12.4292	0.000217153	0.000217153	13.2825		Oxygen
Nitrogen		75.2376*	72.5981	8.72213E-09	8.72213E-09	8.72213E-09	72.5981	8.72213E-09*	8.72213E-09	72.5981	0	72.2601	0.000677240	0.000677240	77.2221		Nitrogen
Water		7.13372*	10.3888	99.9185	99.9185	99.9185	10.3888	99.9185*	99.9185	10.3888	100	10.8056	99.4158	99.4158	8.03125		Water
Carbon Dioxide		3.82869*	3.69632	0.0555783	0.0555783	0.0555783	3.69632	0.0555783*	0.0555783	3.69632	0	3.67937	0.147967	0.147967	0.582518		Carbon Dioxide
Sulfur Dioxide		1.00303E-05*	9.68112E-06	7.69346E-08	7.69346E-08	7.69346E-08	9.68112E-06	7.69346E-08*	7.69346E-08	9.68112E-06	0	9.63641E-06	1.11689E-07	1.11689E-07	1.01780E-05		Sulfur Dioxide
MEA		0*	0.000818982	0.0233448	0.0233448	0.0233448	0.000818982	0.0233448*	0.0233448	0.000818982	0	0.000923858	0.435097	0.435097	0.000258332		MEA
Argon		0.857888*	0.827791	7.76934E-10	7.76934E-10	7.76934E-10	0.827791	7.76934E-10*	7.76934E-10	0.827791	0	0.823937	1.52013E-05	1.52013E-05	0.880507		Argon
NO		0.000320748*	0.000309496	7.72946E-13	7.72946E-13	7.72946E-13	0.000309496	7.72946E-13*	7.72946E-13	0.000309496	0	0.000308055	7.95936E-09	7.95936E-09	0.000329203		NO
NO2		8.00800E-05*	7.72709E-05	6.95654E-09	6.95654E-09	6.95654E-09	7.72709E-05	6.95654E-09*	6.95654E-09	7.72709E-05	0	7.69112E-05	1.85653E-08	1.85653E-08	8.21721E-05		NO2
NH3		0.000400788*	0.000478064	0.00260352	0.00260352	0.00260352	0.000478064	0.00260352*	0.00260352	0.000478064	0	0.000487959	0.000236785	0.000236785	0.000411040		NH3
Molar Flow		kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h		**Molar Flow**
Oxygen		11838.8*	11838.8	3.71087E-07	3.27429E-07	2.18286E-08	5919.38	6.38097E-08*	2.18286E-08	5919.38	0	5919.38	0.178193	0.00970052	5919.27		Oxygen
Nitrogen		68827.6*	68827.6	3.28776E-07	2.90097E-07	1.93398E-08	34413.8	5.65343E-08*	1.93398E-08	34413.8	0	34413.8	0.555735	0.0302532	34413.4		Nitrogen
Water		6525.94*	9849.22	3766.38	3323.28	221.552	4924.61	647.643*	221.552	4924.61	323.492	5146.16	81579.5	4441.04	3579.07		Water
Carbon Dioxide		3502.49*	3504.34	2.09500	1.84853	0.123235	1752.17	0.360242*	0.123235	1752.17	0	1752.29	121.420	6.60991	259.595		Carbon Dioxide
Sulfur Dioxide		0.00917575*	0.00917831	2.90001E-06	2.55883E-06	1.70589E-07	0.00458916	4.98668E-07*	1.70589E-07	0.00458916	0	0.00458933	9.16507E-05	4.98930E-06	0.00453575		Sulfur Dioxide
MEA		0*	0.776446	0.879972	0.776446	0.0517631	0.388223	0.151314*	0.0517631	0.388223	0	0.439986	357.036	19.4364	0.115124		MEA
Argon		784.798*	784.798	2.92862E-08	2.58407E-08	1.72272E-09	392.399	5.03586E-09*	1.72272E-09	392.399	0	392.399	0.0124741	0.000679065	392.391		Argon
NO		0.293422*	0.293422	2.91358E-11	2.57081E-11	1.71387E-12	0.146711	5.01001E-12*	1.71387E-12	0.146711	0	0.146711	6.53136E-06	3.55555E-07	0.146707		NO
NO2		0.0732575*	0.0732577	2.62223E-07	2.31373E-07	1.54249E-08	0.0366288	4.50902E-08*	1.54249E-08	0.0366288	0	0.0366289	1.52345E-05	8.29339E-07	0.0366194		NO2
NH3		0.366642*	0.453234	0.0981383	0.0865927	0.00577284	0.226617	0.0168752*	0.00577284	0.226617	0	0.232390	0.194303	0.0105775	0.183177		NH3
Mass Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mass Fraction**
Oxygen		14.5144*	14.1882	1.74622E-08	1.74622E-08	1.74622E-08	14.1882	1.74622E-08*	1.74622E-08	14.1882	0	14.1459	0.000380930	0.000380930	15.2131		Oxygen
Nitrogen		73.8733*	72.2133	1.35443E-08	1.35443E-08	1.35443E-08	72.2133	1.35443E-08*	1.35443E-08	72.2133	0	71.9975	0.00104005	0.00104005	77.4302		Nitrogen
Water		4.50447*	6.64556	99.7829	99.7829	99.7829	6.64556	99.7829*	99.7829	6.64556	100	6.92379	98.1844	98.1844	5.17878		Water
Carbon Dioxide		5.90586*	5.77619	0.135588	0.135588	0.135588	5.77619	0.135588*	0.135588	5.77619	0	5.75934	0.356992	0.356992	0.917611		Carbon Dioxide
Sulfur Dioxide		2.25224E-05*	2.20224E-05	2.73214E-07	2.73214E-07	2.73214E-07	2.20224E-05	2.73214E-07*	2.73214E-07	2.20224E-05	0	2.19574E-05	3.92255E-07	3.92255E-07	2.33388E-05		Sulfur Dioxide
MEA		0*	0.00177632	0.0790462	0.0790462	0.0790462	0.00177632	0.0790462*	0.0790462	0.00177632	0	0.00200715	1.45698	1.45698	0.000564810		MEA
Argon		1.20119*	1.17420	1.72048E-09	1.72048E-09	1.72048E-09	1.17420	1.72048E-09*	1.72048E-09	1.17420	0	1.17069	3.32907E-05	3.32907E-05	1.25901		Argon
NO		0.000337335*	0.000329754	1.28567E-12	1.28567E-12	1.28567E-12	0.000329754	1.28567E-12*	1.28567E-12	0.000329754	0	0.000328769	1.30928E-08	1.30928E-08	0.000353570		NO
NO2		0.000129128*	0.000126227	1.77408E-08	1.77408E-08	1.77408E-08	0.000126227	1.77408E-08*	1.77408E-08	0.000126227	0	0.000125850	4.68229E-08	4.68229E-08	0.000135312		NO2
NH3		0.000239237*	0.000289094	0.00245786	0.00245786	0.00245786	0.000289094	0.00245786*	0.00245786	0.000289094	0	0.000295573	0.000221069	0.000221069	0.000250562		NH3
Mass Flow		kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h		**Mass Flow**
Oxygen		378826*	378826	1.18743E-05	1.04773E-05	6.98490E-07	189413	2.04183E-06*	6.98490E-07	189413	0	189413	5.70197	0.310405	189409		Oxygen
Nitrogen		1.92809E+06*	1.92809E+06	9.21014E-06	8.12660E-06	5.41773E-07	964047	1.58372E-06*	5.41773E-07	964047	0	964047	15.5680	0.847496	964037		Nitrogen
Water		117567*	177436	67852.4	59869.7	3991.32	88718.2	11667.5*	3991.32	88718.2	5827.80	92709.5	1.46968E+06	80006.6	64477.9		Water
Carbon Dioxide		154143*	154224	92.1997	81.3527	5.42351	77112.2	15.8541*	5.42351	77112.2	0	77117.6	5343.65	290.899	11424.6		Carbon Dioxide
Sulfur Dioxide		0.587834*	0.587997	0.000185786	0.000163929	1.09286E-05	0.293999	3.19465E-05*	1.09286E-05	0.293999	0	0.294010	0.00587149	0.000319633	0.290577		Sulfur Dioxide
MEA		0*	47.4277	53.7514	47.4277	3.16185	23.7139	9.24275*	3.16185	23.7139	0	26.8757	21808.8	1187.23	7.03211		MEA
Argon		31351.1*	31351.1	1.16992E-06	1.03229E-06	6.88191E-08	15675.6	2.01173E-07*	6.88191E-08	15675.6	0	15675.6	0.498313	0.0271273	15675.2		Argon
NO		8.80444*	8.80444	8.74253E-10	7.71399E-10	5.14266E-11	4.40222	1.50331E-10*	5.14266E-11	4.40222	0	4.40222	0.000195981	1.06688E-05	4.40210		NO
NO2		3.37025*	3.37026	1.20637E-05	1.06445E-05	7.09630E-07	1.68513	2.07440E-06*	7.09630E-07	1.68513	0	1.68513	0.000700871	3.81541E-05	1.68469		NO2
NH3		6.24410*	7.71882	1.67135	1.47472	0.0983145	3.85941	0.287394*	0.0983145	3.85941	0	3.95772	3.30909	0.180141	3.11960		NH3
Process Streams		**001**	**002**	**003**	**004**	**005**	**006**	**007**	**008**	**009**	**010**	**100**	**101**	**102**	**103**		**Process Streams**
Property	**Units**															**Units**	**Property**
Temperature	℃	100*	48.1126	47.8879	47.8879	47.8878	60.688 4	45.7207*	47.8878	60.6884	20.0000	54.0026	52.4538	52.4538	41.8036	℃	Temperature
Pressure	bar	1.0017*	1.0017	138*	138	138	1.08857	4.13685*	138	1.08857	4.13685	1.08857	4.48079	4.48079	1.01273	bar	Pressure
Mole Fraction Vapor	%	100	100	0	0	0	100	0	0	100	0	100	0	0	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	28.5307	28.1627	18.0398	18.0398	18.0398	28.1627	18.0398	18.0398	28.1627	18.0153	28.1156	18.2412	18.2412	27.9381	kg/kmol	Molecular Weight
Mass Density	kg/m^3	0.921229	1.05681	990.501	990.501	990.501	1.10509	989.520	990.501	1.10509	997.903	1.12590	987.882	987.882	1.08100	kg/m^3	Mass Density
Molar Flow	kmol/h	91480.3	94806.3	3769.45	3325.99	221.732	47403.1	648.171	221.732	47403.1	323.492	47624.9	82058.9	4467.14	44564.2	kmol/h	Molar Flow
Mass Flow	kg/h	2.61000E+06*	2.67000E+06	68000	60000	4000	1.33500E+06	11692.8*	4000	1.33500E+06	5827.80	1.33900E+06	1.49685E+06	81486.1	1.24504E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	2.16721E+06	2.24600E+06	89300.0	78794.1	5252.94	1.12300E+06	15355.5	5252.94	1.12300E+06	7663.67	1.12825E+06	1.94401E+06	105828	1.05575E+06	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	3051.86	3111.93	68.0868	60.0766	4.00511	1555.97	11.7078	4.00511	1555.97	5.83353	1559.97	1499.04	81.6050	1451.68	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.985483	0.972771	0.991437	0.991437	0.991437	0.972771	0.990455	0.991437	0.972771	0.998846	0.971143	0.988816	0.988816	0.965014		Specific Gravity
Mass Enthalpy	kJ/kg	-1054.38	-1384.39	-15739.9	-15739.9	-15739.9	-1370.99	-15760.7	-15739.9	-1370.99	-15885.0	-1413.92	-15562.9	-15562.9	-759.786	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0209350	0.0186643	0.571407	0.571407	0.571408	0.0192060	0.579363	0.571408	0.0192060	1.01302	0.0189053	0.528406	0.528406	0.0185848	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0300	0.0266	0.6334	0.633 4	0.6334	0.0274	0.6309	0.6334	0.0274	0.5991	0.0270	0.6282	0.6282	0.0265	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm			68.2493	68.2493	68.2493		68.6724	68.2493		73.8205		67.1227	67.1227		dyne/cm	Surface Tension

Process Streams	104	105	106	107	108	109	110	111	200	201	202	203	204	Process Streams
	Lean Amine (Abs. 1)	Cooled Semi-Lean Amine (Abs. 1)	Rich Amine (Abs. 1)	Process Water to Upper Bed (Abs. 1)	Cooled Wash Water to Lower Bed (Abs. 1)	Cooled Wash Water (Abs. 1)	Cooled Wash Water to Upper Bed (Abs. 1)	Combined Wash Water to Upper Bed (Abs. 1)	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 2)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 2)	Lean Amine (Abs. 2)	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	2.14412E-05	4.10422E-07	0.000205017	9.84458E-09	0.000217153	0.000217153	0.000217153	0.000173724	12.4292	0.000217153	0.000217153	13.2825	2.14412E-05	Oxygen
Nitrogen	6.68690E-05	8.68573E-07	0.000641035	8.72213E-09	0.000677240	0.000677240	0.000677240	0.000541794	72.2601	0.000677240	0.000677240	77.2221	6.68690E-05	Nitrogen
Water	82.3389	78.9823	78.6517	99.9185	99.4158	99.4158	99.4158	99.5163	10.8056	99.4158	99.4158	8.03125	82.3389	Water
Carbon Dioxide	3.30309	6.04871	6.61467	0.0555783	0.147967	0.147967	0.147967	0.129490	3.67937	0.147967	0.147967	0.582518	3.30309	Carbon Dioxide
Sulfur Dioxide	1.10598E-08	3.02511E-08	1.03913E-07	7.69346E-08	1.11689E-07	1.11689E-07	1.11689E-07	1.04738E-07	9.63641E-06	1.11689E-07	1.11689E-07	1.01780E-05	1.10598E-08	Sulfur Dioxide
MEA	14.3577	14.9687	14.7324	0.0233448	0.435097	0.435097	0.435097	0.352746	0.000923858	0.435097	0.435097	0.000258332	14.3577	MEA
Argon	1.50094E-06	2.75399E-08	1.43324E-05	7.76934E-10	1.52013E-05	1.52013E-05	1.52013E-05	1.21612E-05	0.823937	1.52013E-05	1.52013E-05	0.880507	1.50094E-06	Argon
NO	7.85888E-10	2.47223E-11	7.51700E-09	7.72946E-13	7.95936E-09	7.95936E-09	7.95936E-09	6.36764E-09	0.000308055	7.95936E-09	7.95936E-09	0.000329203	7.85888E-10	NO
NO2	1.83598E-09	3.03958E-10	1.73621E-08	6.95654E-09	1.85653E-08	1.85653E-08	1.85653E-08	1.62436E-08	7.69112E-05	1.85653E-08	1.85653E-08	8.21721E-05	1.83598E-09	NO2
NH3	0.000223103	0.000310837	0.000329574	0.00260352	0.000236785	0.000236785	0.000236785	0.000710132	0.000487959	0.000236785	0.000236785	0.000411040	0.000223103	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0.00970052	4.43877E-05	0.112659	2.95337E-08	0.175587	0.178193	0.00260583	0.00260586	5919.38	0.178193	0.00970052	5919.27	0.00970052	Oxygen
Nitrogen	0.0302532	9.39373E-05	0.352255	2.61664E-08	0.547609	0.555735	0.00812688	0.00812690	34413.8	0.555735	0.0302532	34413.4	0.0302532	Nitrogen
Water	37252.2	8542.04	43219.9	299.755	80386.5	81579.5	1192.99	1492.74	5146.16	81579.5	4441.04	3579.07	37252.2	Water
Carbon Dioxide	1494.40	654.175	3634.83	0.166735	119.645	121.420	1.77561	1.94234	1752.29	121.420	6.60991	259.595	1494.40	Carbon Dioxide
Sulfur Dioxide	5.00372E-06	3.27170E-06	5.71015E-05	2.30804E-07	9.03104E-05	9.16507E-05	1.34027E-06	1.57107E-06	0.00458933	9.16507E-05	4.98930E-06	0.00453575	5.00372E-06	Sulfur Dioxide
MEA	6495.77	1618.88	8095.60	0.0700345	351.814	357.036	5.22116	5.29120	0.439986	357.036	19.4364	0.115124	6495.77	MEA
Argon	0.000679065	2.97848E-06	0.00787581	2.33080E-09	0.0122916	0.0124741	0.000182416	0.000182418	392.399	0.0124741	0.000679065	392.391	0.000679065	Argon
NO	3.55555E-07	2.67375E-09	4.13067E-06	2.31884E-12	6.43585E-06	6.53136E-06	9.55123E-08	9.55146E-08	0.146711	6.53136E-06	3.55555E-07	0.146707	3.55555E-07	NO
NO2	8.30642E-07	3.28734E-08	9.54065E-06	2.08696E-08	1.50117E-05	1.52345E-05	2.22784E-07	2.43654E-07	0.0366289	1.52345E-05	8.29339E-07	0.0366194	8.30642E-07	NO2
NH3	0.100937	0.0336174	0.181104	0.00781055	0.191462	0.194303	0.00284142	0.0106520	0.232390	0.194303	0.0105775	0.183177	0.100937	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	2.73807E-05	5.04451E-07	0.000251548	1.74622E-08	0.000380930	0.000380930	0.000380930	0.000305422	14.1459	0.000380930	0.000380930	15.2131	2.73807E-05	Oxygen
Nitrogen	7.47574E-05	9.34603E-07	0.000688565	1.35443E-08	0.00104005	0.00104005	0.00104005	0.000833885	71.9975	0.00104005	0.00104005	77.4302	7.47574E-05	Nitrogen
Water	59.1984	54.6545	54.3308	99.7829	98.1844	98.1844	98.1844	98.5012	6.92379	98.1844	98.1844	5.17878	59.1984	Water
Carbon Dioxide	5.80137	10.2250	11.1623	0.135588	0.356992	0.356992	0.356992	0.313103	5.75934	0.356992	0.356992	0.917611	5.80137	Carbon Dioxide
Sulfur Dioxide	2.82763E-08	7.44405E-08	2.55259E-07	2.73214E-07	3.92255E-07	3.92255E-07	3.92255E-07	3.68658E-07	2.19574E-05	3.92255E-07	3.92255E-07	2.33388E-05	2.82763E-08	Sulfur Dioxide
MEA	35	35.1203	34.5057	0.0790462	1.45698	1.45698	1.45698	1.18383	0.00200715	1.45698	1.45698	0.000564810	35	MEA
Argon	2.39289E-06	4.22583E-08	2.19539E-05	1.72048E-09	3.32907E-05	3.32907E-05	3.32907E-05	2.66919E-05	1.17069	3.32907E-05	3.32907E-05	1.25901	2.39289E-06	Argon
NO	9.41095E-10	2.84940E-11	8.64871E-09	1.28567E-12	1.30928E-08	1.30928E-08	1.30928E-08	1.04977E-08	0.000328769	1.30928E-08	1.30928E-08	0.000353570	9.41095E-10	NO
NO2	3.37086E-09	5.37128E-10	3.06273E-08	1.77408E-08	4.68229E-08	4.68229E-08	4.68229E-08	4.10580E-08	0.000125850	4.68229E-08	4.68229E-08	0.000135312	3.37086E-09	NO2
NH3	0.000151634	0.000203337	0.000215217	0.00245786	0.000221069	0.000221069	0.000221069	0.000664467	0.000295573	0.000221069	0.000221069	0.000250562	0.000151634	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0.310405	0.00142035	3.60495	9.45044E-07	5.61859	5.70197	0.0833836	0.0833845	189413	5.70197	0.310405	189409	0.310405	Oxygen
Nitrogen	0.847496	0.00263150	9.86787	7.33009E-07	15.3404	15.5680	0.227661	0.227662	964047	15.5680	0.847496	964037	0.847496	Nitrogen
Water	671109	153887	778619	5400.18	1.44819E+06	1.46968E+06	21492.0	26892.2	92709.5	1.46968E+06	80006.6	64477.9	671109	Water
Carbon Dioxide	65767.8	28789.9	159967	7.33791	5265.51	5343.65	78.1437	85.4816	77117.6	5343.65	290.899	11424.6	65767.8	Carbon Dioxide
Sulfur Dioxide	0.000320557	0.000209597	0.00365814	1.47862E-05	0.00578563	0.00587149	8.58626E-05	0.000100649	0.294010	0.00587149	0.000319633	0.290577	0.000320557	Sulfur Dioxide
MEA	396781	98886.1	494504	4.27792	21489.9	21808.8	318.925	323.203	26.8757	21808.8	1187.23	7.03211	396781	MEA
Argon	0.0271273	0.000118984	0.314623	9.31109E-08	0.491026	0.498313	0.00728716	0.00728725	15675.6	0.498313	0.0271273	15675.2	0.0271273	Argon
NO	1.06688E-05	8.02287E-08	0.000123945	6.95793E-11	0.000193115	0.000195981	2.86595E-06	2.86602E-06	4.40222	0.000195981	1.06688E-05	4.40210	1.06688E-05	NO
NO2	3.82141E-05	1.51236E-06	0.000438922	9.60117E-07	0.000690622	0.000700871	1.02493E-05	1.12094E-05	1.68513	0.000700871	3.81541E-05	1.68469	3.82141E-05	NO2
NH3	1.71902	0.572522	3.08430	0.133018	3.26070	3.30909	0.0483909	0.181409	3.95772	3.30909	0.180141	3.11960	1.71902	NH3

Process Streams		104	105	106	107	108	109	110	111	200	201	202	203	204	Process Streams	
Property	**Units**														**Units**	**Property**
Temperature	℃	53.9381	58.9133	53.3596	45.7208	20.0000	20.0000	20.0000	25.2480	54.0026	52.4538	52.4538	41.8036	53.9381	℃	Temperatu re
Pressure	bar	3.68912	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	1.08857	4.48079	4.48079	1.01273	3.68912	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	100	0	0	100	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	25.0574	26.0343	26.0797	18.0398	18.2412	18.2412	18.2412	18.2009	28.1156	18.2412	18.2412	27.9381	25.0574	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1088.79	1142.94	1152.37	989.520	999.738	999.738	999.738	997.930	1.12590	987.882	987.882	1.08100	1088.79	kg/m^3	Mass Density
Molar Flow	kmol/h	45242.5	10815.1	54951.0	300	80858.9	82058.9	1200	1500	47624.9	82058.9	4467.14	44564.2	45242.5	kmol/h	Molar Flow
Mass Flow	kg/h	1.13366E+06	281564	1.43311E+06	5411.93	1.47497E+06	1.49685E+06	21889.5	27301.4	1.33900E+06	1.49685E+06	81486.1	1.24504E+06	1.13366E+06	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	1.07182E+06	256215	1.30181E+06	7107.13	1.91558E+06	1.94401E+06	28428.5	35535.7	1.12825E+06	1.94401E+06	105828	1.05575E+06	1.07182E+06	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	1140.82	286.034	1458.96	5.41884	1477.12	1499.04	21.9214	27.3403	1559.97	1499.04	81.6050	1451.68	1140.82	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.08982	1.14402	1.15346	0.990455	1.00068	1.00068	1.00068	0.998873	0.971143	0.988816	0.988816	0.965014	1.08982		Specific Gravity
Mass Enthalpy	kJ/kg	-11403.5	-11146.1	-11187.2	-15760.7	-15697.0	-15697.0	-15697.0	-15709.7	-1413.92	-15562.9	-15562.9	-759.786	-11403.5	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	1.77319	2.17583	2.60238	0.579362	1.04740	1.04740	1.04740	0.913216	0.0189053	0.528406	0.528406	0.0185848	1.77319	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.4168	0.3873	0.3812	0.6309	0.5885	0.5885	0.5885	0.5976	0.0270	0.6282	0.6282	0.0265	0.4168	W/(m*℃)	Thermal Conducti vity
Surface Tension	dyne/cm	59.3976	92.8648	95.6192	68.6724	73.3892	73.3892	73.3892	72.4546		67.1227	67.1227		59.3976	dyne/cm	Surface Tension

Process Streams	205	206	207	208	209	210	211	300	302	303	304	305	306	Process Streams
	Cooled Semi-Lean Amine (Abs. 2)	Rich Amine (Abs. 2)	Process Water to Upper Bed (Abs. 2)	Cooled Wash Water to Lower Bed (Abs. 2)	Cooled Wash Water (Abs. 2)	Cooled Wash Water to Upper Bed (Abs. 2)	Combined Wash Water to Upper Bed (Abs. 2)	Combined Cold Rich Amine	Hot Rich Amine	Stripper Bottoms to E-108 Inlet	Rich Amine to E-103	Lean Amine	Filtered Lean Amine	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	4.10422E-07	0.000205017	9.84458E-09	0.000217153	0.000217153	0.000217153	0.000173724	0.000205017	0.000205017	0	0.000205017	2.14412E-05	2.14412E-05	Oxygen
Nitrogen	8.68573E-07	0.000641035	8.72213E-09	0.000677240	0.000677240	0.000677240	0.000541794	0.000641035	0.000641035	0	0.000641035	6.68690E-05	6.68690E-05	Nitrogen
Water	78.9823	78.6517	99.9185	99.4158	99.4158	99.4158	99.5163	78.6517	78.6517	80.4568	78.6517	82.3389	82.3389	Water
Carbon Dioxide	6.04871	6.61467	0.0555783	0.147967	0.147967	0.147967	0.129490	6.61467	6.61467	3.65089	6.61467	3.30309	3.30309	Carbon Dioxide
Sulfur Dioxide	3.02511E-08	1.03913E-07	7.69346E-08	1.11689E-07	1.11689E-07	1.11689E-07	1.04738E-07	1.03913E-07	1.03913E-07	0	1.03913E-07	1.10598E-08	1.10598E-08	Sulfur Dioxide
MEA	14.9687	14.7324	0.0233448	0.435097	0.435097	0.435097	0.352746	14.7324	14.7324	15.8921	14.7324	14.3577	14.3577	MEA
Argon	2.75399E-08	1.43324E-05	7.76934E-10	1.52013E-05	1.52013E-05	1.52013E-05	1.21612E-05	1.43324E-05	1.43324E-05	0	1.43324E-05	1.50094E-06	1.50094E-06	Argon
NO	2.47223E-11	7.51700E-09	7.72946E-13	7.95936E-09	7.95936E-09	7.95936E-09	6.36764E-09	7.51700E-09	7.51700E-09	0	7.51700E-09	7.85888E-10	7.85888E-10	NO
NO2	3.03958E-10	1.73621E-08	6.95654E-09	1.85653E-08	1.85653E-08	1.85653E-08	1.62436E-08	1.73621E-08	1.73621E-08	0	1.73621E-08	1.83598E-09	1.83598E-09	NO2
NH3	0.000310837	0.000329574	0.00260352	0.000236785	0.000236785	0.000236785	0.000710132	0.000329574	0.000329574	0.000220537	0.000329574	0.000223103	0.000223103	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	4.43877E-05	0.112659	2.95337E-08	0.175587	0.178193	0.00260583	0.00260586	0.225318	0.180254	0	0.0450636	0.0155208	0.00388021	Oxygen
Nitrogen	9.39373E-05	0.352255	2.61664E-08	0.547609	0.555735	0.00812688	0.00812690	0.704511	0.563608	0	0.140902	0.0484052	0.0121013	Nitrogen
Water	8542.04	43219.9	299.755	80386.5	81579.5	1192.99	1492.74	86439.8	69151.9	65574.2	17288.0	59603.5	14900.9	Water
Carbon Dioxide	654.175	3634.83	0.166735	119.645	121.420	1.77561	1.94234	7269.66	5815.73	2975.56	1453.93	2391.04	597.760	Carbon Dioxide
Sulfur Dioxide	3.27170E-06	5.71015E-05	2.30804E-07	9.03104E-05	9.16507E-05	1.34027E-06	1.57107E-06	0.000114203	9.13624E-05	0	2.28406E-05	8.00595E-06	2.00149E-06	Sulfur Dioxide
MEA	1618.88	8095.60	0.0700345	351.814	357.036	5.22116	5.29120	16191.2	12953.0	12952.4	3238.24	10393.2	2598.31	MEA
Argon	2.97848E-06	0.00787581	2.33080E-09	0.0122916	0.0124741	0.000182416	0.000182418	0.0157516	0.0126013	0	0.00315033	0.00108650	0.000271626	Argon
NO	2.67375E-09	4.13067E-06	2.31884E-12	6.43585E-06	6.53136E-06	9.55123E-08	9.55146E-08	8.26134E-06	6.60907E-06	0	1.65227E-06	5.68889E-07	1.42222E-07	NO
NO2	3.28734E-08	9.54065E-06	2.08696E-08	1.50117E-05	1.52345E-05	2.22784E-07	2.43654E-07	1.90813E-05	1.52650E-05	0	3.81626E-06	1.32903E-06	3.32257E-07	NO2
NH3	0.0336174	0.181104	0.00781055	0.191462	0.194303	0.00284142	0.0106520	0.362208	0.289766	0.179743	0.0724416	0.161500	0.0403750	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	5.04451E-07	0.000251548	1.74622E-08	0.000380930	0.000380930	0.000380930	0.000305422	0.000251548	0.000251548	0	0.000251548	2.73807E-05	2.73807E-05	Oxygen
Nitrogen	9.34603E-07	0.000688565	1.35443E-08	0.00104005	0.00104005	0.00104005	0.000833885	0.000688565	0.000688565	0	0.000688565	7.47574E-05	7.47574E-05	Nitrogen
Water	54.6545	54.3308	99.7829	98.1844	98.1844	98.1844	98.5012	54.3308	54.3308	56.1615	54.3308	59.1984	59.1984	Water
Carbon Dioxide	10.2250	11.1623	0.135588	0.356992	0.356992	0.356992	0.313103	11.1623	11.1623	6.22557	11.1623	5.80137	5.80137	Carbon Dioxide
Sulfur Dioxide	7.44405E-08	2.55259E-07	2.73214E-07	3.92255E-07	3.92255E-07	3.92255E-07	3.68658E-07	2.55259E-07	2.55259E-07	0	2.55259E-07	2.82763E-08	2.82763E-08	Sulfur Dioxide
MEA	35.1203	34.5057	0.0790462	1.45698	1.45698	1.45698	1.18383	34.5057	34.5057	37.6128	34.5057	35	35	MEA
Argon	4.22583E-08	2.19539E-05	1.72048E-09	3.32907E-05	3.32907E-05	3.32907E-05	2.66919E-05	2.19539E-05	2.19539E-05	0	2.19539E-05	2.39289E-06	2.39289E-06	Argon
NO	2.84940E-11	8.64871E-09	1.28567E-12	1.30928E-08	1.30928E-08	1.30928E-08	1.04977E-08	8.64871E-09	8.64871E-09	0	8.64871E-09	9.41095E-10	9.41095E-10	NO
NO2	5.37128E-10	3.06273E-08	1.77408E-08	4.68229E-08	4.68229E-08	4.68229E-08	4.10580E-08	3.06273E-08	3.06273E-08	0	3.06273E-08	3.37086E-09	3.37086E-09	NO2
NH3	0.000203337	0.000215217	0.00245786	0.000221069	0.000221069	0.000221069	0.000664467	0.000215217	0.000215217	0.000145527	0.000215217	0.000151634	0.000151634	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0.00142035	3.60495	9.45044E-07	5.61859	5.70197	0.0833836	0.0833845	7.20991	5.76792	0	1.44198	0.496648	0.124162	Oxygen
Nitrogen	0.00263150	9.86787	7.33009E-07	15.3404	15.5680	0.227661	0.227662	19.7357	15.7886	0	3.94715	1.35599	0.338998	Nitrogen
Water	153887	778619	5400.18	1.44819E+06	1.46968E+06	21492.0	26892.2	1.55724E+06	1.24579E+06	1.18134E+06	311448	1.07377E+06	268444	Water
Carbon Dioxide	28789.9	159967	7.33791	5265.51	5343.65	78.1437	85.4816	319934	255947	130953	63986.8	105229	26307.1	Carbon Dioxide
Sulfur Dioxide	0.000209597	0.00365814	1.47862E-05	0.00578563	0.00587149	8.58626E-05	0.000100649	0.00731628	0.00585302	0	0.00146326	0.000512891	0.000128223	Sulfur Dioxide
MEA	98886.1	494504	4.27792	21489.9	21808.8	318.925	323.203	989009	791207	791173	197802	634850	158713	MEA
Argon	0.000118984	0.314623	9.31109E-08	0.491026	0.498313	0.00728716	0.00728725	0.629246	0.503397	0	0.125849	0.0434037	0.0108509	Argon
NO	8.02287E-08	0.000123945	6.95793E-11	0.000193115	0.000195981	2.86595E-06	2.86602E-06	0.000247891	0.000198312	0	4.95781E-05	1.70701E-05	4.26753E-06	NO
NO2	1.51236E-06	0.000438922	9.60117E-07	0.000690622	0.000700871	1.02493E-05	1.12094E-05	0.000877845	0.000702276	0	0.000175569	6.11426E-05	1.52856E-05	NO2
NH3	0.572522	3.08430	0.133018	3.26070	3.30909	0.0483909	0.181409	6.16859	4.93487	3.06111	1.23372	2.75043	0.687607	NH3

Process Streams		205	206	207	208	209	210	211	300	302	303	304	305	306	Process Streams	
Property	**Units**														**Units**	**Property**
Temperature	℃	58.9133	53.3596	45.7208	20.0000	20.0000	20.0000	25.2480	53.5053	117*	126.353	53.5053	53.9381	53.9381	℃	Temperature
Pressure	bar	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	10.7412	9.70702	5.41280	10.7412	3.68912	3.68912	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	0	0	0	0	0	0	0	0	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	26.0343	26.0797	18.0398	18.2412	18.2412	18.2412	18.2009	26.0797	26.0797	25.8087	26.0797	25.0574	25.0574	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1142.94	1152.37	989.520	999.738	999.738	999.738	997.930	1152.44	1132.88	1068.43	1152.44	1088.79	1088.79	kg/m^3	Mass Density
Molar Flow	kmol/h	10815.1	54951.0	300	80858.9	82058.9	1200	1500	109902	87921.6	81502.4	21980.4	72388.0	18097.0	kmol/h	Molar Flow
Mass Flow	kg/h	281564	1.43311E+06	5411.93	1.47497E+06	1.49685E+06	21889.5	27301.4	2.86621E+06	2.29297E+06	2.10347E+06	573243	1.81386E+06	453465	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	256215	1.30181E+06	7107.13	1.91558E+06	1.94401E+06	28428.5	35535.7	2.60363E+06	2.08290E+06	1.93083E+06	520725	1.71490E+06	428726	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	286.034	1458.96	5.41884	1477.12	1499.04	21.9214	27.3403	2917.91	2334.33	2117.55	583.582	1825.31	456.328	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.14402	1.15346	0.990455	1.00068	1.00068	1.00068	0.998873	1.15353	1.13395	1.06944	1.15353	1.08982	1.08982		Specific Gravity
Mass Enthalpy	kJ/kg	-11146.1	-11187.2	-15760.7	-15697.0	-15697.0	-15697.0	-15709.7	-11186.0	-10958.4	-10814.8	-11186.0	-11403.5	-11403.5	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	2.17583	2.60238	0.579362	1.04740	1.04740	1.04740	0.913216	2.59641	0.690755	0.520515	2.59641	1.77319	1.77319	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.3873	0.3812	0.6309	0.5885	0.5885	0.5885	0.5976	0.3813	0.3943	0.4149	0.3813	0.4168	0.4168	W/(m*℃)	Thermal Conducti vity
Surface Tension	dyne/cm	92.8648	95.6192	68.6724	73.3892	73.3892	73.3892	72.4546	93.0895	87.1830	46.6040	93.0895	59.3976	59.3976	dyne/cm	Surface Tension

Process Streams		307	309	310	311	312	313	314	315	316	317	318	319	320	322	323	324		Process Streams
		Fresh Amine	Rich Amine to E-107	Rich Amine to E-109	Rich Amine to V-101	Flash Gas	Hot Semi-Lean Amine	Stripper Bottoms	Stripper Bottoms to E-107	Reclaimer Feed	Reclaimer Product	Stripper Reboiler Inlet	Stripper Reboiler Discharge	Stripper Overhead	Stripper Reflux	Reflux Purge	Cooled Stripper Overhead		
Mole Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mole Fraction**
Oxygen		0	0.000205017	0.000205017	0.000205017	0.0128445	4.10422E-07	0	0	0	0	0	0	0.00299646	2.20237E-07	2.20237E-07	0.00299646		Oxygen
Nitrogen		0	0.000641035	0.000641035	0.000641035	0.0401872	8.68573E-07	0	0	0	0	0	0	0.00937033	3.65715E-07	3.65715E-07	0.00937033		Nitrogen
Water		0	78.6517	78.6517	78.6517	58.2303	78.9823	80.4568	80.4568	80.4568	95.6590	80.4568	80.4568	60.2430	99.8824	99.8824	60.2430		Water
Carbon Dioxide		0	6.61467	6.61467	6.61467	41.5768	6.04871	3.65089	3.65089	3.65089	4.34072	3.65089	3.65089	39.7275	0.0881969	0.0881969	39.7275		Carbon Dioxide
Sulfur Dioxide		0	1.03913E-07	1.03913E-07	1.03913E-07	4.65439E-06	3.02511E-08	0	0	0	0	0	0	1.43643E-06	7.17408E-08	7.17408E-08	1.43643E-06		Sulfur Dioxide
MEA		100	14.7324	14.7324	14.7324	0.137491	14.9687	15.8921	15.8921	15.8921	0	15.8921	15.8921	0.0152098	0.0264361	0.0264361	0.0152098		MEA
Argon		0	1.43324E-05	1.43324E-05	1.43324E-05	0.000898013	2.75399E-08	0	0	0	0	0	0	0.000209481	1.63361E-08	1.63361E-08	0.000209481		Argon
NO		0	7.51700E-09	7.51700E-09	7.51700E-09	4.70351E-07	2.47223E-11	0	0	0	0	0	0	1.09838E-07	1.19293E-11	1.19293E-11	1.09838E-07		NO
NO2		0	1.73621E-08	1.73621E-08	1.73621E-08	1.07112E-06	3.03957E-10	0	0	0	0	0	0	2.52998E-07	2.62728E-10	2.62728E-10	2.52998E-07		NO2
NH3		0	0.000329574	0.000329574	0.000329574	0.00148724	0.000310834	0.000220537	0.000220537	0.000220537	0.000262207	0.000220537	0.000220537	0.00170289	0.00294964	0.00294964	0.00170289		NH3
Molar Flow		kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h		**Molar Flow**
Oxygen		0	0.0450636	0.0450636	0.0450636	0.0449748	8.87752E-05	0	0	0	0	0	0	0.225230	9.52432E-07	8.57189E-06	0.225230		Oxygen
Nitrogen		0	0.140902	0.140902	0.140902	0.140714	0.000187874	0	0	0	0	0	0	0.704324	1.58156E-06	1.42341E-05	0.704324		Nitrogen
Water		0	17288.0	17288.0	17288.0	203.892	17084.1	65574.2	65574.2	0	0	43716.2	43716.2	4528.19	431.949	3887.54	4528.19		Water
Carbon Dioxide		0	1453.93	1453.93	1453.93	145.580	1308.35	2975.56	2975.56	0	0	1983.71	1983.71	2986.13	0.381414	3.43272	2986.13		Carbon Dioxide
Sulfur Dioxide		0	2.28406E-05	2.28406E-05	2.28406E-05	1.62972E-05	6.54339E-06	0	0	0	0	0	0	0.000107970	3.10248E-07	2.79223E-06	0.000107970		Sulfur Dioxide
MEA		0.237686	3238.24	3238.24	3238.24	0.481421	3237.76	12952.4	12952.4	0	0	8634.94	8634.94	1.14325	0.114325	1.02893	1.14325		MEA
Argon		0	0.00315033	0.00315033	0.00315033	0.00314437	5.95695E-06	0	0	0	0	0	0	0.0157457	7.06467E-08	6.35820E-07	0.0157457		Argon
NO		0	1.65227E-06	1.65227E-06	1.65227E-06	1.64692E-06	5.34749E-09	0	0	0	0	0	0	8.25604E-06	5.15892E-11	4.64303E-10	8.25604E-06		NO
NO2		0	3.81626E-06	3.81626E-06	3.81626E-06	3.75051E-06	6.57467E-08	0	0	0	0	0	0	1.90167E-05	1.13619E-09	1.02257E-08	1.90167E-05		NO2
NH3		0	0.0724416	0.0724416	0.0724416	0.00520751	0.0672341	0.179743	0.179743	0	0	0.119829	0.119829	0.127999	0.0127559	0.114803	0.127999		NH3
Mass Fraction		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mass Fraction**
Oxygen		0	0.000251548	0.000251548	0.000251548	0.0142277	5.04451E-07	0	0	0	0	0	0	0.00338212	3.90443E-07	3.90443E-07	0.00338212		Oxygen
Nitrogen		0	0.000688565	0.000688565	0.000688565	0.0389704	9.34602E-07	0	0	0	0	0	0	0.00925906	5.67599E-07	5.67599E-07	0.00925906		Nitrogen
Water		0	54.3308	54.3308	54.3308	36.3138	54.6545	56.1615	56.1615	56.1615	90.0208	56.1615	56.1615	38.2819	99.6927	99.6927	38.2819		Water
Carbon Dioxide		0	11.1623	11.1623	11.1623	63.3401	10.2250	6.22557	6.22557	6.22557	9.97893	6.22557	6.22557	61.6713	0.215047	0.215047	61.6713		Carbon Dioxide
Sulfur Dioxide		0	2.55259E-07	2.55259E-07	2.55259E-07	1.03218E-05	7.44403E-08	0	0	0	0	0	0	3.24596E-06	2.54631E-07	2.54631E-07	3.24596E-06		Sulfur Dioxide
MEA		100	34.5057	34.5057	34.5057	0.290721	35.1203	37.6128	37.6128	37.6128	0	37.6128	37.6128	0.0327712	0.0894648	0.0894648	0.0327712		MEA
Argon		0	2.19539E-05	2.19539E-05	2.19539E-05	0.00124182	4.22583E-08	0	0	0	0	0	0	0.000295180	3.61557E-08	3.61557E-08	0.000295180		Argon
NO		0	8.64871E-09	8.64871E-09	8.64871E-09	4.88555E-07	2.84939E-11	0	0	0	0	0	0	1.16255E-07	1.98316E-11	1.98316E-11	1.16255E-07		NO
NO2		0	3.06273E-08	3.06273E-08	3.06273E-08	1.70581E-06	5.37127E-10	0	0	0	0	0	0	4.10557E-07	6.69652E-10	6.69652E-10	4.10557E-07		NO2
NH3		0	0.000215217	0.000215217	0.000215217	0.000876778	0.000203334	0.000145527	0.000145527	0.000145527	0.000233264	0.000145527	0.000145527	0.00102297	0.00278311	0.00278311	0.00102297		NH3
Mass Flow		kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h		**Mass Flow**
Oxygen		0	1.44198	1.44198	1.44198	1.43914	0.00284070	0	0	0	0	0	0	7.20710	3.04767E-05	0.000274290	7.20710		Oxygen
Nitrogen		0	3.94715	3.94715	3.94715	3.94188	0.00526300	0	0	0	0	0	0	19.7305	4.43049E-05	0.000398744	19.7305		Nitrogen
Water		0	311448	311448	311448	3673.17	307774	1.18134E+06	1.18134E+06	0	0	787559	787559	81576.6	7781.68	70035.1	81576.6		Water
Carbon Dioxide		0	63986.8	63986.8	63986.8	6406.90	57579.9	130953	130953	0	0	87302.0	87302.0	131418	16.7858	151.073	131418		Carbon Dioxide
Sulfur Dioxide		0	0.00146326	0.00146326	0.00146326	0.00104406	0.000419194	0	0	0	0	0	0	0.00691696	1.98757E-05	0.000178881	0.00691696		Sulfur Dioxide
MEA		14.5186	197802	197802	197802	29.4067	197772	791173	791173	0	0	527449	527449	69.8334	6.98333	62.8499	69.8334		MEA
Argon		0	0.125849	0.125849	0.125849	0.125611	0.000237968	0	0	0	0	0	0	0.629011	2.82219E-06	2.53998E-05	0.629011		Argon
NO		0	4.95781E-05	4.95781E-05	4.95781E-05	4.94177E-05	1.60457E-07	0	0	0	0	0	0	0.000247732	1.54799E-09	1.39319E-08	0.000247732		NO
NO2		0	0.000175569	0.000175569	0.000175569	0.000172544	3.02471E-06	0	0	0	0	0	0	0.000874872	5.22708E-08	4.70437E-07	0.000874872		NO2
NH3		0	1.23372	1.23372	1.23372	0.0886867	1.14503	3.06111	3.06111	0	0	2.04074	2.04074	2.17988	0.217240	1.95516	2.17988		NH3
Process Streams		**307**	**309**	**310**	**311**	**312**	**313**	**314**	**315**	**316**	**317**	**318**	**319**	**320**	**322**	**323**	**324**		**Process Streams**
Property	**Units**																	**Units**	**Property**
Temperature	℃	20.0000	108*	112.778*	121.550	113.728	113.781	127.542	127.610			127.542	130.125	104.856	48.7469	48.7469	48.8889*	℃	Temperature
Pressure	bar	4.13685	9.70702	8.67281	7.63859	2.39982*	5.84719	2.31016	6.10228	6.10228	6.10228	2.31016	2.31016	1.96543	5.24044	5.24044	1.82753	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	100	0	0	0			0	19.1855	100	0	0	42.4389	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	61.0831	26.0797	26.0797	26.0797	28.8880	26.0343	25.8087	25.8087	25.8087	19.1436	25.8087	25.8087	28.3501	18.0496	18.0496	28.3501	kg/kmol	Molecular Weight
Mass Density	kg/m^3	1021.42	1136.55	1134.62	1130.90	2.17932	1124.67	1067.66	1067.68			1067.66	9.34453	1.79065	988.420	988.420	4.58985	kg/m^3	Mass Density
Molar Flow	kmol/h	0.237686	21980.4	21980.4	21980.4	350.147	21630.3	81502.4	81502.4	0	0	54334.9	54334.9	7516.53	432.457	3892.12	7516.53	kmol/h	Molar Flow
Mass Flow	kg/h	14.5186	573243	573243	573243	10115.1	563128	2.10347E+06	2.10347E+06	0	0	1.40231E+06	1.40231E+06	213094	7805.67	70251.0	213094	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	5.63090	520725	520725	520725	8295.14	512430	1.93083E+06	1.93083E+06	0	0	1.28722E+06	1.28722E+06	178070	10245.1	92206.0	178070	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	0.0142325	583.582	583.582	583.582	11.5137	572.069	2117.55	2117.55	0	0	1411.70	1411.70	241.788	7.81698	70.3528	241.788	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.02239	1.13762	1.13570	1.13197	0.997826	1.12573	1.06867	1.06869			1.06867		0.979243	0.989354	0.989354			Specific Gravity
Mass Enthalpy	kJ/kg	-4445.34	-10992.7	-10974.7	-10940.8	-10439.9	-10949.4	-10810.4	-10809.9	-10809.9		-10810.4	-10495.4	-10556.0	-15741.5	-15741.5	-11498.2	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	26.8174	0.796759	0.737383	0.645129	0.0170316	0.708349	0.511868	0.511850			0.511868		0.0165437	0.548086	0.548086		cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.2355	0.3940	0.3942	0.3943	0.0247	0.3981	0.4148	0.4148			0.4148		0.0240	0.6335	0.6335		W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm	48.9361	88.3433	87.9905	87.0818		86.9301	46.4007	46.3822			46.4007			68.0582	68.0582		dyne/cm	Surface Tension

Process Streams	325	330	332	333	334	400	401	402	403	404	405	406	407	408	409	Process Streams
	Stripper Overhead Liquid	Hot Semi-Lean Amine	Cold Rich Amine to Lean / Rich Exchanger	Process Water to Absorbers	Lean Amine to E-102 Inlet	CO2	1st Stage Suction	Hot 1st Stage Discharge	Cooled 1st Stage Discharge	Cold 1st Stage Discharge	2nd Stage Suction	Hot 2nd Stage Discharge	Cooled 2nd Stage Discharge	Cold 2nd Stage Discharge	Dryer Inlet	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	2.20237E-07	4.10422E-07	0.000205017	9.84458E-09*	0	0.00705588	0.00705594	0.00705594	0.00705594	0.00705594	0.00750067	0.00750067	0.00750067	0.00750067	0.00753644	Oxygen
Nitrogen	3.65715E-07	8.68573E-07	0.000641035	8.72213E-09*	0	0.0220651	0.0220653	0.0220653	0.0220653	0.0220653	0.0234561	0.0234561	0.0234561	0.0234561	0.0235680	Nitrogen
Water	99.8824	78.9823	78.6517	99.9185*	80.4568	6.53827	6.53747	6.53747	6.53747	6.53747	0.658027	0.658027	0.658027	0.658027	0.188667	Water
Carbon Dioxide	0.0881969	6.04871	6.61467	0.0555783*	3.65089	93.4321	93.4329	93.4329	93.4329	93.4329	99.3105	99.3105	99.3105	99.3105	99.7797	Carbon Dioxide
Sulfur Dioxide	7.17408E-08	3.02511E-08	1.03913E-07	7.69346E-08*	0	3.28536E-06	3.28539E-06	3.28539E-06	3.28539E-06	3.28539E-06	3.47476E-06	3.47476E-06	3.47476E-06	3.47476E-06	3.48552E-06	Sulfur Dioxide
MEA	0.0264361	14.9687	14.7324	0.0233448*	15.8921	7.99930E-08	7.99671E-08	7.99671E-08	7.99671E-08	7.99671E-08	2.83077E-09	2.83077E-09	2.83077E-09	2.83077E-09	4.56643E-10	MEA
Argon	1.63361E-08	2.75399E-08	1.43324E-05	7.76934E-10*	0	0.000493272	0.000493276	0.000493276	0.000493276	0.000493276	0.000524367	0.000524367	0.000524367	0.000524367	0.000526868	Argon
NO	1.19293E-11	2.47223E-11	7.51700E-09	7.72946E-13*	0	2.58635E-07	2.58637E-07	2.58637E-07	2.58637E-07	2.58637E-07	2.74938E-07	2.74938E-07	2.74938E-07	2.74938E-07	2.76249E-07	NO
NO2	2.62728E-10	3.03957E-10	1.73621E-08	6.95654E-09*	0	5.95413E-07	5.95417E-07	5.95417E-07	5.95417E-07	5.95417E-07	6.12949E-07	6.12949E-07	6.12949E-07	6.12949E-07	6.09559E-07	NO2
NH3	0.00294964	0.000310834	0.000329574	0.00260352*	0.000220537	1.37573E-05	1.37573E-05	1.37573E-05	1.37573E-05	1.37573E-05	1.03368E-05	1.03368E-05	1.03368E-05	1.03368E-05	9.17392E-06	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	9.52432E-06	8.87752E-05	0.180254	4.74224E-09*	0	0.225221	0.225221	0.225221	0.225221	0.225221	0.225219	0.225219	0.225219	0.225219	0.225219	Oxygen
Nitrogen	1.58156E-05	0.000187874	0.563608	4.20154E-09*	0	0.704308	0.704308	0.704308	0.704308	0.704308	0.704306	0.704306	0.704306	0.704306	0.704305	Nitrogen
Water	4319.49	17084.1	69151.9	48.1318*	65574.2	208.699	208.672	208.672	208.672	208.672	19.7583	19.7583	19.7583	19.7583	5.63813	Water
Carbon Dioxide	3.81414	1308.35	5815.73	0.0267726*	2975.56	2982.31	2982.31	2982.31	2982.31	2982.31	2981.95	2981.95	2981.95	2981.95	2981.81	Carbon Dioxide
Sulfur Dioxide	3.10248E-06	6.54339E-06	9.13624E-05	3.70602E-08*	0	0.000104867	0.000104867	0.000104867	0.000104867	0.000104867	0.000104335	0.000104335	0.000104335	0.000104335	0.000104161	Sulfur Dioxide
MEA	1.14325	3237.76	12953.0	0.0112455*	12952.4	2.55334E-06	2.55250E-06	2.55250E-06	2.55250E-06	2.55250E-06	8.49983E-08	8.49983E-08	8.49983E-08	8.49983E-08	1.36463E-08	MEA
Argon	7.06467E-07	5.95695E-06	0.0126013	3.74258E-10*	0	0.0157450	0.0157450	0.0157450	0.0157450	0.0157450	0.0157449	0.0157449	0.0157449	0.0157449	0.0157449	Argon
NO	5.15892E-10	5.34749E-09	6.60907E-06	3.72336E-13*	0	8.25553E-06	8.25553E-06	8.25553E-06	8.25553E-06	8.25553E-06	8.25546E-06	8.25546E-06	8.25546E-06	8.25546E-06	8.25542E-06	NO
NO2	1.13619E-08	6.57467E-08	1.52650E-05	3.35104E-09*	0	1.90053E-05	1.90053E-05	1.90053E-05	1.90053E-05	1.90053E-05	1.84048E-05	1.84048E-05	1.84048E-05	1.84048E-05	1.82160E-05	NO2
NH3	0.127559	0.0672341	0.289766	0.00125414*	0.179743	0.000439126	0.000439123	0.000439123	0.000439123	0.000439123	0.000310378	0.000310378	0.000310378	0.000310378	0.000274153	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	3.90443E-07	5.04451E-07	0.000251548	1.74622E-08*	0	0.00533688	0.00533690	0.00533690	0.00533690	0.00533690	0.00547551	0.00547551	0.00547551	0.00547551	0.00548636	Oxygen
Nitrogen	5.67599E-07	9.34602E-07	0.000688565	1.35443E-08*	0	0.0146108	0.0146109	0.0146109	0.0146109	0.0146109	0.0149904	0.0149904	0.0149904	0.0149904	0.0150201	Nitrogen
Water	99.6927	54.6545	54.3308	99.7829*	56.1615	2.78424	2.78389	2.78389	2.78389	2.78389	0.270443	0.270443	0.270443	0.270443	0.0773254	Water
Carbon Dioxide	0.215047	10.2250	11.1623	0.135588*	6.22557	97.1953	97.1957	97.1957	97.1957	97.1957	99.7086	99.7086	99.7086	99.7086	99.9017	Carbon Dioxide
Sulfur Dioxide	2.54631E-07	7.44403E-08	2.55259E-07	2.73214E-07*	0	4.97506E-06	4.97508E-06	4.97508E-06	4.97508E-06	4.97508E-06	5.07842E-06	5.07842E-06	5.07842E-06	5.07842E-06	5.08001E-06	Sulfur Dioxide
MEA	0.0894648	35.1203	34.5057	0.0790462*	37.6128	1.15498E-07	1.15460E-07	1.15460E-07	1.15460E-07	1.15460E-07	3.94472E-09	3.94472E-09	3.94472E-09	3.94472E-09	6.34574E-10	MEA
Argon	3.61557E-08	4.22583E-08	2.19539E-05	1.72048E-09*	0	0.000465784	0.000465785	0.000465785	0.000465785	0.000465785	0.000477883	0.000477883	0.000477883	0.000477883	0.000478829	Argon
NO	1.98316E-11	2.84939E-11	8.64871E-09	1.28567E-12*	0	1.83443E-07	1.83443E-07	1.83443E-07	1.83443E-07	1.83443E-07	1.88207E-07	1.88207E-07	1.88207E-07	1.88207E-07	1.88580E-07	NO
NO2	6.69652E-10	5.37127E-10	3.06273E-08	1.77408E-08*	0	6.47487E-07	6.47489E-07	6.47489E-07	6.47489E-07	6.47489E-07	6.43317E-07	6.43317E-07	6.43317E-07	6.43317E-07	6.37984E-07	NO2
NH3	0.00278311	0.000203334	0.000215217	0.00245786*	0.000145527	5.53813E-06	5.53810E-06	5.53810E-06	5.53810E-06	5.53810E-06	4.01610E-06	4.01610E-06	4.01610E-06	4.01610E-06	3.55441E-06	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	0.000304767	0.00284070	5.76792	1.51746E-07*	0	7.20679	7.20679	7.20679	7.20679	7.20679	7.20675	7.20675	7.20675	7.20675	7.20673	Oxygen
Nitrogen	0.000443049	0.00526300	15.7886	1.17699E-07*	0	19.7301	19.7301	19.7301	19.7301	19.7301	19.7300	19.7300	19.7300	19.7300	19.7300	Nitrogen
Water	77816.8	307774	1.24579E+06	867.108*	1.18134E+06	3759.77	3759.28	3759.28	3759.28	3759.28	355.951	355.951	355.951	355.951	101.572	Water
Carbon Dioxide	167.858	57579.9	255947	1.17825*	130953	131250	131250	131250	131250	131250	131234	131234	131234	131234	131228	Carbon Dioxide
Sulfur Dioxide	0.000198757	0.000419194	0.00585302	2.37422E-06*	0	0.00671820	0.00671820	0.00671820	0.00671820	0.00671820	0.00668411	0.00668411	0.00668411	0.00668411	0.00667296	Sulfur Dioxide
MEA	69.8333	197772	791207	0.686907*	791173	0.000155966	0.000155914	0.000155914	0.000155914	0.000155914	5.19196E-06	5.19196E-06	5.19196E-06	5.19196E-06	8.33558E-07	MEA
Argon	2.82219E-05	0.000237968	0.503397	1.49508E-08*	0	0.628983	0.628983	0.628983	0.628983	0.628983	0.628979	0.628979	0.628979	0.628979	0.628977	Argon
NO	1.54799E-08	1.60457E-07	0.000198312	1.11724E-11*	0	0.000247716	0.000247716	0.000247716	0.000247716	0.000247716	0.000247714	0.000247714	0.000247714	0.000247714	0.000247713	NO
NO2	5.22708E-07	3.02471E-06	0.000702276	1.54166E-07*	0	0.000874350	0.000874349	0.000874349	0.000874349	0.000874349	0.000846720	0.000846720	0.000846720	0.000846720	0.000838038	NO2
NH3	2.17240	1.14503	4.93487	0.0213587*	3.06111	0.00747855	0.00747849	0.00747849	0.00747849	0.00747849	0.00528590	0.00528590	0.00528590	0.00528590	0.00466897	NH3

Process Streams		325	330	332	333	334	400	401	402	403	404	405	406	407	408	409		Process Streams
Property	**Units**																**Units**	**Property**
Temperature	℃	48.6909	113.728	53.5053	45.7208*	58.7730	48.7010	48.7010	176.667*	129.444*	26*	25.8867	176.667*	129.444*	26*	25.9261	℃	Temperature
Pressure	bar	1.79306	2.39982	10.7412	4.13685*	4.72333	1.79306	1.79306	6.03552	5.75973	5.41499	5.34605	23.1076	22.8318	22.4870	22.4181	bar	Pressure
Mole Fraction Vapor	%	0	0	0	0	0	99.9991	100	100	100	94.0633	100	100	100	99.5254	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	18.0496	26.0343	26.0797	18.0398	25.8087	42.3055	42.3057	42.3057	42.3057	42.3057	43.8338	43.8338	43.8338	43.8338	43.9558	kg/kmol	Molecular Weight
Mass Density	kg/m^3	988.395	1124.65	1152.44	989.520	1100.41	2.85806	2.85805	6.88503	7.37042	10.0902	9.71147	27.9169	31.3460	45.7895	45.5574	kg/m^3	Mass Density
Molar Flow	kmol/h	4324.57	21630.3	87921.6	48.1711	81502.4	3191.96	3191.93	3191.93	3191.93	3191.93	3002.66	3002.66	3002.66	3002.66	2988.40	kmol/h	Molar Flow
Mass Flow	kg/h	78056.7	563128	2.29297E+06	868.994*	2.10347E+06	135037	135037	135037	135037	135037	131618	131618	131618	131618	131357	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	102451	512430	2.08290E+06	1141.19	1.93083E+06	75618.9	75618.3	75618.3	75618.3	75618.3	71134.3	71134.3	71134.3	71134.3	70796.4	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	78.1698	572.069	2334.33	0.870104	2117.55	163.618	163.618	163.618	163.618	163.618	160.192	160.192	160.192	160.192	159.930	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.989329	1.12571	1.15353	0.990455	1.10145		1.46129	1.46129	1.46129		1.51407	1.51407	1.51407		1.51828		Specific Gravity
Mass Enthalpy	kJ/kg	-15742.0	-10949.8	-11186.0	-15760.7	-11062.9	-9045.10	-9045.07	-8924.50	-8971.65	-9130.15	-8956.04	-8823.38	-8871.30	-8978.42	-8965.08	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.548233	0.708427	2.59641	0.579362	1.86394		0.0161454	0.0216019	0.0197044		0.0152834	0.0220095	0.0201805		0.0159386	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.6334	0.3981	0.3813	0.6309	0.4048		0.0187	0.0287	0.0251		0.0172	0.0296	0.0261		0.0189	W/(m*℃)	Thermal Conductivit y
Surface Tension	dyne/cm	68.0691	87.7229	93.0895	68.6724	57.9010											dyne/cm	Surface Tension

Process Streams	410	411	412	413	414	415	416	417	501	502	503	504	505	506	509	510	511	Process Streams
	3rd Stage Suction	Hot 3rd Stage Discharge	Cooled 3rd Stage Discharge	Cold 3rd Stage Discharge	CO2 Product	Inter-stage Liquid	Liquefied CO2	Dryer Water	SCW Supply to E-101	SCW Return From E-101	SCW Supply to E-104	SCW Return From E-104	SCW Supply to E-102	SCW Return From E-102	SCW Supply to E-111	SCW Return From E-111	LP Steam from E-112	
Mole Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mole Fraction**
Oxygen	0.00754986	0.00754986	0.00754986	0.00754986	0.00754986	9.44606E-07	0.00754986	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	0.0236100	0.0236100	0.0236100	0.0236100	0.0236100	1.46631E-06	0.0236100	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	0.0110000	0.0110000	0.0110000	0.0110000	0.0110000	99.7532	0.0110000	100	100*	100	100*	100	100*	100	100*	100	100	Water
Carbon Dioxide	99.9573	99.9573	99.9573	99.9573	99.9573	0.246722	99.9573	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	3.49172E-06	3.49172E-06	3.49172E-06	3.49172E-06	3.49172E-06	3.46978E-07	3.49172E-06	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	4.57456E-10	4.57456E-10	4.57456E-10	4.57456E-10	4.57456E-10	1.24761E-06	4.57456E-10	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.000527806	0.000527806	0.000527806	0.000527806	0.000527806	7.15640E-08	0.000527806	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	2.76741E-07	2.76741E-07	2.76741E-07	2.76741E-07	2.76741E-07	5.13855E-11	2.76741E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	6.10644E-07	6.10644E-07	6.10644E-07	6.10644E-07	6.10644E-07	3.87768E-07	6.10644E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	9.19025E-06	9.19025E-06	9.19025E-06	9.19025E-06	9.19025E-06	8.09937E-05	9.19025E-06	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Molar Flow	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	**Molar Flow**
Oxygen	0.225219	0.225219	0.225219	0.225219	0.225219	1.92286E-06	0.225219	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	0.704305	0.704305	0.704305	0.704305	0.704305	2.98485E-06	0.704305	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	0.328139	0.328139	0.328139	0.328139	0.328139	203.060	0.328139	5.30999	275071*	275071	275071*	275071	47837.2*	47837.2	275025*	275025	152.254	Water
Carbon Dioxide	2981.81	2981.81	2981.81	2981.81	2981.81	0.502233	2981.81	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0.000104161	0.000104161	0.000104161	0.000104161	0.000104161	7.06317E-07	0.000104161	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	1.36463E-08	1.36463E-08	1.36463E-08	1.36463E-08	1.36463E-08	2.53966E-06	1.36463E-08	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.0157449	0.0157449	0.0157449	0.0157449	0.0157449	1.45677E-07	0.0157449	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	8.25542E-06	8.25542E-06	8.25542E-06	8.25542E-06	8.25542E-06	1.04602E-10	8.25542E-06	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	1.82160E-05	1.82160E-05	1.82160E-05	1.82160E-05	1.82160E-05	7.89349E-07	1.82160E-05	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	0.000274153	0.000274153	0.000274153	0.000274153	0.000274153	0.000164873	0.000274153	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Mass Fraction	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	**Mass Fraction**
Oxygen	0.00549036	0.00549036	0.00549036	0.00549036	0.00549036	1.67186E-06	0.00549036	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	0.0150311	0.0150311	0.0150311	0.0150311	0.0150311	2.27199E-06	0.0150311	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	0.00450362	0.00450362	0.00450362	0.00450362	0.00450362	99.3993	0.00450362	100	100*	100	100*	100	100*	100	100*	100	100	Water
Carbon Dioxide	99.9745	99.9745	99.9745	99.9745	99.9745	0.600579	99.9745	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	5.08371E-06	5.08371E-06	5.08371E-06	5.08371E-06	5.08371E-06	1.22951E-06	5.08371E-06	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	6.35036E-10	6.35036E-10	6.35036E-10	6.35036E-10	6.35036E-10	4.21516E-06	6.35036E-10	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.000479178	0.000479178	0.000479178	0.000479178	0.000479178	1.58127E-07	0.000479178	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	1.88717E-07	1.88717E-07	1.88717E-07	1.88717E-07	1.88717E-07	8.52837E-11	1.88717E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	6.38449E-07	6.38449E-07	6.38449E-07	6.38449E-07	6.38449E-07	9.86727E-07	6.38449E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	3.55700E-06	3.55700E-06	3.55700E-06	3.55700E-06	3.55700E-06	7.62948E-05	3.55700E-06	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Mass Flow	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	**Mass Flow**
Oxygen	7.20673	7.20673	7.20673	7.20673	7.20673	6.15293E-05	7.20673	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen	19.7300	19.7300	19.7300	19.7300	19.7300	8.36157E-05	19.7300	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water	5.91152	5.91152	5.91152	5.91152	5.91152	3658.18	5.91152	95.6609	4.95548E+06*	4.95548E+06	4.95548E+06*	4.95548E+06	861801*	861801	4.95465E+06*	4.95465E+06	2742.90	Water
Carbon Dioxide	131228	131228	131228	131228	131228	22.1030	131228	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0.00667296	0.00667296	0.00667296	0.00667296	0.00667296	4.52494E-05	0.00667296	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Dioxide
MEA	8.33558E-07	8.33558E-07	8.33558E-07	8.33558E-07	8.33558E-07	0.000155130	8.33558E-07	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon	0.628977	0.628977	0.628977	0.628977	0.628977	5.81952E-06	0.628977	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO	0.000247713	0.000247713	0.000247713	0.000247713	0.000247713	3.13869E-09	0.000247713	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2	0.000838038	0.000838038	0.000838038	0.000838038	0.000838038	3.63144E-05	0.000838038	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3	0.00466897	0.00466897	0.00466897	0.00466897	0.00466897	0.00280787	0.00466897	0	0*	0	0*	0	0*	0	0*	0	0	NH3

Process Streams		410	411	412	413	414	415	416	417	501	502	503	504	505	506	509	510	511	Process Streams	
Property	**Units**																		**Units**	**Property**
Temperature	℃	25.9261	176.667*	129.444*	28*	48.2023	25.6326	27.9889	25.9261	11*	21	11*	21	11*	21*	11*	21*	125.835	℃	Temperature
Pressure	bar	22.4181	93.5828	93.3070	92.9622	201.000*	1.79306	92.8933	22.4181	1.9999*	0.965686	1.9999*	0.965686	1.9999*	1.31042	1.9999*	0.965686	2.37913	bar	Pressure
Mole Fraction Vapor	%	100	100	100	0	100	0.167175	0	0	0	0	0	0	0	0	0	0	100*	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	44.0019	44.0019	44.0019	44.0019	44.0019	18.0794	44.0019	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	45.5945	123.168	148.590	722.629?	778.532	440.987	722.521	996.481	1000.00	997.597	1000.00	997.597	1000.00	997.602	1000.00	997.597	1.31446	kg/m^3	Mass Density
Molar Flow	kmol/h	2983.09	2983.09	2983.09	2983.09	2983.09	203.562	2983.09	5.30999	275071	275071	275071	275071	47837.2	47837.2	275025	275025	152.254	kmol/h	Molar Flow
Mass Flow	kg/h	131262	131262	131262	131262	131262	3680.29	131262	95.6609	4.95548E+06	4.95548E+06	4.95548E+06	4.95548E+06	861801	861801	4.95465E+06	4.95465E+06	2742.90	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	70670.6	70670.6	70670.6	70670.6	70670.6	4822.48	70670.6	125.796	6.51656E+06	6.51656E+06	6.51656E+06	6.51656E+06	1.13328E+06	1.13328E+06	6.51547E+06	6.51547E+06	3606.97	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	159.834	159.834	159.834	159.834	159.834	3.68870	159.834	0.0957550	4960.36	4960.36	4960.36	4960.36	862.649	862.649	4959.53	4959.53	2.74560	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		1.51988	1.51988	1.51988	0.723312?	1.51988		0.723204?	0.997422	1.00095	0.998540	1.00095	0.998540	1.00095	0.998544	1.00095	0.998540	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-8961.76	-8844.38	-8902.60	-9167.60	-9147.65	-15823.3	-9167.60	-15861.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-13240.4	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.0159403	0.0242104	0.0230638	0.0609532	0.0692271		0.0609671	0.879296	1.29092	0.987115	1.29092	0.987115	1.29092	0.987185	1.29092	0.987115	0.0106144	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.0189	0.0342	0.0319	0.1073	0.0909		0.1073	0.6076	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.0270	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm				0.0000			0.0000	72.6316	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192		dyne/cm	Surface Tension

Process Streams	**512**	**513**	**514**	**515**	**516**	**517**	**518**	**519**	**520**	**521**	**522**	**523**	**524**	**525**	**526**	**527**	**Process Streams**
	LP Condensate from E-109	**LP Steam from E-114**	**LP Steam to E-109**	**SCW Supply to E-113**	**SCW Return From E-113**	**SCW Supply to E-115**	**SCW Return From E-115**	**Condensate to E-112**	**Condensate to E-114**	**Condensate to E-116**	**SCW Supply to E-117**	**SCW Return From E-117**	**LP Steam from E-116**	**LP Steam to E-110**	**LP Condensate from E-110**	**Vent Steam**	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fraction**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100	100	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	487.823	150.833	485.819	28908.9*	28908.9	19043.1*	19043.1	152.254*	150.833*	182.732*	46982.0*	46982.0	182.732	11323.7*	11323.7	314.691	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Fraction**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	100	100	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Oxygen
Nitrogen	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Nitrogen
Water	8788.27	2717.29	8752.16	520803*	520803	343066*	343066	2742.90*	2717.29*	3291.97*	846394*	846394	3291.97	204000*	204000	5669.24	Water
Carbon Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Carbon Dioxide
Sulfur Dioxide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Sulfur Dioxide
MEA	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	MEA
Argon	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	Argon
NO	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO
NO2	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NO2
NH3	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0	NH3

Process Streams		**512**	**513**	**514**	**515**	**516**	**517**	**518**	**519**	**520**	**521**	**522**	**523**	**524**	**525**	**526**	**527**		**Process Streams**
Property	**Units**																	**Units**	**Property**
Temperature	℃	125.835	125.835	125.835	16*	26*	16*	26*	98.8889*	98.8889*	98.8889*	16*	26*	125.835	135*	133.594	146.435	℃	Temperature
Pressure	bar	2.37913	2.37913	2.37913	1.9999*	1.31042	1.9999*	1.31042	2.37913*	2.37913*	2.37913*	1.9999*	1.31042	2.37913	2.9999*	2.9999	2.3499*	bar	Pressure
Mole Fraction Vapor	%	0*	100	100	0	0	0	0	0	0	0	0	0	100	100	0*	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	938.857	1.31446	1.31446	998.879	996.185	998.879	996.185	959.505	959.505	959.505	998.879	996.185	1.31446	1.62556	932.265	1.23159	kg/m^3	Mass Density
Molar Flow	kmol/h	487.823	150.833	485.819	28908.9	28908.9	19043.1	19043.1	152.254	150.833	182.732	46982.0	46982.0	182.732	11323.7	11323.7	314.691	kmol/h	Molar Flow
Mass Flow	kg/h	8788.27	2717.29	8752.16	520803	520803	343066	343066	2742.90	2717.29	3291.97	846394	846394	3291.97	204000*	204000	5669.24	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	11556.7	3573.29	11509.3	684866	684866	451138	451138	3606.97	3573.29	4329.00	1.11303E+06	1.11303E+06	4329.00	268264	268264	7455.16	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	8.79692	2.71997	8.76077	521.315	521.315	343.404	343.404	2.74560	2.71997	3.29521	847.227	847.227	3.29521	204.201	204.201	5.67482	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		0.939745	0.622268	0.622268	0.999823	0.997127	0.999823	0.997127	0.960412	0.960412	0.960412	0.999823	0.997127	0.622268	0.622268	0.933146	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	-15448.2	-13240.4	-13240.4	-15904.0	-15862.9	-15904.0	-15862.9	-15561.8	-15561.8	-15561.8	-15904.0	-15862.9	-13240.4	-13224.7	-15390.4	-13200.2	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	0.219521	0.0106144	0.0106144	1.12405	0.874153	1.12405	0.874153	0.279294	0.279294	0.279294	1.12405	0.874153	0.0106144	0.0110023	0.206890	0.0114855	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	0.6847	0.0270	0.0270	0.5931	0.6077	0.5931	0.6077	0.6758	0.6758	0.6758	0.5931	0.6077	0.0270	0.0278	0.6856	0.0287	W/(m*°C)	Thermal Conductivity
Surface Tension	dyne/cm	53.1489			74.6291	72.6168	74.6291	72.6168	58.4280	58.4280	58.4280	74.6291	72.6168			51.6045		dyne/cm	Surface Tension

Process Streams	001	002	003	004	005	006	007	008	009	010	100	101	102	103	Process
	Flue Gas From CCPP	Flue Gas From Common Fogger	Process Water to Foggers	Process Water to Common Fogger	Process Water to Abs. 1 Fogger	Abs 1. Flue Gas Blower Discharge	Process Water to Absorbers	Process Water to Abs. 2 Fogger	Abs 2. Flue Gas Blower Discharge	Softened Water	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 1)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 1)	
Mole Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fract**
Oxygen	13.2199*	12.8362	1.02194E-08	1.02194E-08	1.02194E-08	12.8362	1.00791E-08*	1.02194E-08	12.8362	0	12.7523	0.000224200	0.000224200	13.5359	Oxygen
Nitrogen	74.6917*	72.5237	8.80283E-09	8.80283E-09	8.80283E-09	72.5237	8.68876E-09*	8.80283E-09	72.5237	0	72.0497	0.000678671	0.000678671	76.4775	Nitrogen
Water	7.73242*	10.4081	99.9159	99.9159	99.9159	10.4081	99.9161*	99.9159	10.4081	100	10.9931	99.3508	99.3508	8.59823	Water
Carbon Dioxide	3.50117*	3.40120	0.0569770	0.0569770	0.0569770	3.40120	0.0567783*	0.0569770	3.40120	0	3.37934	0.166604	0.166604	0.512896	Carbon Dic
Sulfur Dioxide	9.98459E-06*	9.69702E-06	7.71650E-08	7.71650E-08	7.71650E-08	9.69702E-06	7.57268E-08*	7.71650E-08	9.69702E-06	0	9.63414E-06	1.13323E-07	1.13323E-07	1.01161E-05	Sulfur Diox
MEA	0*	0.000710082	0.0244640	0.0244640	0.0244640	0.000710082	0.0244914*	0.0244640	0.000710082	0	0.000865340	0.481486	0.481486	0.000304138	MEA
Argon	0.853978*	0.829190	7.85845E-10	7.85845E-10	7.85845E-10	0.829190	7.74769E-10*	7.85845E-10	0.829190	0	0.823771	1.53030E-05	1.53030E-05	0.874387	Argon
NO	0.000319287*	0.000310019	7.81744E-13	7.81744E-13	7.81744E-13	0.000310019	7.71094E-13*	7.81744E-13	0.000310019	0	0.000307993	8.00652E-09	8.00652E-09	0.000326915	NO
NO2	7.97150E-05*	7.74015E-05	6.82385E-09	6.82385E-09	6.82385E-09	7.74015E-05	6.70462E-09*	6.82385E-09	7.74015E-05	0	7.68956E-05	1.87616E-08	1.87616E-08	8.16024E-05	NO2
NH3	0.000398961*	0.000464497	0.00265682	0.00265682	0.00265682	0.000464497	0.00262444*	0.00265682	0.000464497	0	0.000478826	0.000235387	0.000235387	0.000408216	NH3
Molar Flow	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen	9192.55*	9192.55	2.60576E-07	2.12426E-07	2.40749E-08	4596.27	6.58886E-08*	2.40749E-08	4596.27	0	4596.27	0.167024	0.00696763	4596.19	Oxygen
Nitrogen	51937.2*	51937.2	2.24455E-07	1.82980E-07	2.07377E-08	25968.6	5.67995E-08*	2.07377E-08	25968.6	0	25968.6	0.505594	0.0210916	25968.4	Nitrogen
Water	5376.77*	7453.67	2547.66	2076.90	235.382	3726.83	653.164*	235.382	3726.83	241.983	3962.22	74013.9	3087.60	2919.58	Water
Carbon Dioxide	2434.55*	2435.74	1.45280	1.18435	0.134226	1217.87	0.371167*	0.134226	1217.87	0	1218.00	124.116	5.17767	174.157	Carbon Dic
Sulfur Dioxide	0.00694283*	0.00694443	1.96756E-06	1.60399E-06	1.81785E-07	0.00347222	4.95035E-07*	1.81785E-07	0.00347222	0	0.00347240	8.44226E-05	3.52181E-06	0.00343497	Sulfur Diox
MEA	0*	0.508519	0.623783	0.508519	0.0576321	0.254259	0.160103*	0.0576321	0.254259	0	0.311891	358.696	14.9635	0.103272	MEA
Argon	593.817*	593.817	2.00375E-08	1.63349E-08	1.85129E-09	296.909	5.06476E-09*	1.85129E-09	296.909	0	296.909	0.0114004	0.000475583	296.903	Argon
NO	0.222017*	0.222017	1.99329E-11	1.62497E-11	1.84163E-12	0.111009	5.04073E-12*	1.84163E-12	0.111009	0	0.111009	5.96466E-06	2.48824E-07	0.111006	NO
NO2	0.0554302*	0.0554304	1.73995E-07	1.41844E-07	1.60756E-08	0.0277152	4.38289E-08*	1.60756E-08	0.0277152	0	0.0277152	1.39769E-05	5.83068E-07	0.0277086	NO2
NH3	0.277419*	0.332645	0.0677437	0.0552258	0.00625893	0.166323	0.0171563*	0.00625893	0.166323	0	0.172581	0.175357	0.00731528	0.138612	NH3
Mass Fraction	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Frac**
Oxygen	14.8799*	14.6029	1.81263E-08	1.81263E-08	1.81263E-08	14.6029	1.78775E-08*	1.81263E-08	14.6029	0	14.5415	0.000392758	0.000392758	15.5358	Oxygen
Nitrogen	73.5995*	72.2293	1.36690E-08	1.36690E-08	1.36690E-08	72.2293	1.34919E-08*	1.36690E-08	72.2293	0	71.9258	0.00104083	0.00104083	76.8443	Nitrogen
Water	4.89996*	6.66623	99.7757	99.7757	99.7757	6.66623	99.7761*	99.7757	6.66623	100	7.05748	97.9868	97.9868	5.55600	Water
Carbon Dioxide	5.41996*	5.32165	0.138994	0.138994	0.138994	5.32165	0.138509*	0.138994	5.32165	0	5.29987	0.401409	0.401409	0.809633	Carbon Dic
Sulfur Dioxide	2.24998E-05*	2.20861E-05	2.74020E-07	2.74020E-07	2.74020E-07	2.20861E-05	2.68913E-07*	2.74020E-07	2.20861E-05	0	2.19944E-05	3.97452E-07	3.97452E-07	2.32454E-05	Sulfur Diox
MEA	0*	0.00154204	0.0828317	0.0828317	0.0828317	0.00154204	0.0829247*	0.0828317	0.00154204	0	0.00188363	1.61013	1.61013	0.000666352	MEA
Argon	1.19999*	1.17765	1.74013E-09	1.74013E-09	1.74013E-09	1.17765	1.71561E-09*	1.74013E-09	1.17765	0	1.17270	3.34678E-05	3.34678E-05	1.25288	Argon
NO	0.000336998*	0.000330724	1.30024E-12	1.30024E-12	1.30024E-12	0.000330724	1.28253E-12*	1.30024E-12	0.000330724	0	0.000329334	1.31525E-08	1.31525E-08	0.000351849	NO
NO2	0.000128999*	0.000126598	1.74016E-08	1.74016E-08	1.74016E-08	0.000126598	1.70975E-08*	1.74016E-08	0.000126598	0	0.000126066	4.72536E-08	4.72536E-08	0.000134656	NO2
NH3	0.000238998*	0.000281241	0.00250806	0.00250806	0.00250806	0.000281241	0.00247750*	0.00250806	0.000281241	0	0.000290598	0.000219465	0.000219465	0.000249362	NH3
Mass Flow	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen	294150*	294150	8.33811E-06	6.79737E-06	7.70369E-07	147075	2.10835E-06*	7.70369E-07	147075	0	147075	5.34456	0.222956	147073	Oxygen
Nitrogen	1.45494E+06*	1.45494E+06	6.28775E-06	5.12588E-06	5.80933E-07	727469	1.59115E-06*	5.80933E-07	727469	0	727469	14.1634	0.590846	727462	Nitrogen
Water	96864.1*	134280	45896.8	37415.9	4240.47	67140.0	11766.9*	4240.47	67140.0	4359.39	71380.4	1.33338E+06	55623.9	52597.0	Water
Carbon Dioxide	107144*	107196	63.9371	52.1226	5.90723	53597.8	16.3349*	5.90723	53597.8	0	53603.7	5462.28	227.867	7664.55	Carbon Dic
Sulfur Dioxide	0.444784*	0.444887	0.000126049	0.000102757	1.16458E-05	0.222443	3.17138E-05*	1.16458E-05	0.222443	0	0.222455	0.00540843	0.000225620	0.220057	Sulfur Diox
MEA	0*	31.0619	38.1026	31.0619	3.52035	15.5309	9.77959*	3.52035	15.5309	0	19.0513	21910.2	914.016	6.30815	MEA
Argon	23721.8*	23721.8	8.00458E-07	6.52548E-07	7.39554E-08	11860.9	2.02327E-07*	7.39554E-08	11860.9	0	11860.9	0.455422	0.0189986	11860.7	Argon
NO	6.66188*	6.66188	5.98110E-10	4.87590E-10	5.52602E-11	3.33094	1.51253E-10*	5.52602E-11	3.33094	0	3.33094	0.000178976	7.46625E-06	3.33085	NO
NO2	2.55009*	2.55010	8.00472E-06	6.52558E-06	7.39566E-07	1.27505	2.01637E-06*	7.39566E-07	1.27505	0	1.27505	0.000643017	2.68243E-05	1.27475	NO2
NH3	4.72459*	5.66512	1.15371	0.940524	0.106593	2.83256	0.292180*	0.106593	2.83256	0	2.93915	2.98643	0.124583	2.36064	NH3

Process Streams		001	002	003	004	005	006	007	008	009	010	100	101	102	103	
Property	**Units**															**Units**
Temperature	℃	90*	47.3510	48.1539	48.1539	48.1538	59.9094	45.9851*	48.1538	59.9094	20.0000	50.5250	52.0023	52.0023	43.1143	℃
Pressure	bar	1.0017*	1.0017	138*	138	138	1.08857	4.13685*	138	1.08857	4.13685	1.08857	4.48079	4.48079	1.01273	bar
Mole Fraction Vapor	%	100	100	0	0	0	100	0	0	100	0	100	0	0	100	%
Molecular Weight	kg/kmol	28.4291	28.1276	18.0406	18.0406	18.0406	28.1276	18.0406	18.0406	28.1276	18.0153	28.0617	18.2661	18.2661	27.8797	kg/kmol
Mass Density	kg/m^3	0.943296	1.05800	990.398	990.398	990.398	1.10630	989.418	990.398	1.10630	997.903	1.13587	988.288	988.288	1.07428	kg/m^3
Molar Flow	kmol/h	69535.5	71614.1	2549.80	2078.64	235.580	35807.1	653.712	235.580	35807.1	241.983	36042.6	74497.6	3107.77	33955.6	kmol/h
Mass Flow	kg/h	1.97683E+06*	2.01433E+06	46000	37500	4250	1.00717E+06	11793.3*	4250	1.00717E+06	4359.39	1.01142E+06	1.36078E+06	56766.7	946670	kg/h
Std Vapor Volumetric Flow	m^3/h	1.64733E+06	1.69657E+06	60406.0	49244.0	5580.99	848285	15486.7	5580.99	848285	5732.69	853866	1.76488E+06	73624.5	804423	m^3/h
Std Liquid Volumetric Flow	m^3/h	2307.23	2344.77	46.0591	37.5481	4.25546	1172.39	11.8085	4.25546	1172.39	4.36368	1176.64	1362.85	56.8532	1101.88	m^3/h
Specific Gravity		0.981974	0.971558	0.991334	0.991334	0.991335	0.971558	0.990354	0.991335	0.971558	0.998846	0.969281	0.989222	0.989222	0.962995	
Mass Enthalpy	kJ/kg	-1074.32	-1347.31	-15738.1	-15738.1	-15738.1	-1333.93	-15759.0	-15738.1	-1333.93	-15885.0	-1394.46	-15544.8	-15544.8	-799.333	kJ/kg
Dynamic Viscosity	cP	0.0205331	0.0186505	0.568716	0.568716	0.568717	0.0191922	0.576578	0.568717	0.0191922	1.01302	0.0187686	0.534003	0.534003	0.0186351	cP
Thermal Conductivity	W/(m*℃)	0.0293	0.0266	0.6337	0.633 7	0.6337	0.0274	0.6312	0.6337	0.0274	0.5991	0.0268	0.6265	0.6265	0.0266	W/(m*℃)
Surface Tension	dyne/cm			68.1959	68.1959	68.1960		68.6194	68.1960		73.8205		67.1773	67.1773		dyne/cm

Process Streams	Streams	104	105	106	107	108	109	110	111	200	201	202	203	204	Process
		Lean Amine (Abs. 1)	Cooled Semi-Lean Amine (Abs. 1)	Rich Amine (Abs. 1)	Process Water to Upper Bed (Abs. 1)	Cooled Wash Water to Lower Bed (Abs. 1)	Cooled Wash Water (Abs. 1)	Cooled Wash Water to Upper Bed (Abs. 1)	Combined Wash Water to Upper Bed (Abs. 1)	Cooled Flue Gas to Abs. 1	Warm Wash Water (Abs. 2)	Excess Water to Absorbers	Off Gas to Atmosphere (Abs. 2)	Lean Amine (Abs. 2)	
Mole Fraction	**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fract**
Oxygen		2.21328E-05	4.39524E-07	0.000211242	1.02194E-08	0.000224200	0.000224200	0.000224200	0.000179362	12.7523	0.000224200	0.000224200	13.5359	2.21328E-05	Oxygen
Nitrogen		6.69978E-05	9.04991E-07	0.000641773	8.80283E-09	0.000678671	0.000678671	0.000678671	0.000542939	72.0497	0.000678671	0.000678671	76.4775	6.69978E-05	Nitrogen
Water		82.4435	79.0891	78.7778	99.9159	99.3508	99.3508	99.3508	99.4638	10.9931	99.3508	99.3508	8.59823	82.4435	Water
Carbon Dioxide	xide	3.21583	5.99973	6.53672	0.0569770	0.166604	0.166604	0.166604	0.144679	3.37934	0.166604	0.166604	0.512896	3.21583	Carbon Dic
Sulfur Dioxide	ide	1.11990E-08	3.11231E-08	1.04453E-07	7.71650E-08	1.13323E-07	1.13323E-07	1.13323E-07	1.06091E-07	9.63414E-06	1.13323E-07	1.13323E-07	1.01161E-05	1.11990E-08	Sulfur Diox
MEA		14.3404	14.9109	14.6843	0.0244640	0.481486	0.481486	0.481486	0.390082	0.000865340	0.481486	0.481486	0.000304138	14.3404	MEA
Argon		1.51070E-06	2.87289E-08	1.43917E-05	7.85845E-10	1.53030E-05	1.53030E-05	1.53030E-05	1.22426E-05	0.823771	1.53030E-05	1.53030E-05	0.874387	1.51070E-06	Argon
NO		7.90396E-10	2.58195E-11	7.54724E-09	7.81744E-13	8.00652E-09	8.00652E-09	8.00652E-09	6.40537E-09	0.000307993	8.00652E-09	8.00652E-09	0.000326915	7.90396E-10	NO
NO2		1.85318E-09	3.16785E-10	1.74434E-08	6.82385E-09	1.87616E-08	1.87616E-08	1.87616E-08	1.63741E-08	7.68956E-05	1.87616E-08	1.87616E-08	8.16024E-05	1.85318E-09	NO2
NH3		0.000211367	0.000306284	0.000324450	0.00265682	0.000235387	0.000235387	0.000235387	0.000719673	0.000478826	0.000235387	0.000235387	0.000408216	0.000211367	NH3
Molar Flow	**v**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flov**
Oxygen		0.00697299	3.31538E-05	0.0809127	3.06583E-08	0.164333	0.167024	0.00269040	0.00269043	4596.27	0.167024	0.00696763	4596.19	0.00697299	Oxygen
Nitrogen		0.0211078	6.82645E-05	0.245821	2.64085E-08	0.497450	0.505594	0.00814406	0.00814408	25968.6	0.505594	0.0210916	25968.4	0.0211078	Nitrogen
Water		25973.9	5965.78	30174.5	299.748	72821.7	74013.9	1192.21	1491.96	3962.22	74013.9	3087.60	2919.58	25973.9	Water
Carbon Dioxide	xide	1013.15	452.567	2503.78	0.170931	122.117	124.116	1.99925	2.17018	1218.00	124.116	5.17767	174.157	1013.15	Carbon Dic
Sulfur Dioxide	ide	3.52827E-06	2.34765E-06	4.00091E-05	2.31495E-07	8.30627E-05	8.44226E-05	1.35987E-06	1.59137E-06	0.00347240	8.44226E-05	3.52181E-06	0.00343497	3.52827E-06	Sulfur Diox
MEA		4517.97	1124.75	5624.56	0.0733919	352.918	358.696	5.77783	5.85123	0.311891	358.696	14.9635	0.103272	4517.97	MEA
Argon		0.000475948	2.16705E-06	0.00551249	2.35753E-09	0.0112167	0.0114004	0.000183636	0.000183638	296.909	0.0114004	0.000475583	296.903	0.000475948	Argon
NO		2.49016E-07	1.94760E-09	2.89085E-06	2.34523E-12	5.86859E-06	5.96466E-06	9.60782E-08	9.60806E-08	0.111009	5.96466E-06	2.48824E-07	0.111006	2.49016E-07	NO
NO2		5.83848E-07	2.38955E-08	6.68139E-06	2.04715E-08	1.37518E-05	1.39769E-05	2.25139E-07	2.45611E-07	0.0277152	1.39769E-05	5.83068E-07	0.0277086	5.83848E-07	NO2
NH3		0.0665916	0.0231034	0.124275	0.00797046	0.172533	0.175357	0.00282464	0.0107951	0.172581	0.175357	0.00731528	0.138612	0.0665916	NH3
Mass Fraction	**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Frac**
Oxygen		2.82981E-05	5.41002E-07	0.000259593	1.81263E-08	0.000392758	0.000392758	0.000392758	0.000314988	14.5415	0.000392758	0.000392758	15.5358	2.82981E-05	Oxygen
Nitrogen		7.49915E-05	9.75198E-07	0.000690443	1.36690E-08	0.00104083	0.00104083	0.00104083	0.000834729	71.9258	0.00104083	0.00104083	76.8443	7.49915E-05	Nitrogen
Water		59.3448	54.8075	54.5036	99.7757	97.9868	97.9868	97.9868	98.3410	7.05748	97.9868	97.9868	5.55600	59.3448	Water
Carbon Dioxide	xide	5.65490	10.1569	11.0481	0.138994	0.401409	0.401409	0.401409	0.349445	5.29987	0.401409	0.401409	0.809633	5.65490	Carbon Dic
Sulfur Dioxide	ide	2.86668E-08	7.66969E-08	2.56989E-07	2.74020E-07	3.97452E-07	3.97452E-07	3.97452E-07	3.73010E-07	2.19944E-05	3.97452E-07	3.97452E-07	2.32454E-05	2.86668E-08	Sulfur Diox
MEA		35	35.0354	34.4471	0.0828317	1.61013	1.61013	1.61013	1.30769	0.00188363	1.61013	1.61013	0.000666352	35	MEA
Argon		2.41134E-06	4.41465E-08	2.20794E-05	1.74013E-09	3.34678E-05	3.34678E-05	3.34678E-05	2.68408E-05	1.17270	3.34678E-05	3.34678E-05	1.25288	2.41134E-06	Argon
NO		9.47633E-10	2.98017E-11	8.69717E-09	1.30024E-12	1.31525E-08	1.31525E-08	1.31525E-08	1.05483E-08	0.000329334	1.31525E-08	1.31525E-08	0.000351849	9.47633E-10	NO
NO2		3.40654E-09	5.60606E-10	3.08191E-08	1.74016E-08	4.72536E-08	4.72536E-08	4.72536E-08	4.13423E-08	0.000126066	4.72536E-08	4.72536E-08	0.000134656	3.40654E-09	NO2
NH3		0.000143831	0.000200648	0.000212205	0.00250806	0.000219465	0.000219465	0.000219465	0.000672654	0.000290598	0.000219465	0.000219465	0.000249362	0.000143831	NH3
Mass Flow	**v**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen		0.223127	0.00106088	2.58911	9.81029E-07	5.25847	5.34456	0.0860897	0.0860907	147075	5.34456	0.222956	147073	0.223127	Oxygen
Nitrogen		0.591300	0.00191232	6.88627	7.39792E-07	13.9353	14.1634	0.228143	0.228143	727469	14.1634	0.590846	727462	0.591300	Nitrogen
Water		467928	107475	543603	5400.04	1.31190E+06	1.33338E+06	21478.0	26878.0	71380.4	1.33338E+06	55623.9	52597.0	467928	Water
Carbon Dioxide	xide	44588.3	19917.2	110190	7.52259	5374.29	5462.28	87.9859	95.5085	53603.7	5462.28	227.867	7664.55	44588.3	Carbon Dic
Sulfur Dioxide	ide	0.000226035	0.000150399	0.00256314	1.48304E-05	0.00532131	0.00540843	8.71185E-05	0.000101949	0.222455	0.00540843	0.000225620	0.220057	0.000226035	Sulfur Diox
MEA		275971	68702.9	343566	4.48300	21557.3	21910.2	352.928	357.411	19.0513	21910.2	914.016	6.30815	275971	MEA
Argon		0.0190132	8.65694E-05	0.220213	9.41788E-08	0.448086	0.455422	0.00733590	0.00733599	11860.9	0.455422	0.0189986	11860.7	0.0190132	Argon
NO		7.47199E-06	5.84398E-08	8.67430E-05	7.03713E-11	0.000176093	0.000178976	2.88293E-06	2.88300E-06	3.33094	0.000178976	7.46625E-06	3.33085	7.47199E-06	NO
NO2		2.68602E-05	1.09932E-06	0.000307381	9.41804E-07	0.000632659	0.000643017	1.03576E-05	1.12995E-05	1.27505	0.000643017	2.68243E-05	1.27475	2.68602E-05	NO2
NH3		1.13409	0.393463	2.11647	0.135741	2.93832	2.98643	0.0481051	0.183846	2.93915	2.98643	0.124583	2.36064	1.13409	NH3

Process Streams		Process Streams	104	105	106	107	108	109	110	111	200	201	202	203	204	
Property	**Units**	**Property**														**Units**
Temperature	℃	Temperature	54.2565	59.2258	53.2964	45.9852	28.0000	28.0000	28.0000	31.6673	50.5250	52.0023	52.0023	43.1143	54.2565	℃
Pressure	bar	Pressure	3.68912	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	1.08857	4.48079	4.48079	1.01273	3.68912	bar
Mole Fraction Vapor	%	Mole Fraction Vapor	0	0	0	0	0	0	0	0	100	0	0	100	0	%
Molecular Weight	kg/kmol	Molecular Weight	25.0273	25.9967	26.0387	18.0406	18.2661	18.2661	18.2661	18.2210	28.0617	18.2661	18.2661	27.8797	25.0273	kg/kmol
Mass Density	kg/m^3	Mass Density	1086.70	1141.77	1150.90	989.419	997.600	997.600	997.600	996.051	1.13587	988.288	988.288	1.07428	1086.70	kg/m^3
Molar Flow	kmol/h	Molar Flow	31505.2	7543.11	38303.3	300	73297.6	74497.6	1200	1500	36042.6	74497.6	3107.77	33955.6	31505.2	kmol/h
Mass Flow	kg/h	Mass Flow	788489	196096	997370	5412.18	1.33886E+06	1.36078E+06	21919.3	27331.4	1.01142E+06	1.36078E+06	56766.7	946670	788489	kg/h
Std Vapor Volumetric Flow	m^3/h	Std Vapor Volumetric Flow	746371	178700	907423	7107.13	1.73645E+06	1.76488E+06	28428.5	35535.7	853866	1.76488E+06	73624.5	804423	746371	m^3/h
Std Liquid Volumetric Flow	m^3/h	Std Liquid Volumetric Flow	793.218	199.184	1015.13	5.41913	1340.90	1362.85	21.9527	27.3718	1176.64	1362.85	56.8532	1101.88	793.218	m^3/h
Specific Gravity		Specific Gravity	1.08773	1.14285	1.15199	0.990354	0.998543	0.998543	0.998543	0.996992	0.969281	0.989222	0.989222	0.962995	1.08773	
Mass Enthalpy	kJ/kg	Mass Enthalpy	-11409.8	-11158.3	-11200.2	-15758.9	-15644.5	-15644.5	-15644.5	-15667.1	-1394.46	-15544.8	-15544.8	-799.333	-11409.8	kJ/kg
Dynamic Viscosity	cP	Dynamic Viscosity	1.74103	2.13328	2.57119	0.576570	0.864393	0.864393	0.864393	0.789799	0.0187686	0.534003	0.534003	0.0186351	1.74103	cP
Thermal Conductivity	W/(m*℃)	Thermal Conductivity	0.4180	0.3882	0.3822	0.6312	0.5983	0.5983	0.5983	0.6052	0.0268	0.6265	0.6265	0.0266	0.4180	W/(m*℃)
Surface Tension	dyne/cm	Surface Tension	59.4102	92.6045	95.3224	68.6193	71.7937	71.7937	71.7937	71.1919		67.1773	67.1773		59.4102	dyne/cm

Process Streams		s Streams	205	206	207	208	209	210	211	300	302	303	304	305	306	Process
			Cooled Semi-Lean Amine (Abs. 2)	Rich Amine (Abs. 2)	Process Water to Upper Bed (Abs. 2)	Cooled Wash Water to Lower Bed (Abs. 2)	Cooled Wash Water (Abs. 2)	Cooled Wash Water to Upper Bed (Abs. 2)	Combined Wash Water to Upper Bed (Abs. 2)	Combined Cold Rich Amine	Hot Rich Amine	Stripper Bottoms to E-108 Inlet	Rich Amine to E-103	Lean Amine	Filtered Lean Amine	
Mole Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fract**
Oxygen			4.39524E-07	0.000211242	1.02194E-08	0.000224200	0.000224200	0.000224200	0.000179362	0.000211242	0.000211242	0	0.000211242	2.21328E-05	2.21328E-05	Oxygen
Nitrogen			9.04991E-07	0.000641773	8.80283E-09	0.000678671	0.000678671	0.000678671	0.000542939	0.000641773	0.000641773	0	0.000641773	6.69978E-05	6.69978E-05	Nitrogen
Water			79.0891	78.7778	99.9159	99.3508	99.3508	99.3508	99.4638	78.7778	78.7778	80.5735	78.7778	82.4435	82.4435	Water
Carbon Dioxide		xide	5.99973	6.53672	0.0569770	0.166604	0.166604	0.166604	0.144679	6.53672	6.53672	3.55319	6.53672	3.21583	3.21583	Carbon Dic
Sulfur Dioxide		ide	3.11231E-08	1.04453E-07	7.71650E-08	1.13323E-07	1.13323E-07	1.13323E-07	1.06091E-07	1.04453E-07	1.04453E-07	0	1.04453E-07	1.11990E-08	1.11990E-08	Sulfur Diox
MEA			14.9109	14.6843	0.0244640	0.481486	0.481486	0.481486	0.390082	14.6843	14.6843	15.8731	14.6843	14.3404	14.3404	MEA
Argon			2.87289E-08	1.43917E-05	7.85845E-10	1.53030E-05	1.53030E-05	1.53030E-05	1.22426E-05	1.43917E-05	1.43917E-05	0	1.43917E-05	1.51070E-06	1.51070E-06	Argon
NO			2.58195E-11	7.54724E-09	7.81744E-13	8.00652E-09	8.00652E-09	8.00652E-09	6.40537E-09	7.54724E-09	7.54724E-09	0	7.54724E-09	7.90396E-10	7.90396E-10	NO
NO2			3.16785E-10	1.74434E-08	6.82385E-09	1.87616E-08	1.87616E-08	1.87616E-08	1.63741E-08	1.74434E-08	1.74434E-08	0	1.74434E-08	1.85318E-09	1.85318E-09	NO2
NH3			0.000306284	0.000324450	0.00265682	0.000235387	0.000235387	0.000235387	0.000719673	0.000324450	0.000324450	0.000208479	0.000324450	0.000211367	0.000211367	NH3
Molar Flow		**v**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flov**
Oxygen			3.31538E-05	0.0809127	3.06583E-08	0.164333	0.167024	0.00269040	0.00269043	0.161825	0.129460	0	0.0323651	0.00696763	0.00696763	Oxygen
Nitrogen			6.82645E-05	0.245821	2.64085E-08	0.497450	0.505594	0.00814406	0.00814408	0.491641	0.393313	0	0.0983282	0.0210916	0.0210916	Nitrogen
Water			5965.78	30174.5	299.748	72821.7	74013.9	1192.21	1491.96	60349.1	48279.3	45679.0	12069.8	25954.0	25954.0	Water
Carbon Dioxide		xide	452.567	2503.78	0.170931	122.117	124.116	1.99925	2.17018	5007.56	4006.05	2014.39	1001.51	1012.37	1012.37	Carbon Dic
Sulfur Dioxide		ide	2.34765E-06	4.00091E-05	2.31495E-07	8.30627E-05	8.44226E-05	1.35987E-06	1.59137E-06	8.00183E-05	6.40146E-05	0	1.60037E-05	3.52556E-06	3.52556E-06	Sulfur Diox
MEA			1124.75	5624.56	0.0733919	352.918	358.696	5.77783	5.85123	11249.1	8999.30	8998.86	2249.82	4514.50	4514.50	MEA
Argon			2.16705E-06	0.00551249	2.35753E-09	0.0112167	0.0114004	0.000183636	0.000183638	0.0110250	0.00881999	0	0.00220500	0.000475583	0.000475583	Argon
NO			1.94760E-09	2.89085E-06	2.34523E-12	5.86859E-06	5.96466E-06	9.60782E-08	9.60806E-08	5.78169E-06	4.62535E-06	0	1.15634E-06	2.48824E-07	2.48824E-07	NO
NO2			2.38955E-08	6.68139E-06	2.04715E-08	1.37518E-05	1.39769E-05	2.25139E-07	2.45611E-07	1.33628E-05	1.06902E-05	0	2.67256E-06	5.83400E-07	5.83400E-07	NO2
NH3			0.0231034	0.124275	0.00797046	0.172533	0.175357	0.00282464	0.0107951	0.248550	0.198840	0.118192	0.0497101	0.0665405	0.0665405	NH3
Mass Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Frac**
Oxygen			5.41002E-07	0.000259593	1.81263E-08	0.000392758	0.000392758	0.000392758	0.000314988	0.000259593	0.000259593	0	0.000259593	2.82981E-05	2.82981E-05	Oxygen
Nitrogen			9.75198E-07	0.000690443	1.36690E-08	0.00104083	0.00104083	0.00104083	0.000834729	0.000690443	0.000690443	0	0.000690443	7.49915E-05	7.49915E-05	Nitrogen
Water			54.8075	54.5036	99.7757	97.9868	97.9868	97.9868	98.3410	54.5036	54.5036	56.3161	54.5036	59.3448	59.3448	Water
Carbon Dioxide		xide	10.1569	11.0481	0.138994	0.401409	0.401409	0.401409	0.349445	11.0481	11.0481	6.06687	11.0481	5.65490	5.65490	Carbon Dic
Sulfur Dioxide		ide	7.66969E-08	2.56989E-07	2.74020E-07	3.97452E-07	3.97452E-07	3.97452E-07	3.73010E-07	2.56989E-07	2.56989E-07	0	2.56989E-07	2.86668E-08	2.86668E-08	Sulfur Diox
MEA			35.0354	34.4471	0.0828317	1.61013	1.61013	1.61013	1.30769	34.4471	34.4471	37.6169	34.4471	35	35	MEA
Argon			4.41465E-08	2.20794E-05	1.74013E-09	3.34678E-05	3.34678E-05	3.34678E-05	2.68408E-05	2.20794E-05	2.20794E-05	0	2.20794E-05	2.41134E-06	2.41134E-06	Argon
NO			2.98017E-11	8.69717E-09	1.30024E-12	1.31525E-08	1.31525E-08	1.31525E-08	1.05483E-08	8.69717E-09	8.69717E-09	0	8.69717E-09	9.47633E-10	9.47633E-10	NO
NO2			5.60606E-10	3.08191E-08	1.74016E-08	4.72536E-08	4.72536E-08	4.72536E-08	4.13423E-08	3.08191E-08	3.08191E-08	0	3.08191E-08	3.40654E-09	3.40654E-09	NO2
NH3			0.000200648	0.000212205	0.00250806	0.000219465	0.000219465	0.000219465	0.000672654	0.000212205	0.000212205	0.000137749	0.000212205	0.000143831	0.000143831	NH3
Mass Flow		**v**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen			0.00106088	2.58911	9.81029E-07	5.25847	5.34456	0.0860897	0.0860907	5.17822	4.14257	0	1.03564	0.222956	0.222956	Oxygen
Nitrogen			0.00191232	6.88627	7.39792E-07	13.9353	14.1634	0.228143	0.228143	13.7725	11.0180	0	2.75451	0.590846	0.590846	Nitrogen
Water			107475	543603	5400.04	1.31190E+06	1.33338E+06	21478.0	26878.0	1.08721E+06	869765	822919	217441	467569	467569	Water
Carbon Dioxide		xide	19917.2	110190	7.52259	5374.29	5462.28	87.9859	95.5085	220380	176304	88652.2	44076.1	44554.1	44554.1	Carbon Dic
Sulfur Dioxide		ide	0.000150399	0.00256314	1.48304E-05	0.00532131	0.00540843	8.71185E-05	0.000101949	0.00512627	0.00410102	0	0.00102525	0.000225861	0.000225861	Sulfur Diox
MEA			68702.9	343566	4.48300	21557.3	21910.2	352.928	357.411	687131	549705	549678	137426	275759	275759	MEA
Argon			8.65694E-05	0.220213	9.41788E-08	0.448086	0.455422	0.00733590	0.00733599	0.440426	0.352341	0	0.0880852	0.0189986	0.0189986	Argon
NO			5.84398E-08	8.67430E-05	7.03713E-11	0.000176093	0.000178976	2.88293E-06	2.88300E-06	0.000173486	0.000138789	0	3.46972E-05	7.46625E-06	7.46625E-06	NO
NO2			1.09932E-06	0.000307381	9.41804E-07	0.000632659	0.000643017	1.03576E-05	1.12995E-05	0.000614762	0.000491809	0	0.000122952	2.68396E-05	2.68396E-05	NO2
NH3			0.393463	2.11647	0.135741	2.93832	2.98643	0.0481051	0.183846	4.23294	3.38635	2.01286	0.846588	1.13322	1.13322	NH3
Process Streams		**Process Streams**	**205**	**206**	**207**	**208**	**209**	**210**	**211**	**300**	**302**	**303**	**304**	**305**	**306**	
Property	**Units**	**Property**														**Units**
Temperature	℃	Temperature	59.2258	53.2964	45.9852	28.0000	28.0000	28.0000	31.6673	53.4425	117*	126.527	53.4425	54.2565	54.2565	℃
Pressure	bar	Pressure	5.15772	1.08857	4.13685	3.44658	3.44658	3.44658	3.44658	10.7412	9.70702	5.41280	10.7412	3.68912	3.68912	bar
Mole Fraction Vapor	%	Mole Fraction Vapor	0	0	0	0	0	0	0	0	0	0	0	0	0	%
Molecular Weight	kg/kmol	Molecular Weight	25.9967	26.0387	18.0406	18.2661	18.2661	18.2661	18.2210	26.0387	26.0387	25.7751	26.0387	25.0273	25.0273	kg/kmol
Mass Density	kg/m^3	Mass Density	1141.77	1150.90	989.419	997.600	997.600	997.600	996.051	1150.98	1131.18	1065.65	1150.98	1086.70	1086.70	kg/m^3
Molar Flow	kmol/h	Molar Flow	7543.11	38303.3	300	73297.6	74497.6	1200	1500	76606.7	61285.4	56692.3	15321.3	31481.0	31481.0	kmol/h
Mass Flow	kg/h	Mass Flow	196096	997370	5412.18	1.33886E+06	1.36078E+06	21919.3	27331.4	1.99474E+06	1.59579E+06	1.46125E+06	398948	787884	787884	kg/h
Std Vapor Volumetric Flow	m^3/h	Std Vapor Volumetric Flow	178700	907423	7107.13	1.73645E+06	1.76488E+06	28428.5	35535.7	1.81485E+06	1.45188E+06	1.34307E+06	362969	745798	745798	m^3/h
Std Liquid Volumetric Flow	m^3/h	Std Liquid Volumetric Flow	199.184	1015.13	5.41913	1340.90	1362.85	21.9527	27.3718	2030.25	1624.20	1470.53	406.050	792.610	792.610	m^3/h
Specific Gravity		Specific Gravity	1.14285	1.15199	0.990354	0.998543	0.998543	0.998543	0.996992	1.15206	1.13224	1.06666	1.15206	1.08773	1.08773	
Mass Enthalpy	kJ/kg	Mass Enthalpy	-11158.3	-11200.2	-15758.9	-15644.5	-15644.5	-15644.5	-15667.1	-11198.9	-10971.1	-10821.4	-11198.9	-11409.8	-11409.8	kJ/kg
Dynamic Viscosity	cP	Dynamic Viscosity	2.13328	2.57119	0.576570	0.864393	0.864393	0.864393	0.789799	2.56530	0.684104	0.514774	2.56530	1.74103	1.74103	cP
Thermal Conductivity	W/(m*℃)	Thermal Conductivity	0.3882	0.3822	0.6312	0.5983	0.5983	0.5983	0.6052	0.3823	0.3954	0.4160	0.3823	0.4180	0.4180	W/(m*℃)
Surface Tension	dyne/cm	Surface Tension	92.6045	95.3224	68.6193	71.7937	71.7937	71.7937	71.1919	92.8018	86.8476	46.6289	92.8018	59.4102	59.4102	dyne/cm

Process Streams		Streams	307	309	310	311	312	313	314	315	316	317	318	319	320	322	323	324	Process
			Fresh Amine	Rich Amine to E-107	Rich Amine to E-109	Rich Amine to V-101	Flash Gas	Hot Semi-Lean Amine	Stripper Bottoms	Stripper Bottoms to E-107	Reclaimer Feed	Reclaimer Product	Stripper Reboiler Inlet	Stripper Reboiler Discharge	Stripper Overhead	Stripper Reflux	Reflux Purge	Cooled Stripper Overhead	
Mole Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fract**
Oxygen			0	0.000211242	0.000211242	0.000211242	0.0137370	4.39523E-07	0	0	0	0	0	0	0.00301455	2.26180E-07	2.26180E-07	0.00301455	Oxygen
Nitrogen			0	0.000641773	0.000641773	0.000641773	0.0417620	9.04988E-07	0	0	0	0	0	0	0.00915969	3.64940E-07	3.64940E-07	0.00915969	Nitrogen
Water			0	78.7778	78.7778	78.7778	58.8108	79.0890	80.5735	80.5735	80.5735	95.7761	80.5735	80.5735	61.0520	99.8804	99.8804	61.0520	Water
Carbon Dioxide		xide	0	6.53672	6.53672	6.53672	40.9906	5.99974	3.55319	3.55319	3.55319	4.22361	3.55319	3.55319	38.9179	0.0891793	0.0891793	38.9179	Carbon Dic
Sulfur Dioxide		ide	0	1.04453E-07	1.04453E-07	1.04453E-07	4.80956E-06	3.11230E-08	0	0	0	0	0	0	1.40791E-06	7.17026E-08	7.17026E-08	1.40791E-06	Sulfur Diox
MEA			100	14.6843	14.6843	14.6843	0.140694	14.9109	15.8731	15.8731	15.8731	0	15.8731	15.8731	0.0160055	0.0274058	0.0274058	0.0160055	MEA
Argon			0	1.43917E-05	1.43917E-05	1.43917E-05	0.000935965	2.87288E-08	0	0	0	0	0	0	0.000205382	1.63498E-08	1.63498E-08	0.000205382	Argon
NO			0	7.54724E-09	7.54724E-09	7.54724E-09	4.90146E-07	2.58195E-11	0	0	0	0	0	0	1.07676E-07	1.19379E-11	1.19379E-11	1.07676E-07	NO
NO2			0	1.74434E-08	1.74434E-08	1.74434E-08	1.11634E-06	3.16784E-10	0	0	0	0	0	0	2.48153E-07	2.63050E-10	2.63050E-10	2.48153E-07	NO2
NH3			0	0.000324450	0.000324450	0.000324450	0.00148991	0.000306286	0.000208479	0.000208479	0.000208479	0.000247815	0.000208479	0.000208479	0.00174182	0.00297231	0.00297231	0.00174182	NH3
Molar Flow		**v**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flov**
Oxygen			0	0.0323651	0.0323651	0.0323651	0.0322988	6.63073E-05	0	0	0	0	0	0	0.161760	7.08805E-07	6.37925E-06	0.161760	Oxygen
Nitrogen			0	0.0983282	0.0983282	0.0983282	0.0981917	0.000136528	0	0	0	0	0	0	0.491506	1.14365E-06	1.02929E-05	0.491506	Nitrogen
Water			0	12069.8	12069.8	12069.8	138.277	11931.5	45679.0	45679.0	0	0	30452.6	30452.6	3276.03	313.007	2817.06	3276.03	Water
Carbon Dioxide		xide	0	1001.51	1001.51	1001.51	96.3780	905.134	2014.39	2014.39	0	0	1342.93	1342.93	2088.32	0.279472	2.51524	2088.32	Carbon Dic
Sulfur Dioxide		ide	0	1.60037E-05	1.60037E-05	1.60037E-05	1.13084E-05	4.69529E-06	0	0	0	0	0	0	7.55477E-05	2.24703E-07	2.02232E-06	7.55477E-05	Sulfur Diox
MEA			0.211460	2249.82	2249.82	2249.82	0.330803	2249.49	8998.86	8998.86	0	0	5999.24	5999.24	0.858848	0.0858846	0.772962	0.858848	MEA
Argon			0	0.00220500	0.00220500	0.00220500	0.00220066	4.33409E-06	0	0	0	0	0	0	0.0110207	5.12373E-08	4.61135E-07	0.0110207	Argon
NO			0	1.15634E-06	1.15634E-06	1.15634E-06	1.15244E-06	3.89518E-09	0	0	0	0	0	0	5.77784E-06	3.74112E-11	3.36701E-10	5.77784E-06	NO
NO2			0	2.67256E-06	2.67256E-06	2.67256E-06	2.62477E-06	4.77908E-08	0	0	0	0	0	0	1.33158E-05	8.24351E-10	7.41916E-09	1.33158E-05	NO2
NH3			0	0.0497101	0.0497101	0.0497101	0.00350312	0.0462069	0.118192	0.118192	0	0	0.0787943	0.0787943	0.0934655	0.00931468	0.0838321	0.0934655	NH3
Mass Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Frac**
Oxygen			0	0.000259593	0.000259593	0.000259593	0.0152960	5.41000E-07	0	0	0	0	0	0	0.00342794	4.00963E-07	4.00963E-07	0.00342794	Oxygen
Nitrogen			0	0.000690443	0.000690443	0.000690443	0.0407099	9.75194E-07	0	0	0	0	0	0	0.00911851	5.66375E-07	5.66375E-07	0.00911851	Nitrogen
Water			0	54.5036	54.5036	54.5036	36.8682	54.8074	56.3161	56.3161	56.3161	90.2746	56.3161	56.3161	39.0857	99.6870	99.6870	39.0857	Water
Carbon Dioxide		xide	0	11.0481	11.0481	11.0481	62.7746	10.1569	6.06687	6.06687	6.06687	9.72518	6.06687	6.06687	60.8657	0.217434	0.217434	60.8657	Carbon Dic
Sulfur Dioxide		ide	0	2.56989E-07	2.56989E-07	2.56989E-07	1.07219E-05	7.66968E-08	0	0	0	0	0	0	3.20526E-06	2.54486E-07	2.54486E-07	3.20526E-06	Sulfur Diox
MEA			100	34.4471	34.4471	34.4471	0.299054	35.0354	37.6169	37.6169	37.6169	0	37.6169	37.6169	0.0347429	0.0927428	0.0927428	0.0347429	MEA
Argon			0	2.20794E-05	2.20794E-05	2.20794E-05	0.00130109	4.41464E-08	0	0	0	0	0	0	0.000291564	3.61847E-08	3.61847E-08	0.000291564	Argon
NO			0	8.69717E-09	8.69717E-09	8.69717E-09	5.11786E-07	2.98016E-11	0	0	0	0	0	0	1.14816E-07	1.98452E-11	1.98452E-11	1.14816E-07	NO
NO2			0	3.08191E-08	3.08191E-08	3.08191E-08	1.78715E-06	5.60604E-10	0	0	0	0	0	0	4.05702E-07	6.70449E-10	6.70449E-10	4.05702E-07	NO2
NH3			0	0.000212205	0.000212205	0.000212205	0.000882962	0.000200649	0.000137749	0.000137749	0.000137749	0.000220812	0.000137749	0.000137749	0.00105416	0.00280440	0.00280440	0.00105416	NH3
Mass Flow		**v**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen			0	1.03564	1.03564	1.03564	1.03352	0.00212176	0	0	0	0	0	0	5.17612	2.26809E-05	0.000204128	5.17612	Oxygen
Nitrogen			0	2.75451	2.75451	2.75451	2.75068	0.00382463	0	0	0	0	0	0	13.7688	3.20376E-05	0.000288339	13.7688	Nitrogen
Water			0	217441	217441	217441	2491.11	214950	822919	822919	0	0	548613	548613	59018.6	5638.91	50750.2	59018.6	Water
Carbon Dioxide		xide	0	44076.1	44076.1	44076.1	4241.55	39834.5	88652.2	88652.2	0	0	59101.5	59101.5	91905.8	12.2994	110.695	91905.8	Carbon Dic
Sulfur Dioxide		ide	0	0.00102525	0.00102525	0.00102525	0.000724457	0.000300798	0	0	0	0	0	0	0.00483987	1.43953E-05	0.000129558	0.00483987	Sulfur Diox
MEA			12.9166	137426	137426	137426	20.2065	137406	549678	549678	0	0	366452	366452	52.4611	5.24610	47.2149	52.4611	MEA
Argon			0	0.0880852	0.0880852	0.0880852	0.0879121	0.000173138	0	0	0	0	0	0	0.440255	2.04683E-06	1.84214E-05	0.440255	Argon
NO			0	3.46972E-05	3.46972E-05	3.46972E-05	3.45803E-05	1.16879E-07	0	0	0	0	0	0	0.000173370	1.12256E-09	1.01031E-08	0.000173370	NO
NO2			0	0.000122952	0.000122952	0.000122952	0.000120754	2.19864E-06	0	0	0	0	0	0	0.000612601	3.79247E-08	3.41322E-07	0.000612601	NO2
NH3			0	0.846588	0.846588	0.846588	0.0596599	0.786928	2.01286	2.01286	0	0	1.34191	1.34191	1.59177	0.158634	1.42770	1.59177	NH3
Process Streams		**Process Streams**	**307**	**309**	**310**	**311**	**312**	**313**	**314**	**315**	**316**	**317**	**318**	**319**	**320**	**322**	**323**	**324**	
Property	**Units**	**Property**																	**Units**
Temperature	℃	Temperature	20.0000	108*	112.778*	121.562	114.013	114.066	127.716	127.784			127.716	130.249	105.251	48.7494	48.7494	48.8889*	℃
Pressure	bar	Pressure	4.13685	9.70702	8.67281	7.63859	2.39982*	5.84719	2.31016	6.10228	6.10228	6.10228	2.31016	2.31016	1.96543	5.24044	5.24044	1.82753	bar
Mole Fraction Vapor	%	Mole Fraction Vapor	0	0	0	0	100	0	0	0			0	19.7407	100	0	0	41.5715	%
Molecular Weight	kg/kmol	Molecular Weight	61.0831	26.0387	26.0387	26.0387	28.7373	25.9967	25.7751	25.7751	25.7751	19.1132	25.7751	25.7751	28.1399	18.0502	18.0502	28.1399	kg/kmol
Mass Density	kg/m^3	Mass Density	1021.42	1134.88	1132.93	1129.17	2.16649	1123.30	1064.88	1064.90			1064.88	9.06973	1.77565	988.425	988.425	4.65060	kg/m^3
Molar Flow	kmol/h	Molar Flow	0.211460	15321.3	15321.3	15321.3	235.122	15086.2	56692.3	56692.3	0	0	37794.9	37794.9	5365.96	313.382	2820.43	5365.96	kmol/h
Mass Flow	kg/h	Mass Flow	12.9166	398948	398948	398948	6756.79	392191	1.46125E+06	1.46125E+06	0	0	974168	974168	150998	5656.61	50909.5	150998	kg/h
Std Vapor Volumetric Flow	m^3/h	Std Vapor Volumetric Flow	5.00958	362969	362969	362969	5570.16	357399	1.34307E+06	1.34307E+06	0	0	895378	895378	127122	7424.15	66817.3	127122	m^3/h
Std Liquid Volumetric Flow	m^3/h	Std Liquid Volumetric Flow	0.0126621	406.050	406.050	406.050	7.68279	398.367	1470.53	1470.53	0	0	980.352	980.352	171.067	5.66483	50.9835	171.067	m^3/h
Specific Gravity		Specific Gravity	1.02239	1.13595	1.13401	1.13024	0.992620	1.12436	1.06589	1.06591			1.06589		0.971985	0.989360	0.989360		
Mass Enthalpy	kJ/kg	Mass Enthalpy	-4445.34	-11005.4	-10987.4	-10953.5	-10463.2	-10961.5	-10817.0	-10816.5	-10816.5		-10817.0	-10493.6	-10590.8	-15741.0	-15741.0	-11553.7	kJ/kg
Dynamic Viscosity	cP	Dynamic Viscosity	26.8174	0.788711	0.730122	0.638957	0.0170053	0.699380	0.506259	0.506241			0.506259		0.0165058	0.548078	0.548078		cP
Thermal Conductivity	W/(m*℃)	Thermal Conductivity	0.2355	0.3950	0.3953	0.3954	0.0247	0.3990	0.4159	0.4159			0.4159		0.0240	0.6334	0.6334		W/(m*°C)
Surface Tension	dyne/cm	Surface Tension	48.9361	88.0177	87.6570	86.7343		86.6206	46.4253	46.4067			46.4253			68.0566	68.0566		dyne/cm

Process Streams		**Streams**	**325**	**330**	**332**	**333**	**334**	**400**	**401**	**402**	**403**	**404**	**405**	**406**	**407**	**408**	**409**	**Process**
			Stripper Overhead Liquid	**Hot Semi-Lean Amine**	**Cold Rich Amine to Lean / Rich Exchanger**	**Process Water to Absorbers**	**Lean Amine to E-102 Inlet**	**CO2**	**1st Stage Suction**	**Hot 1st Stage Discharge**	**Cooled 1st Stage Discharge**	**Cold 1st Stage Discharge**	**2nd Stage Suction**	**Hot 2nd Stage Discharge**	**Cooled 2nd Stage Discharge**	**Cold 2nd Stage Discharge**	**Dryer Inlet**	
Mole Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fract**
Oxygen			2.26180E-07	4.39523E-07	0.000211242	1.00791E-08*	0	0.00724650	0.00724656	0.00724656	0.00724656	0.00724656	0.00770337	0.00770337	0.00770337	0.00770337	0.00774011	Oxygen
Nitrogen			3.64940E-07	9.04988E-07	0.000641773	8.68876E-09*	0	0.0220189	0.0220191	0.0220191	0.0220191	0.0220191	0.0234072	0.0234072	0.0234072	0.0234072	0.0235189	Nitrogen
Water			99.8804	79.0890	78.7778	99.9161*	80.5735	6.53896	6.53819	6.53819	6.53819	6.53819	0.658045	0.658045	0.658045	0.658045	0.188672	Water
Carbon Dioxide		xide	0.0891793	5.99974	6.53672	0.0567783*	3.55319	93.4313	93.4320	93.4320	93.4320	93.4320	99.3103	99.3103	99.3103	99.3103	99.7795	Carbon Dic
Sulfur Dioxide		ide	7.17026E-08	3.11230E-08	1.04453E-07	7.57268E-08*	0	3.28386E-06	3.28389E-06	3.28389E-06	3.28389E-06	3.28389E-06	3.47321E-06	3.47321E-06	3.47321E-06	3.47321E-06	3.48396E-06	Sulfur Diox
MEA			0.0274058	14.9109	14.6843	0.0244914*	15.8731	8.54045E-08	8.53776E-08	8.53776E-08	8.53776E-08	8.53776E-08	3.02193E-09	3.02193E-09	3.02193E-09	3.02193E-09	4.87472E-10	MEA
Argon			1.63498E-08	2.87288E-08	1.43917E-05	7.74769E-10*	0	0.000493703	0.000493708	0.000493708	0.000493708	0.000493708	0.000524829	0.000524829	0.000524829	0.000524829	0.000527333	Argon
NO			1.19379E-11	2.58195E-11	7.54724E-09	7.71094E-13*	0	2.58830E-07	2.58832E-07	2.58832E-07	2.58832E-07	2.58832E-07	2.75147E-07	2.75147E-07	2.75147E-07	2.75147E-07	2.76459E-07	NO
NO2			2.63050E-10	3.16784E-10	1.74434E-08	6.70462E-09*	0	5.96178E-07	5.96183E-07	5.96183E-07	5.96183E-07	5.96183E-07	6.13746E-07	6.13746E-07	6.13746E-07	6.13746E-07	6.10352E-07	NO2
NH3			0.00297231	0.000306286	0.000324450	0.00262444*	0.000208479	1.42766E-05	1.42766E-05	1.42766E-05	1.42766E-05	1.42766E-05	1.07273E-05	1.07273E-05	1.07273E-05	1.07273E-05	9.52048E-06	NH3
Molar Flow		**v**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen			7.08805E-06	6.63073E-05	0.129460	5.41359E-09*	0	0.161753	0.161753	0.161753	0.161753	0.161753	0.161752	0.161752	0.161752	0.161752	0.161751	Oxygen
Nitrogen			1.14365E-05	0.000136528	0.393313	4.66680E-09*	0	0.491494	0.491494	0.491494	0.491494	0.491494	0.491493	0.491493	0.491493	0.491493	0.491492	Nitrogen
Water			3130.07	11931.5	48279.3	53.6658*	45679.0	145.959	145.941	145.941	145.941	145.941	13.8173	13.8173	13.8173	13.8173	3.94282	Water
Carbon Dioxide		xide	2.79472	905.134	4006.05	0.0304961*	2014.39	2085.52	2085.52	2085.52	2085.52	2085.52	2085.27	2085.27	2085.27	2085.27	2085.17	Carbon Dic
Sulfur Dioxide		ide	2.24703E-06	4.69529E-06	6.40146E-05	4.06735E-08*	0	7.33006E-05	7.33006E-05	7.33006E-05	7.33006E-05	7.33006E-05	7.29288E-05	7.29288E-05	7.29288E-05	7.29288E-05	7.28071E-05	Sulfur Diox
MEA			0.858846	2249.49	8999.30	0.0131545*	8998.86	1.90635E-06	1.90574E-06	1.90574E-06	1.90574E-06	1.90574E-06	6.34532E-08	6.34532E-08	6.34532E-08	6.34532E-08	1.01871E-08	MEA
Argon			5.12373E-07	4.33409E-06	0.00881999	4.16135E-10*	0	0.0110202	0.0110202	0.0110202	0.0110202	0.0110202	0.0110201	0.0110201	0.0110201	0.0110201	0.0110201	Argon
NO			3.74112E-10	3.89518E-09	4.62535E-06	4.14161E-13*	0	5.77746E-06	5.77746E-06	5.77746E-06	5.77746E-06	5.77746E-06	5.77741E-06	5.77741E-06	5.77741E-06	5.77741E-06	5.77739E-06	NO
NO2			8.24351E-09	4.77908E-08	1.06902E-05	3.60111E-09*	0	1.33076E-05	1.33076E-05	1.33076E-05	1.33076E-05	1.33076E-05	1.28872E-05	1.28872E-05	1.28872E-05	1.28872E-05	1.27550E-05	NO2
NH3			0.0931468	0.0462069	0.198840	0.00140961*	0.118192	0.000318676	0.000318673	0.000318673	0.000318673	0.000318673	0.000225246	0.000225246	0.000225246	0.000225246	0.000198957	NH3
Mass Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Frac**
Oxygen			4.00963E-07	5.41000E-07	0.000259593	1.78775E-08*	0	0.00548109	0.00548111	0.00548111	0.00548111	0.00548111	0.00562349	0.00562349	0.00562349	0.00562349	0.00563463	Oxygen
Nitrogen			5.66375E-07	9.75194E-07	0.000690443	1.34919E-08*	0	0.0145803	0.0145803	0.0145803	0.0145803	0.0145803	0.0149591	0.0149591	0.0149591	0.0149591	0.0149888	Nitrogen
Water			99.6870	54.8074	54.5036	99.7761*	56.3161	2.78455	2.78420	2.78420	2.78420	2.78420	0.270450	0.270450	0.270450	0.270450	0.0773271	Water
Carbon Dioxide		xide	0.217434	10.1569	11.0481	0.138509*	6.06687	97.1949	97.1953	97.1953	97.1953	97.1953	99.7085	99.7085	99.7085	99.7085	99.9016	Carbon Dic
Sulfur Dioxide		ide	2.54486E-07	7.66968E-08	2.56989E-07	2.68913E-07*	0	4.97282E-06	4.97283E-06	4.97283E-06	4.97283E-06	4.97283E-06	5.07615E-06	5.07615E-06	5.07615E-06	5.07615E-06	5.07774E-06	Sulfur Diox
MEA			0.0927428	35.0354	34.4471	0.0829247*	37.6169	1.23312E-07	1.23273E-07	1.23273E-07	1.23273E-07	1.23273E-07	4.21112E-09	4.21112E-09	4.21112E-09	4.21112E-09	6.77415E-10	MEA
Argon			3.61847E-08	4.41464E-08	2.20794E-05	1.71561E-09*	0	0.000466193	0.000466195	0.000466195	0.000466195	0.000466195	0.000478304	0.000478304	0.000478304	0.000478304	0.000479252	Argon
NO			1.98452E-11	2.98016E-11	8.69717E-09	1.28253E-12*	0	1.83581E-07	1.83582E-07	1.83582E-07	1.83582E-07	1.83582E-07	1.88350E-07	1.88350E-07	1.88350E-07	1.88350E-07	1.88723E-07	NO
NO2			6.70449E-10	5.60604E-10	3.08191E-08	1.70975E-08*	0	6.48322E-07	6.48324E-07	6.48324E-07	6.48324E-07	6.48324E-07	6.44155E-07	6.44155E-07	6.44155E-07	6.44155E-07	6.38815E-07	NO2
NH3			0.00280440	0.000200649	0.000212205	0.00247750*	0.000137749	5.74723E-06	5.74720E-06	5.74720E-06	5.74720E-06	5.74720E-06	4.16782E-06	4.16782E-06	4.16782E-06	4.16782E-06	3.68868E-06	NH3
Mass Flow		**v**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen			0.000226809	0.00212176	4.14257	1.73228E-07*	0	5.17589	5.17589	5.17589	5.17589	5.17589	5.17586	5.17586	5.17586	5.17586	5.17585	Oxygen
Nitrogen			0.000320376	0.00382463	11.0180	1.30733E-07*	0	13.7684	13.7684	13.7684	13.7684	13.7684	13.7684	13.7684	13.7684	13.7684	13.7684	Nitrogen
Water			56389.1	214950	869765	966.804*	822919	2629.50	2629.16	2629.16	2629.16	2629.16	248.923	248.923	248.923	248.923	71.0310	Water
Carbon Dioxide		xide	122.994	39834.5	176304	1.34212*	88652.2	91782.9	91782.9	91782.9	91782.9	91782.9	91771.8	91771.8	91771.8	91771.8	91767.4	Carbon Dic
Sulfur Dioxide		ide	0.000143953	0.000300798	0.00410102	2.60570E-06*	0	0.00469592	0.00469592	0.00469592	0.00469592	0.00469592	0.00467210	0.00467210	0.00467210	0.00467210	0.00466430	Sulfur Diox
MEA			52.4610	137406	549705	0.803518*	549678	0.000116446	0.000116408	0.000116408	0.000116408	0.000116408	3.87591E-06	3.87591E-06	3.87591E-06	3.87591E-06	6.22259E-07	MEA
Argon			2.04683E-05	0.000173138	0.352341	1.66238E-08*	0	0.440235	0.440235	0.440235	0.440235	0.440235	0.440232	0.440232	0.440232	0.440232	0.440230	Argon
NO			1.12256E-08	1.16879E-07	0.000138789	1.24274E-11*	0	0.000173359	0.000173359	0.000173359	0.000173359	0.000173359	0.000173358	0.000173358	0.000173358	0.000173358	0.000173357	NO
NO2			3.79247E-07	2.19864E-06	0.000491809	1.65671E-07*	0	0.000612222	0.000612221	0.000612221	0.000612221	0.000612221	0.000592880	0.000592880	0.000592880	0.000592880	0.000586801	NO2
NH3			1.58634	0.786928	3.38635	0.0240064*	2.01286	0.00542721	0.00542717	0.00542717	0.00542717	0.00542717	0.00383606	0.00383606	0.00383606	0.00383606	0.00338834	NH3
Process Streams		**Process Streams**	**325**	**330**	**332**	**333**	**334**	**400**	**401**	**402**	**403**	**404**	**405**	**406**	**407**	**408**	**409**	
Property	**Units**	**Property**																**Units**
Temperature	℃	Temperature	48.6934	114.013	53.4425	45.9852*	58.8405	48.7032	48.7032	176.667*	129.444*	26*	25.8867	176.667*	129.444*	26*	25.9261	℃
Pressure	bar	Pressure	1.79306	2.39982	10.7412	4.13685*	4.72333	1.79306	1.79306	6.03537	5.75958	5.41484	5.34589	23.1069	22.8311	22.4864	22.4174	bar
Mole Fraction Vapor	%	Mole Fraction Vapor	0	0	0	0	0	99.9992	100	100	100	94.0626	100	100	100	99.5254	100	%
Molecular Weight	kg/kmol	Molecular Weight	18.0502	25.9967	26.0387	18.0406	25.7751	42.3053	42.3055	42.3055	42.3055	42.3055	43.8338	43.8338	43.8338	43.8338	43.9557	kg/kmol
Mass Density	kg/m^3	Mass Density	988.400	1123.28	1150.98	989.418	1098.16	2.85803	2.85802	6.88482	7.37019	10.0900	9.71118	27.9160	31.3450	45.7879	45.5558	kg/m^3
Molar Flow	kmol/h	Molar Flow	3133.82	15086.2	61285.4	53.7108	56692.3	2232.15	2232.13	2232.13	2232.13	2232.13	2099.75	2099.75	2099.75	2099.75	2089.78	kmol/h
Mass Flow	kg/h	Mass Flow	56566.1	392191	1.59579E+06	968.973*	1.46125E+06	94431.7	94431.4	94431.4	94431.4	94431.4	92040.1	92040.1	92040.1	92040.1	91857.8	kg/h
Std Vapor Volumetric Flow	m^3/h	Std Vapor Volumetric Flow	74241.5	357399	1.45188E+06	1272.43	1.34307E+06	52880.6	52880.1	52880.1	52880.1	52880.1	49744.1	49744.1	49744.1	49744.1	49507.8	m^3/h
Std Liquid Volumetric Flow	m^3/h	Std Liquid Volumetric Flow	56.6483	398.367	1624.20	0.970216	1470.53	114.418	114.418	114.418	114.418	114.418	112.022	112.022	112.022	112.022	111.838	m^3/h
Specific Gravity		Specific Gravity	0.989334	1.12434	1.15206	0.990354	1.09920		1.46128	1.46128	1.46128		1.51407	1.51407	1.51407		1.51828	
Mass Enthalpy	kJ/kg	Mass Enthalpy	-15741.5	-10962.0	-11198.9	-15759.0	-11070.2	-9045.10	-9045.08	-8924.50	-8971.66	-9130.17	-8956.03	-8823.37	-8871.29	-8978.41	-8965.07	kJ/kg
Dynamic Viscosity	cP	Dynamic Viscosity	0.548226	0.699454	2.56530	0.576577	1.83764		0.0161455	0.0216019	0.0197044		0.0152834	0.0220095	0.0201805		0.0159385	cP
Thermal Conductivity	W/(m*℃)	Thermal Conductivity	0.6334	0.3990	0.3823	0.6312	0.4060		0.0187	0.0287	0.0251		0.0172	0.0296	0.0261		0.0189	W/(m*℃)
Surface Tension	dyne/cm	Surface Tension	68.0675	87.4090	92.8018	68.6194	57.9601											dyne/cm

Process Streams		Streams	410	411	412	413	414	415	416	417	501	502	503	504	505	506	509	510	511	Process
			3rd Stage Suction	Hot 3rd Stage Discharge	Cooled 3rd Stage Discharge	Cold 3rd Stage Discharge	CO2 Product	Inter-stage Liquid	Liquefied CO2	Dryer Water	SCW Supply to E-101	SCW Return From E-101	SCW Supply to E-104	SCW Return From E-104	SCW Supply to E-102	SCW Return From E-102	SCW Supply to E-111	SCW Return From E-111	LP Steam from E-112	
Mole Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mole Fract**
Oxygen			0.00775389	0.00775389	0.00775389	0.00775389	0.00775389	9.70204E-07	0.00775389	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen			0.0235607	0.0235607	0.0235607	0.0235607	0.0235607	1.46335E-06	0.0235607	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water			0.0110002	0.0110002	0.0110002	0.0110002	0.0110002	99.7532	0.0110002	100	100*	100	100*	100	100*	100	100*	100	100	Water
Carbon Dioxide		xide	99.9571	99.9571	99.9571	99.9571	99.9571	0.246741	99.9571	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dic
Sulfur Dioxide		ide	3.49016E-06	3.49016E-06	3.49016E-06	3.49016E-06	3.49016E-06	3.46852E-07	3.49016E-06	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Diox
MEA			4.88340E-10	4.88340E-10	4.88340E-10	4.88340E-10	4.88340E-10	1.33156E-06	4.88340E-10	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon			0.000528271	0.000528271	0.000528271	0.000528271	0.000528271	7.16324E-08	0.000528271	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO			2.76951E-07	2.76951E-07	2.76951E-07	2.76951E-07	2.76951E-07	5.14283E-11	2.76951E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2			6.11439E-07	6.11439E-07	6.11439E-07	6.11439E-07	6.11439E-07	3.88307E-07	6.11439E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3			9.53742E-06	9.53742E-06	9.53742E-06	9.53742E-06	9.53742E-06	8.40604E-05	9.53742E-06	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Molar Flow		**v**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**kmol/h**	**Molar Flow**
Oxygen			0.161751	0.161751	0.161751	0.161751	0.161751	1.38105E-06	0.161751	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen			0.491492	0.491492	0.491492	0.491492	0.491492	2.08303E-06	0.491492	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water			0.229472	0.229472	0.229472	0.229472	0.229472	141.995	0.229472	3.71335	246262*	246262	246262*	246262	30912.8*	30912.8	199161*	199161	106.472	Water
Carbon Dioxide		xide	2085.17	2085.17	2085.17	2085.17	2085.17	0.351227	2085.17	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dic
Sulfur Dioxide		ide	7.28071E-05	7.28071E-05	7.28071E-05	7.28071E-05	7.28071E-05	4.93732E-07	7.28071E-05	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Diox
MEA			1.01871E-08	1.01871E-08	1.01871E-08	1.01871E-08	1.01871E-08	1.89543E-06	1.01871E-08	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon			0.0110201	0.0110201	0.0110201	0.0110201	0.0110201	1.01966E-07	0.0110201	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO			5.77739E-06	5.77739E-06	5.77739E-06	5.77739E-06	5.77739E-06	7.32066E-11	5.77739E-06	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2			1.27550E-05	1.27550E-05	1.27550E-05	1.27550E-05	1.27550E-05	5.52743E-07	1.27550E-05	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3			0.000198957	0.000198957	0.000198957	0.000198957	0.000198957	0.000119657	0.000198957	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Mass Fraction		**tion**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**Mass Frac**
Oxygen			0.00563873	0.00563873	0.00563873	0.00563873	0.00563873	1.71717E-06	0.00563873	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen			0.0149997	0.0149997	0.0149997	0.0149997	0.0149997	2.26741E-06	0.0149997	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water			0.00450372	0.00450372	0.00450372	0.00450372	0.00450372	99.3993	0.00450372	100	100*	100	100*	100	100*	100	100*	100	100	Water
Carbon Dioxide		xide	99.9744	99.9744	99.9744	99.9744	99.9744	0.600624	99.9744	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dic
Sulfur Dioxide		ide	5.08144E-06	5.08144E-06	5.08144E-06	5.08144E-06	5.08144E-06	1.22906E-06	5.08144E-06	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Diox
MEA			6.77909E-10	6.77909E-10	6.77909E-10	6.77909E-10	6.77909E-10	4.49880E-06	6.77909E-10	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon			0.000479601	0.000479601	0.000479601	0.000479601	0.000479601	1.58278E-07	0.000479601	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO			1.88861E-07	1.88861E-07	1.88861E-07	1.88861E-07	1.88861E-07	8.53547E-11	1.88861E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2			6.39280E-07	6.39280E-07	6.39280E-07	6.39280E-07	6.39280E-07	9.88100E-07	6.39280E-07	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3			3.69137E-06	3.69137E-06	3.69137E-06	3.69137E-06	3.69137E-06	7.91836E-05	3.69137E-06	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Mass Flow		**v**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**kg/h**	**Mass Flow**
Oxygen			5.17585	5.17585	5.17585	5.17585	5.17585	4.41921E-05	5.17585	0	0*	0	0*	0	0*	0	0*	0	0	Oxygen
Nitrogen			13.7684	13.7684	13.7684	13.7684	13.7684	5.83528E-05	13.7684	0	0*	0	0*	0	0*	0	0*	0	0	Nitrogen
Water			4.13400	4.13400	4.13400	4.13400	4.13400	2558.09	4.13400	66.8970	4.43647E+06*	4.43647E+06	4.43647E+06*	4.43647E+06	556903*	556903	3.58794E+06*	3.58794E+06	1918.12	Water
Carbon Dioxide		xide	91767.4	91767.4	91767.4	91767.4	91767.4	15.4573	91767.4	0	0*	0	0*	0	0*	0	0*	0	0	Carbon Dic
Sulfur Dioxide		ide	0.00466430	0.00466430	0.00466430	0.00466430	0.00466430	3.16304E-05	0.00466430	0	0*	0	0*	0	0*	0	0*	0	0	Sulfur Diox
MEA			6.22259E-07	6.22259E-07	6.22259E-07	6.22259E-07	6.22259E-07	0.000115779	6.22259E-07	0	0*	0	0*	0	0*	0	0*	0	0	MEA
Argon			0.440230	0.440230	0.440230	0.440230	0.440230	4.07335E-06	0.440230	0	0*	0	0*	0	0*	0	0*	0	0	Argon
NO			0.000173357	0.000173357	0.000173357	0.000173357	0.000173357	2.19664E-09	0.000173357	0	0*	0	0*	0	0*	0	0*	0	0	NO
NO2			0.000586801	0.000586801	0.000586801	0.000586801	0.000586801	2.54292E-05	0.000586801	0	0*	0	0*	0	0*	0	0*	0	0	NO2
NH3			0.00338834	0.00338834	0.00338834	0.00338834	0.00338834	0.00203783	0.00338834	0	0*	0	0*	0	0*	0	0*	0	0	NH3
Process Streams		**Process Streams**	**410**	**411**	**412**	**413**	**414**	**415**	**416**	**417**	**501**	**502**	**503**	**504**	**505**	**506**	**509**	**510**	**511**	
Property	**Units**	**Property**																		**Units**
Temperature	℃	Temperature	25.9261	176.667*	129.444*	28*	48.2035	25.8867	27.9889	25.9261	11*	21	11*	21	11*	21*	11*	21*	125.835	℃
Pressure	bar	Pressure	22.4174	93.5800	93.3042	92.9595	201.000*	5.34589	92.8905	22.4174	1.9999*	0.965686	1.9999*	0.965686	1.9999*	1.31042	1.9999*	0.965686	2.37913	bar
Mole Fraction Vapor	%	Mole Fraction Vapor	100	100	100	0	100	0	0	0	0	0	0	0	0	0	0	0	100*	%
Molecular Weight	kg/kmol	Molecular Weight	44.0019	44.0019	44.0019	44.0019	44.0019	18.0794	44.0019	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol
Mass Density	kg/m^3	Mass Density	45.5929	123.164	148.585	722.616?	778.522	997.558	722.508	996.481	1000.00	997.597	1000.00	997.597	1000.00	997.602	1000.00	997.597	1.31446	kg/m^3
Molar Flow	kmol/h	Molar Flow	2086.07	2086.07	2086.07	2086.07	2086.07	142.347	2086.07	3.71335	246262	246262	246262	246262	30912.8	30912.8	199161	199161	106.472	kmol/h
Mass Flow	kg/h	Mass Flow	91790.9	91790.9	91790.9	91790.9	91790.9	2573.55	91790.9	66.8970	4.43647E+06	4.43647E+06	4.43647E+06	4.43647E+06	556903	556903	3.58794E+06	3.58794E+06	1918.12	kg/h
Std Vapor Volumetric Flow	m^3/h	Std Vapor Volumetric Flow	49419.8	49419.8	49419.8	49419.8	49419.8	3372.26	49419.8	87.9708	5.83405E+06	5.83405E+06	5.83405E+06	5.83405E+06	732339	732339	4.71821E+06	4.71821E+06	2522.36	m^3/h
Std Liquid Volumetric Flow	m^3/h	Std Liquid Volumetric Flow	111.771	111.771	111.771	111.771	111.771	2.57943	111.771	0.0669628	4440.84	4440.84	4440.84	4440.84	557.451	557.451	3591.47	3591.47	1.92000	m^3/h
Specific Gravity		Specific Gravity	1.51988	1.51988	1.51988	0.723299?	1.51988	0.998500	0.723191?	0.997422	1.00095	0.998540	1.00095	0.998540	1.00095	0.998544	1.00095	0.998540	0.622268	
Mass Enthalpy	kJ/kg	Mass Enthalpy	-8961.75	-8844.37	-8902.59	-9167.59	-9147.64	-15823.4	-9167.59	-15861.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-15921.7	-15881.2	-13240.4	kJ/kg
Dynamic Viscosity	cP	Dynamic Viscosity	0.0159403	0.0242103	0.0230636	0.0609529	0.0692256	0.865915	0.0609668	0.879295	1.29092	0.987115	1.29092	0.987115	1.29092	0.987185	1.29092	0.987115	0.0106144	cP
Thermal Conductivity	W/(m*℃)	Thermal Conductivity	0.0189	0.0342	0.0319	0.1073	0.0909	0.6021	0.1073	0.6076	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.5854	0.6006	0.0270	W/(m*℃)
Surface Tension	dyne/cm	Surface Tension				0.0000		72.3392	0.0000	72.6316	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192	75.6475	73.6192		dyne/cm

Process Streams		Streams	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527		Process Streams
			LP Condensate from E-109	LP Steam from E-114	LP Steam to E-109	SCW Supply to E-113	SCW Return From E-113	SCW Supply to E-115	SCW Return From E-115	Condenstate to E-112	Condenstate to E-114	Condenstate to E-116	SCW Supply to E-117	SCW Return From E-117	LP Steam from E-116	LP Steam to E-110	LP Condensate from E-110	Vent Steam		
Mole Fraction		tion	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mole Fraction**
Oxygen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Oxygen
Nitrogen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Nitrogen
Water			100	100	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100		Water
Carbon Dioxide		xide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Carbon Dioxide
Sulfur Dioxide		ide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Sulfur Dioxide
MEA			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		MEA
Argon			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Argon
NO			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO
NO2			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO2
NH3			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NH3
Molar Flow		v	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h	kmol/h		**Molar Flow**
Oxygen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Oxygen
Nitrogen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Nitrogen
Water			339.640	105.477	339.731	20217.0*	20217.0	13316.7*	13316.7	106.472*	105.477*	127.783*	32854.4*	32854.4	127.783	8076.48*	8076.48	224.436		Water
Carbon Dioxide		xide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Carbon Dioxide
Sulfur Dioxide		ide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Sulfur Dioxide
MEA			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		MEA
Argon			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Argon
NO			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO
NO2			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO2
NH3			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NH3
Mass Fraction		tion	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		**Mass Fraction**
Oxygen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Oxygen
Nitrogen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Nitrogen
Water			100	100	100	100*	100	100*	100	100*	100*	100*	100*	100	100	100*	100	100		Water
Carbon Dioxide		xide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Carbon Dioxide
Sulfur Dioxide		ide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Sulfur Dioxide
MEA			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		MEA
Argon			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Argon
NO			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO
NO2			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO2
NH3			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NH3
Mass Flow		v	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h	kg/h		**Mass Flow**
Oxygen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Oxygen
Nitrogen			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Nitrogen
Water			6118.71	1900.19	6120.36	364215*	364215	239905*	239905	1918.12*	1900.19*	2302.05*	591880*	591880	2302.05	145500*	145500	4043.28		Water
Carbon Dioxide		xide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Carbon Dioxide
Sulfur Dioxide		ide	0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Sulfur Dioxide
MEA			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		MEA
Argon			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		Argon
NO			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO
NO2			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NO2
NH3			0	0	0	0*	0	0*	0	0*	0*	0*	0*	0	0	0*	0	0		NH3
Process Streams		**Process Streams**	**512**	**513**	**514**	**515**	**516**	**517**	**518**	**519**	**520**	**521**	**522**	**523**	**524**	**525**	**526**	**527**		**Process Streams**
Property	**Units**	**Property**																	**Units**	**Property**
Temperature	℃	Temperature	125.835	125.835	125.835	16*	26*	16*	26*	98.8889*	98.8889*	98.8889*	16*	26*	125.835	135*	133.594	146.435	℃	T emperature
Pressure	bar	Pressure	2.37913	2.37913	2.37913	1.9999*	1.31042	1.9999*	1.31042	2.37913*	2.37913*	2.37913*	1.9999*	1.31042	2.37913	2.9999*	2.9999	2.3499*	bar	Pressure
Mole Fraction Vapor	%	Mole Fraction Vapor	0*	100	100	0	0	0	0	0	0	0	0	0	100	100	0*	100	%	Mole Fraction Vapor
Molecular Weight	kg/kmol	Molecular Weight	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	18.0153	kg/kmol	Molecular Weight
Mass Density	kg/m^3	Mass Density	938.857	1.31446	1.31446	998.879	996.185	998.879	996.185	959.505	959.505	959.505	998.879	996.185	1.31446	1.62556	932.265	1.23159	kg/m^3	Mass Density
Molar Flow	kmol/h	Molar Flow	339.640	105.477	339.731	20217.0	20217.0	13316.7	13316.7	106.472	105.477	127.783	32854.4	32854.4	127.783	8076.48	8076.48	224.436	kmol/h	Molar Flow
Mass Flow	kg/h	Mass Flow	6118.71	1900.19	6120.36	364215	364215	239905	239905	1918.12	1900.19	2302.05	591880	591880	2302.05	145500*	145500	4043.28	kg/h	Mass Flow
Std Vapor Volumetric Flow	m^3/h	Std Vapor Volumetric Flow	8046.22	2498.79	8048.39	478950	478950	315480	315480	2522.36	2498.79	3027.24	778334	778334	3027.24	191335	191335	5317.00	m^3/h	Std Vapor Volumetric Flow
Std Liquid Volumetric Flow	m^3/h	Std Liquid Volumetric Flow	6.12473	1.90206	6.12638	364.574	364.574	240.141	240.141	1.92000	1.90206	2.30431	592.463	592.463	2.30431	145.643	145.643	4.04726	m^3/h	Std Liquid Volumetric Flow
Specific Gravity		Specific Gravity	0.939745	0.622268	0.622268	0.999823	0.997127	0.999823	0.997127	0.960412	0.960412	0.960412	0.999823	0.997127	0.622268	0.622268	0.933146	0.622268		Specific Gravity
Mass Enthalpy	kJ/kg	Mass Enthalpy	-15448.2	-13240.4	-13240.4	-15904.0	-15862.9	-15904.0	-15862.9	-15561.8	-15561.8	-15561.8	-15904.0	-15862.9	-13240.4	-13224.7	-15390.4	-13200.2	kJ/kg	Mass Enthalpy
Dynamic Viscosity	cP	Dynamic Viscosity	0.219521	0.0106144	0.0106144	1.12405	0.874153	1.12405	0.874153	0.279294	0.279294	0.279294	1.12405	0.874153	0.0106144	0.0110023	0.206890	0.0114855	cP	Dynamic Viscosity
Thermal Conductivity	W/(m*℃)	Thermal Conductivity	0.6847	0.0270	0.0270	0.5931	0.6077	0.5931	0.6077	0.6758	0.6758	0.6758	0.5931	0.6077	0.0270	0.0278	0.6856	0.0287	W/(m*℃)	Thermal Conductivity
Surface Tension	dyne/cm	Surface Tension	53.1489			74.6291	72.6168	74.6291	72.6168	58.4280	58.4280	58.4280	74.6291	72.6168			51.6045		dyne/cm	Surface Tension

6.0-CO_2 Drying and Compression

6.0 CO_2 Drying and Compression

The CO_2 drying and compression process for the Kårstø CO_2 Carbon Capture and Compression (CCC) Plant is described in this section.

6.1 Drying

The CO_2 leaving the stripper is saturated with water. The compression and cooling cycles of the first two stages of the compression system remove much of the water carried over from the stripper. However, to meet requirement for a final CO_2 water content of less than 50 ppmw, the CO_2 stream must be dried using desiccant dryers. The dryers are provided as a vendor package, with the vendor supplying the vessels, valving, instrumentation, and other associated equipment. The two vessels are operated in parallel—one in regeneration mode and one in operation. The dryers are located between the second and third compression stages. The regeneration method is extremely efficient because the dryer vessel is not depressurized and virtually no CO_2 is vented or recycled.

6.2 Compressor and Cooling

The CO_2 compressor consists of three compression stages in series. This arrangement provides the most cost-effective means of compression. Cooling the gas between compression stages lowers the electric power consumption. The CO_2 is compressed to about 5 bara in the first stage and then cooled; in the second stage, it is compressed to about 22 bara and recooled; in the third stage, it is compressed to about 93 bara and cooled again. The inter-stage cooling is achieved via three low–pressure-(LP)-steam-generating heat exchangers and three seawater-cooled heat exchangers. The LP steam generated, which is a form of heat recovery, is used to heat the amine. The three stages of compression take the CO_2-rich stream from 1.8 bara to 93 bara.

6.3 Compressor Driver

The CO_2 gas compressor is driven by an induction motor coupled through two gear boxes—one to meet the speed requirement of the LP compression stage and the second to meet the speed requirement of the medium/high pressure compression stage. The motor is powered by a variable frequency drive (VFD) that permits the motor to be soft-started to avoid significant electrical power system inrush loading. The CO_2 compressor/motor is expected to run at 100% speed under most operating conditions. As directed by Gassnova/Fichtner, no alternate driver types or systems were studied.

6.4 Drying and Compression Performance

The desiccant dryers remove more than 92% of the inlet water to achieve the CO_2 water specification of < 50 ppmvw.

The compression system performance is enhanced by generating LP steam with inter-stage heat exchangers.

6.5 Liquids Storage and Handling

The desiccant drying process selected precludes the need to store and handle any liquids for drying.

Lubrication oil is required for the compressor and must be stored in a suitable location.

6.6 Waste Discharge

Water generated in the regeneration cycle of the desiccant dryers is shown as a discharged stream. Vendor information shows that the water released from the regeneration operations can be recovered. A small amount of CO_2 remains dissolved in this water.

Each dryer is charged with a total of 3,835 kg of activated alumina desiccant with a running lifetime of 3 to 5 years.

6.7 Conclusions and Recommendations

The compressor pressurizes the CO_2 from 1.8 bara to over 93 bara. The compression energy heat is recovered via LP steam generators located in the discharge stream of each stage. The recovery of process water generated during the regeneration of the desiccant dryers is to be specified with the engineering, procurement, construction, and installation (EPCI) design.

7.0-Mechanical Utility Systems

7.0 Mechanical Utility Systems

7.1 Utilities—Consumptions and Equipment Handling

The mechanical utilities for the Kårstø CO_2 Capture and Compression (CCC) Plant are as follows:

- Steam and condensate
- Cooling (seawater)
- Potable water
- Fire protection water
- Fuel gas (natural)
- Compressed air
- Inerting gases (nitrogen)
- Desalination water

The requirements for these utilities are summarized in Table 7.1-1. The estimated demands are based on using 35% monoethanolamine (MEA) solvent, the heat and mass balances in document 10112936-PB-P-HMB-0001 (25474-000-M4-CN-00001), and other design factors. These utilities support the plant's main amine process for capturing CO_2.

Table 7.1-1. Utility Requirements

Commodity	Demand	Units	Comments
LP Steam	200	tonnes/hr	See 7.2
HP Steam	12	tonnes/hr	See 7.2; during reclaimer operation
LP Condensate	153	tonnes/hr	See 7.2, returned to CCPP
Cooling Water (Seawater)	17,340	m^3/hr	See 7.3
Potable Water	35	m^3/hr	See 7.4; intermittent
Fire Water	340	m^3/hr	See 7.5; intermittent
Fuel Gas	1500	kg/hr	Continuous
Compressed Air			See 7.7
Instrument Air	185	Nm^3/hr	Continuous (400 Nm^3/hr intermittent)
Plant Air	85	Nm^3/hr	Intermittent (maintenance tools)
Inerting Gases	85	Nm^3/hr	See 7.8; intermittent
Desalination Water	10	m^3/hr	See 7.9; intermittent

Some of the major equipment associated with the amine process is very large and requires special attention to installation and shipping. Table 7.1-2 lists the major equipment that requires special handling because it does not fit on a standard trailer truck.

Table 7.1-2. Equipment Requiring Special Handling

Equipment	Tag No.	Length (Mm)	Width (Mm)	Weight (Kg)	Remarks
CO_2 Absorber	T-101 / T-102	11,800	dia.	507,000	Updated weight
Stripper	T-103	6,670	dia	271,000	Updated weight
Flue Gas Blower	MA-101 / MA-102	7,890	7,290	71,000	Fan only
CO_2 Compressor	MC-103A-C	21,500	4,000	149,700	Total for all three stages
CO_2 Gas Drying Skid	X-104	5,100	5,000	139,250	
Concentrated Amine Storage Tank	MT-101	7,000	4,000 dia.	3,800	
Process Water Surge Tank	MT-104	7,300	4,300 dia.	4,000	
Transformer – Step-Down/Reserve 15 MVA	1ESETP03	4,850	3,650	20,000	
Transformer – Step-Down/Reserve 3 MVA	1ESETP02	3,650	3,100	7,000	
Stripper Reflux Drum	MV-202	5,500	3,700 dia.	2,500	
CO_2 Compressor Suction Drum	MV-203	6,000	4,000 dia.	3,000	
Flue Gas Guillotine Damper	MD-008A/B	7,000 x 7,000	1,500	20,000	Each damper
Flue Gas Guillotine Damper	MD-034A/B & MD-060A/B	7,000 x 3,500	1,500	15,000	Each damper
Seawater Cooling Pumps	MP-115A/B	3,850	1,800	15,200	

7.2 Steam and Condensate

The CCC Plant design includes low pressure (LP) steam, auxiliary boiler steam, high pressure (HP) steam, and LP and HP condensate systems for plant operations.

The LP steam supply is from the adjacent NaturKraft combined cycle power plant (CCPP) LP steam turbine crossover piping to an interface at the CCC Plant battery limit (B/L). The LP steam conditions at the

B/L are 2.2 barg and 270 °C, and the maximum quantity of steam available from the CCPP is 165 tonnes/hr. The LP steam is desuperheated using LP condensate to reduce its temperature to approximately 135 °C for use in the reboilers and at the seven CCC Plant utility stations, thereby increasing its volume by about 20 tonnes.

During certain CCC Plant operating scenarios, the quantity of LP steam required exceeds the 165 tonnes/hr available from the CCPP. During these operating scenarios, the CCC Plant auxiliary boiler is used to supplement the LP steam demands to the stripper reboilers. The auxiliary boiler is sized for approximately 20 tonnes/hr of saturated steam to meet the LP steam conditions. LP steam flow control valves are provided on the inlet piping to each reboiler. Steam line drains are provided throughout the system as required and routed to the LP condensate blowdown tank.

HP steam supply is from the CCPP auxiliary boiler to an interface at the CCC Plant B/L. The HP steam conditions at the B/L are 7 barg at approximately 165 °C (saturated). The quantity of HP steam available from the CCPP auxiliary boiler is approximately 12 tonnes/hr and is available only when not required by the CCPP internal use. HP steam is used for amine reclamation in the CCC Plant's thermal reclaimer. Because amine reclamation is not a continuous process, it is expected that steam from the CCPP auxiliary boiler will be available when needed. An HP steam flow control valve is provided on the inlet piping to the reclaimer. Steam line drains are provided throughout the system as required and are routed to the LP condensate blowdown tank. In addition, a manual globe valve is provided in the HP steam line near the reclaimer to facilitate cleaning or aid in reclaimer waste removal.

LP condensate is produced in the stripper reboilers and is piped to the LP condensate blowdown tank. Similarly, HP condensate is produced from the amine reclaimer and piped to the LP blowdown tank. In addition, small quantities of blowdown from the CO_2 compressor 1st-, 2nd-, and 3rd-stage steam generators are routed to the LP blowdown tank. Some of the LP and HP condensate flashes in the blowdown tank and is vented to the stripper column. The remaining condensate in the LP blowdown tank is used as follows:

- Spray water for the LP steam desuperheater
- LP condensate supply to the three CO_2 compressor steam generators
- LP condensate return to the B/L for return to the CCPP condenser
- Supply to the CCC Plant auxiliary boiler
- Reject to the process water surge tank, as required

The LP condensate system includes the blowdown tank and 2 x 100% LP condensate pumps. The LP condensate is continuously sampled before it is returned to the CCPP. If the return condensate doesn't meet plant requirements, it is discharged to the CCC Plant surge water tank.

7.3 Cooling

Seawater is used as the cooling medium for the CCC Plant's heat exchangers via a once-through, direct-cooling water system. Seawater is also the supply source for the plant's desalination system. The cooling water system design includes an intake tunnel and pump structure pit, a discharge pit, and an outfall tunnel, all of which accommodate plant flow rates. The intake and discharge pits are outside the B/L. The design includes 2 x 100% seawater cooling pumps in the intake structure and the piping from the intake structure to the B/L. All other required intake structure equipment (i.e., traveling water screens, screen wash pumps, etc.) is outside the B/L. The design includes seawater return piping from the plant to a discharge pit outside the B/L. A backpressure control valve located in the common return line ensures that the various heat exchangers remain full during operation. This control valve is located in a dry pit within the B/L at the required elevation to preclude cavitation of the valve, and the water enters a weir to control the outfall. The seawater cooling system can be drained by a small bypass valve placed around the control valve to a drain point downstream of the weir, and the weir itself is self-draining.

Seawater cooling booster pumps (2 x 100%) are provided to increase system pressure to the stripper overhead condensers, which are located at a higher elevation than the other system heat exchangers. The flow rate to these condensers is only approximately 30% of the total seawater cooling flow rate. Adding the booster pumps precludes the need to add approximately 8 m head to the main seawater cooling pumps, thereby reducing overall pumping power. The common return piping from the overhead stripper condensers has a control valve that aids in maintaining a backpressure on the condensers and keeps them full during operation. The control valve is located at grade to preclude cavitation.

The seawater cooling system design is based on traveling screens that filter the debris in the seawater to less than 2.5 mm in diameter to preclude plugging of the plant plate-and-frame heat exchangers. The design is also based on seawater supply and return temperatures of 11 °C and 21 °C, respectively. The plant permit limit for cooling water return temperature to the sea is 25 °C.

7.4 Potable Water

Potable water is supplied from outside the CCC Plant B/L to an interface at the B/L. At that point, it is in accordance with the Norwegian potable water quality standard and at 5.0 barg pressure and ambient temperature. Potable water is used for sanitary needs and emergency safety showers (ESSs) and at all utility stations. Potable water is not used for any process needs. A hose connection for potable water is provided at each of the seven utility stations. Eight temperature-controlled ESSs are located in the following areas:

- Amine storage tank area
- CO_2 compressor area
- Absorber 1 area
- Absorber 2 area
- Stripper area
- Reboiler/reclaimer area (upper level)
- Reboiler/reclaimer area (lower level)
- Electrical building area

Heated emergency eyewash stations (EWSs) are supplied by bottle water. There are nine EWSs; eight are located adjacent to each ESS, and one is in the analyzer building area. Total potable water demand is based on the simultaneous use of all sanitary water users and assuming two ESSs operating simultaneously.

7.5 Fire Protection Systems

Fire water is supplied from outside the CCC Plant B/L to two separate interfaces at the B/L. The interface pressure and temperature conditions are 11.7 barg and ambient temperature. The design reflects two fire water supply lines from outside the B/L that feed the plant underground fire loop, which includes service branch lines to the CO_2 compressor area automatic wet pipe sprinkler system and the yard hydrants. Fire hydrants are spaced at approximately 250-foot (76 m) intervals around the fire loop. The hydrants are located in accordance with NFPA 24 and local fire codes. Hose houses are provided for each hydrant. The system supplies the design maximum water demand for any automatic suppression system plus 114 m^3/hr of flow for fire hydrants, based on National Fire Protection Association (NFPA) requirements.

The fire protection system is augmented by portable fire extinguishers located throughout the plant.

The plant fire alarm system includes local fire alarms, automatic fire and gas detectors, and a fire- and gas-detection programmable logic controller (PLC), as required by design codes. The PLC interfaces with the plant distributed control system (DCS). For a description of the CCC Plant fire and gas monitoring and alarm system, refer to Section 9.4.3.

7.6 Fuel Gas

Fuel (natural) gas is required for use in the CCC Plant auxiliary boiler. The gas is supplied from outside the B/L to an interface at the B/L. Fuel gas conditions at the B/L are 4.9 bara and 20 °C. The gas piping routed from the interface point to the auxiliary boiler incorporates an emergency shutdown valve that closes on a burner trip or can be closed by the operator in case of an emergency.

7.7 Compressed Air

The compressed air system (PA) supplies instrument air (IA) and service air (SA) for all consumers within CCC Plant. An air receiver is provided to knock out any water droplets and is of sufficient size to provide instrument air (IA) for 10 minutes at specified pressure in the event of a feed failure.

The PA system consists of 2 x 100% air-cooled compressors, 2 x 100% air dryers, and a single air receiver. The compressed air system supplies dry, oil-free air at 8.62 barg and a dew point of –40 °C and can operate at 100% humidity and maximum ambient temperature. Both IA and SA are supplied dry air. SA connections are provided in each of the seven utility stations located within the plant. A hose connection for SA is provided at each utility station. Also provided is a connection for a temporary portable compressor, which is outside the B/L. The maximum allowable discharge pressure from this portable compressor is 13.8 barg.

Low-priority users (e.g., SA) are automatically shut off in case of low IA system pressure. Both air compressors are connected to emergency power; however, only one runs on emergency power at a time. The continuous IA requirement is based on the modulating control valves being in service and the on/off valves not stroking. For the intermittent IA demand, the flow rate is based on typical sizing flow rate, assuming time-averaged stroking activity for the control valves, including dryer purge air, plus a 10% allowance. For plant air, the demand is based on an estimate of using a few pneumatic tools during maintenance.

7.8 Inerting Gases

The CCC Plant inerting gases needs are supplied via nitrogen gas bottles. The nitrogen is used for system and equipment lay-up as needed. The amine (concentrated) storage tank and the 35% MEA storage tank have nitrogen blanketing. A nitrogen connection is provided in each of the plant's seven utility stations. The nitrogen gas system supply header pressure to the utility stations is controlled to approximately 5 barg. The nitrogen gas system supply header pressure to the storage tanks is controlled to approximately 2 barg.

7.9 Desalination System

The CCC Plant operates in a water-balanced mode requiring no process makeup water. During startup and transition periods where the plant may be out of water balance, process makeup is provided by the desalination system.

A branch connection from the seawater cooling system is used to supply water to the desalination system. This system includes the required filtration, pumps, two-pass reverse osmosis (RO), storage tank, chemical feed skids, clean-in-place (CIP) skid, piping, and instrumentation and controls to produce plant makeup water. The system is designed to produce 8 m^3/hr of permeate, with approximately 9 m^3/hr discharge to the wastewater sump.

7.10 Waste Collection and Drains

7.10.1 Amine Waste

The amine (35% MEA) solvent needs to be drained from the CCC Plant at shutdown and from individual equipment for maintenance activities.

For shutdown, MEA circulation continues without flue gas flow to ensure that the MEA solution is lean throughout all of the equipment. The equipment is pumped out to a minimum level directly, or through other vessels, to the lean amine solvent storage tank. The remaining MEA solution is drained by gravity though the amine waste piping to the amine waste sump. From the sump, the amine solution is pumped through filters to the amine solvent storage tank. Two 100% amine waste-forwarding pumps and two 100% amine waste filters are provided. The amine solvent storage tank has been sized to accommodate the MEA solution from all of the plant's equipment and piping.

The amine waste sump provides the opportunity to test the drained amine to ensure that it is of acceptable quality before it is pumped to the storage tank. This sump has been sized to accommodate the entire contents of the largest vessel (one CO_2 absorber vessel). If the drained MEA solution is not acceptable, it can be pumped from the amine waste sump directly to road tankers for offsite disposal.

7.10.2 Wastewater

Any wastewater effluent from the CCC Plant area open drains is routed to the wastewater sump. Two 100% wastewater forwarding pumps are provided. The wastewater effluent may contain oil; therefore, all wastewater effluent pumped from this sump to the seawater cooling discharge pit is routed through an underground oil/water separator. This separator removes any oil to meet ≤ 1.5 ppm oil content. The oil collected in its reservoir is manually drained for offsite disposal.

The wastewater sump provides the opportunity to test the drained effluent and ensure that it is of acceptable quality before it is pumped to the discharge pit. This sump has been sized to accommodate the entire contents of the largest vessel (one CO_2 absorber vessel). If the drained effluent is not acceptable, it can be pumped from the wastewater sump directly to road tanks for offsite disposal

7.11 Wastewater Treatment

No wastewater treatment facility is provided. Amine-laden water from the process is recycled back into the process. Steam condensate is returned to the CCPP. Backwash water and dissolved solids from the desalinization system RO units are returned to the seawater discharge pipe. Clean service water runoff and stormwater are discharged to the seawater discharge pipe. Sewage (water closets) is sent outside the B/L for processing.

7.12 Piping and Insulation

7.12.1 Piping

The CCC Plant piping design is governed by ASME B31.3, plumbing code, NFPA, and/or local codes as applicable. The piping material classes are given in the piping class selection document, 10112936-PB-L-TED-0001 (25474-000-3DS-P72G-00001).

Piping is designed to resist plant-specific loads. Typical loading for a piping system includes:

- Dead loads
- Live loads
- Wind loads
- Seismic loads
- Temperature and pressure loads
- Test loads

The plant is arranged to minimize the crossing of piping and electrical commodities.

Aboveground piping is routed as directly as possible to its destination, except for the addition of piping flex loops. Routings avoid areas designated as equipment or instrument maintenance space, vertical access hatches, and maintenance crane or monorail travel space. Piping routed overhead maintains a minimum 6-foot, 9-inch headroom clearance above main floor level and walkways. Pipe routed above stairways maintains a minimum 7-foot headroom clearance above the nearest tread. Except for sloped piping, a two-level scheme is maintained to allow pipes to clear each other when a change in direction occurs in the routing path. Piping is routed above lighting fixtures located over floor access aisles.

Pipe racks support pipe routings between structures for piping requiring inspection or maintenance. Pipe rack that crosses access ways or roadways maintains a 20-foot minimum clearance.

Buried piping is routed in a common corridor between structures to minimize construction and traffic crossings.

Piping systems generally include high point vents and low point drains. Piping in unheated areas is either heat traced or designed for draining. Where feasible, steam piping is sloped in the direction of steam flow, with a minimum slope of 1/8 inch per foot. This general design requirement may be modified if it becomes impractical to maintain strict adherence; however, piping is designed to drain properly.

7.12.2 Insulation

Parts of the CCC Plant requiring insulation to reduce heat loss or afford safety to personnel are thermally insulated. Piping, ducts, and other hot surfaces within reach of personnel are limited to 60 °C regardless of ambient conditions or have standoffs or other protection in combination with insulation to meet this standard.

Thermal insulation materials are calcium silicate, fiberglass, or mineral fiber. Asbestos materials are prohibited. A jacket or suitable coating is provided on the outside surface of the insulation. Where a hard-setting compound is used as an outer coating, it is nonabsorbent and non-cracking. Thermal insulation remains chemically inert even when saturated with water. Insulation system materials, including jacketing, have a flame spread rating of 25 or less when tested in accordance with ASTM E 84.

Insulation outside buildings and structures is weatherproofed through the use of longitudinal laps below pipe centerline, downward end laps on vertical piping, and mastic plastic cements at penetrations. Removable insulation is provided at flanged valves 2-1/2 inches and larger.

Antisweat insulation with a moisture-proof barrier is furnished only in occupied (finished) areas. A fluid temperature of less than 10 °C is the basis for using antisweat insulation.

Insulation at valves, pipe joints, and other points where maintenance access may be required is removable with minimal disturbance to the pipe insulation. At each flanged joint, the molded material terminates on the pipe at a distance from the flange equal to the overall length of the flange bolts to permit their removal without damaging the molded insulation. Aboveground insulated piping includes suitable material cladding. At joints, the sheets are sufficiently lapped to prevent moisture from penetrating the insulation.

Design temperature limits for thermal insulation are based on system operating temperature during normal operation.

7.13 External Utility and Piping Interfaces

The CCC Plant external utility and piping interfaces are as follows:

- LP steam from CCPP
- HP steam from CCPP
- LP condensate to CCPP
- HP condensate to CCPP (combined with LP condensate)
- Fuel gas from CCPP
- Flue gas from CCPP
- Fire water from CCPP (two connections)

- Seawater cooling pump intake structure
- Seawater cooling discharge pit
- Potable water from CCPP
- Sewage effluent return to CCPP
- CCC Plant utilities (compressed air, nitrogen gas, water, LP steam) station at CO_2 transport area

The connections information for the above utility interfaces is shown on interface register document 10112936-FI-Z-LST-0004.

8.0-CCC Plant Electrical Distribution System

8.0 CCC Plant Electrical Distribution System

8.1 General

The Kårstø CO_2 Capture and Compression (CCC) Plant electrical distribution system is designed to comply with the front-end engineering and design (FEED) tender documents. The plant receives its power from a 50 MVA transformer located outside the battery limit (B/L) and inside the adjacent Naturkraft combined cycle power plant (CCPP) and is connected to the generator isophase bus. This transformer is connected to the CCC Plant 22 kV switchgear via an in-feed cable installed in sand-filled cable culverts. The CCC Plant receives its backup power (for maintenance only) from the CCPP 6.6 kV switchgear through a dead-time transformer, which is provided inside the B/L and is connected to the 22 kV switchgear via a cable located in a sand-filled culvert.

The 22 kV switchgear is the primary power feeding source for all plant loads. The 22 kV system feeds adjustable speed drive systems for motor loads greater than 3,500 kW. Motors greater than 250 kW but less than or equal to 3,500 kW are fed from the 6.6 kV switchgear through a step-down transformer inside the B/L. The 22 kV system also feeds the 400/230 V loads through redundant load center transformers connected to redundant 400 V load centers for further power distribution.

In the event of a complete loss of in-feed power, critical loads required to safely shut down the plant are fed from the dc and ac uninterruptible power supply (UPS) system. This system has redundant batteries, battery chargers, and inverters.

In the event of an extended loss of in-feed power, the plant has a standby emergency diesel generator. The standby diesel generator is connected to the plant's essential motor control center (MCC), which distributes emergency power to the plant's critical and essential loads.

Power factor correction equipment is connected to the 22 kV switchgear. The power factor correction capacitors are designed with an automatic power factor controller to maintain the plant power factor at approximately 1.0.

The plant uses the following nominal distribution system voltages:

- 22 kV, 3-phase, 50 Hz, isolated neutral (IT)
- 6.6 kV, 3-phase, 50 Hz, IT

- 400/230 V ac, 3-phase, 50 Hz, TN-S (separate neutral and protective earth)
- 400/230 V ac UPS, 3-phase, 50 Hz
- 110 V dc UPS
- 24 V dc UPS

The main electrical distribution components are located in or adjacent to the plant electrical building, as shown in Figure 8.1-1.

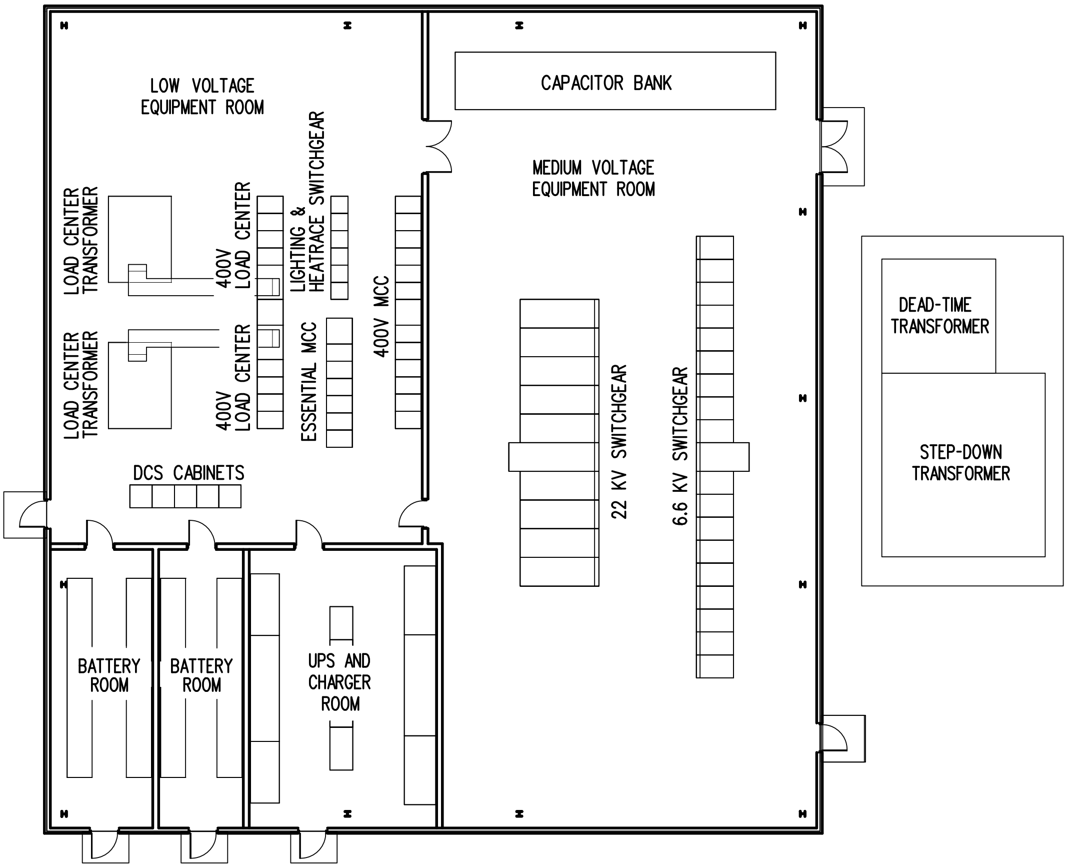


Figure 8.1-1. CCC Plant Electrical Building Layout

8.2 Switchgear

The CCC Plant 22 kV and 6.6 kV switchgear is located indoors in the electrical building, is designed of metal-enclosed (sheet-steel) construction, and is sized for the nameplate rating of the connected transformers. The 22 kV switchgear uses manually initiated, load-limited, make-before-break transfer to transfer power between the maintenance source and the normal power source without service interruption. The 6.6 kV switchgear has a single in-feed.

The 400 V load centers and MCCs are located indoors in the electrical building, are designed of metal-enclosed (sheet-steel) construction, and are sized for the nameplate rating of the connected transformers. The load centers and MCCs have two bus-bar sections with a coupling breaker and two 100% in-feeds. An automatic fast bus-transfer provided with the load center closes the coupling breaker in the event of a loss of one of the in-feeds.

The plant also has a 400 V essential MCC with two 100% normal in-feeds and an emergency in-feed from the standby diesel generator. Interlocks are provided to ensure safe operation.

Low voltage (LV) panelboards are located throughout the plant to supply power to convenience receptacles, certain lighting, and heat tracing. Indoor panelboards are metal enclosed (sheet steel construction), and outdoor panelboards are of stainless steel construction, IP54, and rated for use per the hazardous area classification.

All switchgear is designed for future expandability, has electrical protection to isolate electrical faults as close as possible to the fault location, and communicates with safety and automation systems via digital bus.

8.3 Transformers

The CCC Plant's transformers have copper windings, are sized to feed the plant's worst-case operating loads plus contingency for future growth, and are designed per IEC standards. Main design features are summarized in Table 8.3-1.

Table 8.3-1. Transformer Ratings and Design Features

Transformer	Rating	Feed Source (Input)	Feed Source (Output)	Location	Supplier
CCC Plant Transformer	50 MVA, 20 kV/ 23 kV, ONAN YNd11, with on-load tap changer	CCPP isophase bus	CCC Plant 22 kV switchgear	CCPP	Outside B/L
Dead-Time Transformer	3 MVA, 6.6 kV/ 23 kV YNyn(d)0, ONAN, de-energized tap changer	CCPP 6.6 kV switchgear	CCC Plant 22 kV switchgear	Outdoors adjacent to electrical building	Inside B/L

Transformer	**Rating**	**Feed Source (Input)**	**Feed Source (Output)**	**Location**	**Supplier**
Step-Down Transformer	15 MVA, 22 kV/ 6.9 kV, Dyn1, ONAN, de-energized tap changer	CCC Plant 22 kV switchgear	CCC Plant 6.6 kV switchgear	Outdoors adjacent to electrical building	Inside B/L
Load Center Transformers	2,500 kVA, 22 kV/ 0.42 kV cast resin, Dyn1, de-energized tap changer	CCC Plant 22 kV switchgear	400 V load centers	Indoors in electrical building	Inside B/L

8.4 Power Factor Correction

The CCC Plant's medium voltage (MV) power factor correction equipment consists of a metal-enclosed, multistage, switched capacitor bank in the electrical building. The capacitor bank has a power controller that automatically switches the individual capacitors on or off to provide the required MVAR support to maintain the system power factor at the plant's B/L at a nominal 1.0 based on preliminary design calculations. A four-stage capacitor bank with a total of 20 MVAR support was selected to cover various operating scenarios. The selected capacitor stages are listed in Table 8.4-1.

Table 8.4-1. Power Capacitor Stages

Stage	**MVAr**
A	0.5
B	2.5
C	5.0
D	12.0
Total	20.0

NOTE: Number of stages and MVAr values require adjustment during detailed design to suit final requirements.

8.5 Electrical Loads Summary

Electrical load summaries were performed to outline the expected CCC Plant loads during the operating scenarios summarized in Table 8.5-1. Please see document 10112936-PB-E-PAL-0001 (25474-000-30R-E21G-00001) for complete details.

Table 8.5-1. Electrical Loads Summary

Scenario (~ approximately)	**Load (KW)**
Maximum Operation (for system sizing)	~44,000
Continuous Operation (CO_2 capture during full power plant output)	~32,000
Standby Operation (CO_2 capture imminent)	~5,000
UPS Operation (initial plant shutdown during in-feed power loss)	~65
Essential Operation (standby diesel generator)	~470

NOTE: Values are conservatively estimated but are not to be construed as guarantees.

8.6 System Studies

Electrical system studies were performed to verify the adequacy of the CCC Plant's electrical system design and the suitability of the selected electrical equipment. These studies were performed based on the worst-case input parameters and indicated that the selected equipment provides stable, reliable, and expandable plant power. The system studies summaries are outlined in Table 8.6-1.

Table 8.6-1. Electrical System Studies Summary

Study	**Purpose**	**Result**
Short-Circuit Study	Performed to select the interrupting rating of the circuit breakers.	Selected equipment will safely withstand and interrupt the worst-case fault conditions and have suitable margin.
Load Flow Study	Performed to validate that voltages are within required tolerances during different operating conditions and to validate that all equipment is properly rated for the electrical load.	Voltages remain within acceptable tolerances under each operating condition, and the on-load tap changer on the plant transformer provides suitable voltage regulation.
Transient Stability Study	Performed to that validate the largest motors on each bus are capable of accelerating their loads and to determine power system response to simulated system disturbances (electrical faults).	All motors safely accelerate their loads, and the electrical system is able to fully recover after clearing system disturbances.
Harmonic Distortion Analysis	Performed to ensure that harmonic distortion levels on the electrical network are within acceptable tolerances.	Total harmonic distortion is within acceptable levels using tuned harmonic filters provided with the adjustable speed drives.

8.7 Emergency and UPS Power

The CCC Plant has emergency power sources to provide power if both normal and backup power are unavailable. Emergency power is provided through the UPS system located indoors in the electrical building. The UPS system has 2 x 100% fully redundant batteries, battery chargers, inverters, and two 100% in-feed breakers to all sub-switchgear, as shown in Figure 8.7-1.

The plant also has a 600 kWe standby diesel generator to provide power during an extended loss of in-feed power. The standby diesel generator is connected to the plant's essential MCC and is automatically started upon loss of power on the 400 V system. Upon diesel generator startup, the electrical system is designed to automatically supply power to the plant emergency and essential loads such as the UPS system; essential lighting; essential heat tracing; and essential heating, ventilation, and air-conditioning (HVAC).

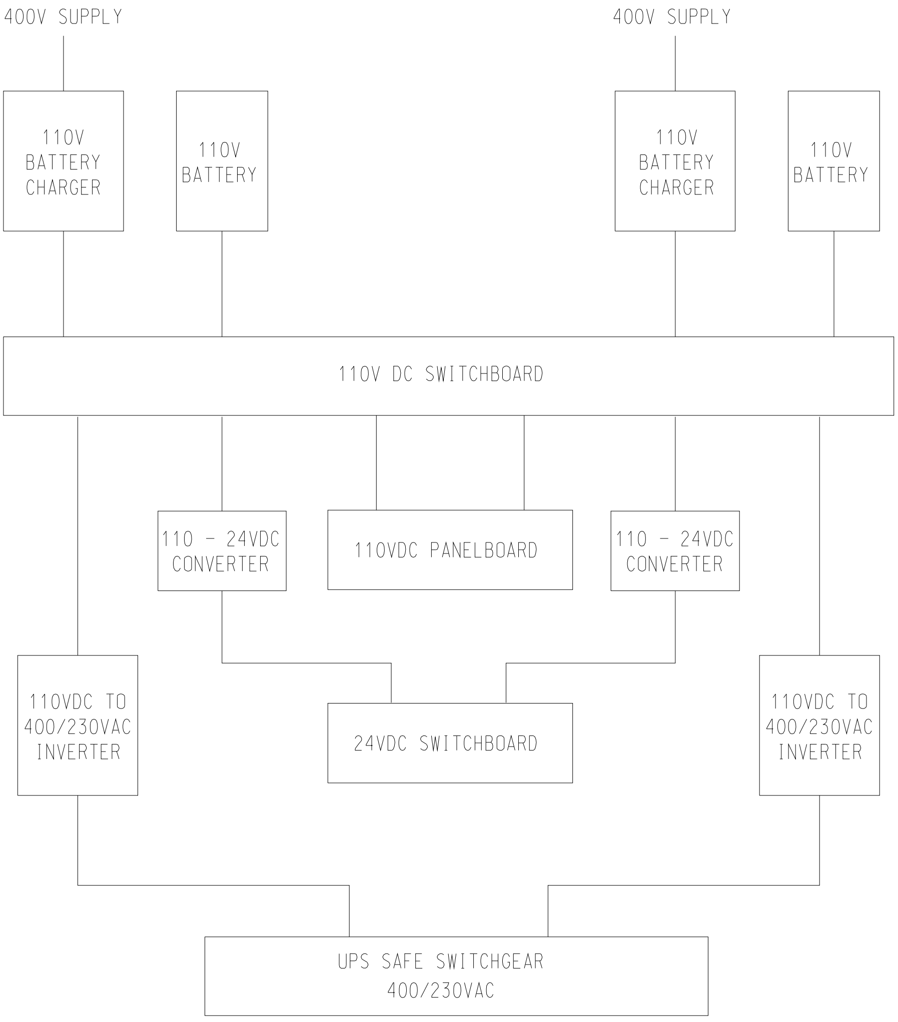


Figure 8.7-1. CCC Plant UPS System Diagram

8.8 Hazardous Areas Classification

Electrical equipment and bulks are suitable for installation for their exposed hazards. Outdoor electrical equipment is designed for Zone 2, Group IIA T2, as a minimum. Indoor electrical equipment and bulks are classified as nonhazardous. See document 10112936-PB-S-HSE-0010 (25474-000-U5Y-0000-00001) for detailed hazardous classifications.

8.9 Cable and Raceway

MV and LV power and control cables use stranded copper conductors. MV power cables are cross-linked polyethylene (XLPE) insulated, with polyvinyl chloride (PVC) jackets, and are designed with insulation levels suitable for application in unearthed systems. LV power cables are XLPE insulated, copper screened, and PVC over-sheathed. LV control cables are PVC insulated, with PVC over-sheath. All cables are armored, using glands for termination.

Aboveground circuits are designed for installation in stainless steel cable ladder or cable tray when outdoors and rigid galvanized steel cable ladder or tray when indoors. Underground circuits are installed in precast, sand-filled, cable culverts.

8.10 Earthing and Lightning Protection

The earthing system consists of three subsystems: instrument earth (IE), protective earth (PE), and intrinsically safe earth (IS). The earthing system is designed to obtain low-impedance earth paths for earth faults, static discharges, and lightning protection, and to meet electromagnetic conductivity (EMC) requirements. The main earthing system consists of buried stranded copper conductors connected at four points to the CCPP earth grid.

A separate neutral and protective conductor is provided for the 400 V system. The MV system is earthed through surge arresters and acts as an ungrounded system.

Lightning protection is provided for the absorbers, strippers, and buildings.

8.11 Lighting

The plant has normal, emergency, and essential lighting. Dedicated lighting columns are used for street and flood lighting. Metal halide lighting is provided for normal outdoor lighting and in locations with large head rooms, such as compressor houses and process buildings.

Outdoor lighting fixtures are suitable for Zone 2 hazardous area and are controlled with photocell-controlled switching circuits. Emergency lighting (escape way lighting) is provided by florescent lamps powered from the 400/230 V UPS system. In addition to emergency lighting, lighting required for emergency egress is automatically transferred to the standby diesel generator in the event of power loss.

8.12 External Electrical Interfaces

The CCC Plant electrical system design includes interfaces with other facilities as summarized in Table 8.12-1.

Table 8.12-1. External Electrical Interfaces

Plant	**Interfaces**
CCPP	Normal and backup electrical power feeds, protection, measuring, control cables, instrument cables, cable trenches and raceway, new flue gas dampers, and earthing system
Karsto Gas Terminal	Cables and required raceway for fire and gas detection system (F&GDS) interfaces
CO_2 Transport Area	Power, control, and instrument cables and required trench and raceway to support the transport system
Seawater Cooling	Power, control, and instrument cables and required trench and raceway to support the seawater pump system

9.0-Automation Systems

9.0 Automation Systems

9.1 Overall Control Systems Architecture

The Kårstø CO_2 Capture and Compression (CCC) Plant is operated from the central control room (CCR) in the control/workshop/stores building. An operator stationed in the CCR has access to the following systems via the operator stations:

- Distributed control system (DCS)
- Process shutdown (PSD) system
- Emergency shutdown (ESD) system
- Fire and gas (F&G) detection system

The operator also can access selected information from the following systems via the operator stations:

- Continuous gas monitoring system (CGMS)
- Auxiliary boiler burner management system (BMS)
- Vibration monitoring system (VMS)

The operator also has access to the following systems from the CCR:

- ESD action panel
- F&G action panel
- CGMS data acquisition and handling system (DAHS)
- Closed-circuit television (CCTV) system
- Public address (PA) system
- Phone and ultra-high-frequency (UHF) radios

9.2 Controls Philosophy and Approach (Human Factors)

9.2.1 General Control Philosophy

The general control philosophy allows for control of major CCC Plant functions, with priority placed on personnel safety and equipment protection, followed by plant availability.

A single qualified inside operator stationed in the CCR controls the plant with the support of one or more qualified outside plant operators as needed during different operational modes.

The plant incorporates sequences that automatically start it and shut it down once it has been filled, vented, and lined up in accordance with detailed operating procedures.

Normal operation is controlled automatically, following the CO_2 master controller signals. Adjustable set points and manual control of devices outside the automatic control routines are incorporated where possible to maximize operating flexibility. Despite this, interlock logic prevents the operator from creating an undesirable operating condition that could endanger personnel safety or cause equipment damage.

9.2.2 CO_2 Removal Control Master

The CO_2 removal control master provides overall automatic control to achieve constant 85% CO_2 removal from the flue gas by controlling the lean amine flow into each absorber column based on the incoming flue gas mass flow and CO_2 concentration in a feed-forward control. The final control trim is accomplished by using the desired removal set point (85%) difference between the incoming flue gas CO_2 flow and off-gas CO_2 flow calculation. Each absorber has a CO_2 master controller. The concept is shown in Figure 9.2-1.

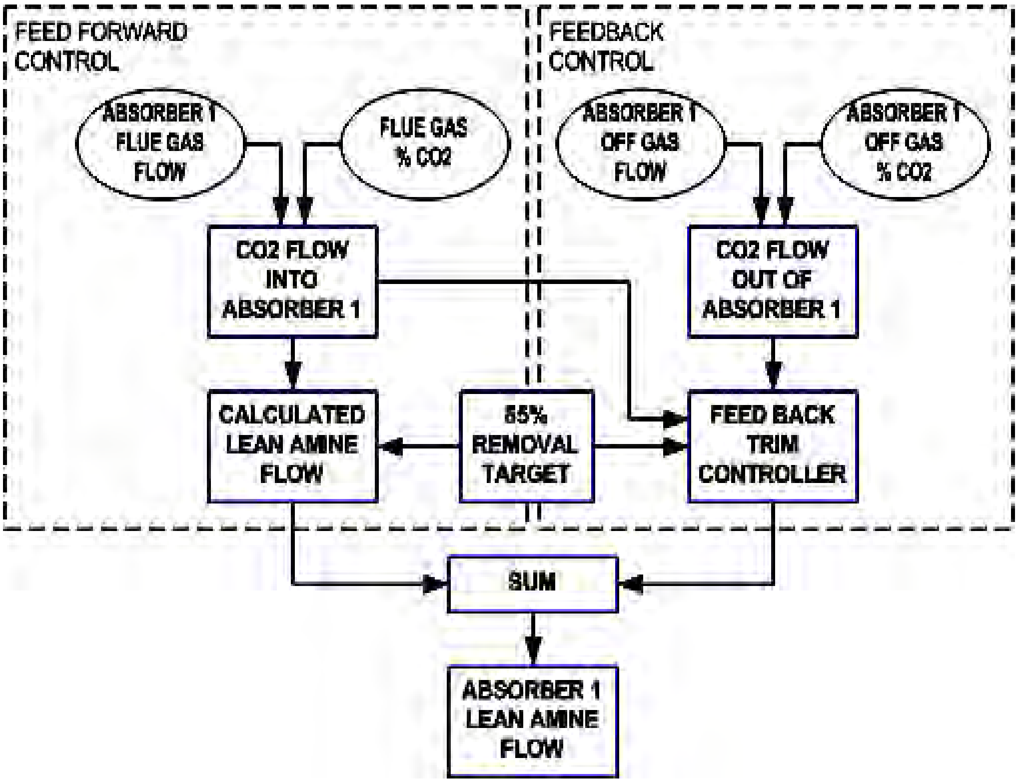


Figure 9.2-1 CO_2 Master Controller Concept

9.2.3 Overview of Normal Operation

A detailed description of the plant controls is provided in the Control Philosophy, 10112936-PB-I-PAL-0001 (25474-000-J0Y-JD-00001). The following is a brief overview of the process controls.

Under normal operation, the CCC Plant takes 100% of the flue gas from the CCPP to the absorbers. The flue gas pressure at the heat recovery steam generator (HRSG) outlet is controlled by modulating the blower speed. To maintain a constant pressure, the DCS uses the combustion turbine exhaust gas flow, absorber inlet flow, and HRSG outlet pressure in a three-element control scheme. The three-element control provides higher overall pressure stability despite process disturbances such as combustion turbine load change or flue gas flow deviations.

The flue gas is cooled by water foggers in two stages prior to entering each absorber at 50 °C. In each cooling stage, a spray water control valve throttles the flow to the cooler to control the temperature of the flue gas downstream of the cooler. A feed-forward control scheme using flue gas flow and fogger inlet temperature reduces variability in the temperature leaving each cooler and the chance of excessive spray water due to time lag associated with temperature measurement.

The CO_2 master determines the required amount of lean amine inlet flow to the absorber. Rich amine flow from the absorber to the stripper is controlled in proportion to the lean amine flow to maintain a constant level in the stripper. A portion of the rich amine flow is diverted, heated, and flashed to create semi-lean amine, which is returned directly to the absorbers. This system can be bypassed and the system run using only lean amine.

Wash water to remove entrained amines from the off-gas is controlled at a constant flow rate into each water wash bed in the absorber. The amine concentration in the wash water system increases over time. To keep the amine concentration in the water wash system at a low level, a continuous flow of fresh process water is added to the system in proportion to the lean amine flow. The level of the water wash chimney tray is controlled by the wash water bleed valve, which sends the excess water to the lean amine system through the bleed line.

Excess water that may be generated by condensation from the flue gas is dumped to the lean amine system. The excess water is boiled off in the stripper and then removed from the stripper overhead, where the level of amine concentration is lowest, to minimize waste production and loss of amine from the process. During times when water is needed, water is added to the water wash system from the process water system. The makeup water in the water wash system cascades via the bleed line to maintain the proper level in the absorber bottom.

Low pressure (LP) steam flow rate to the reboiler is controlled in proportion to the rich amine flow rate entering the stripper column. The steam flow rate is modified as needed to maintain the proper amount of reflux in the stripper overhead system.

Gas leaving the stripper contains some water and solvent. It enters the stripper overhead cooler and is cooled by seawater, condensing the water and solvent. The gas and condensate then enter the stripper reflux drum, where they are separated.

The reflux liquid from the stripper reflux drum is pumped back to the top of the stripper reflux section and is maintained in proportion to the gas stream flow to control overhead solvent loss with the CO_2 product. Excess liquid is pumped back to the process water surge tank. The stripper reflux system is shown in Figure 9.2-2.

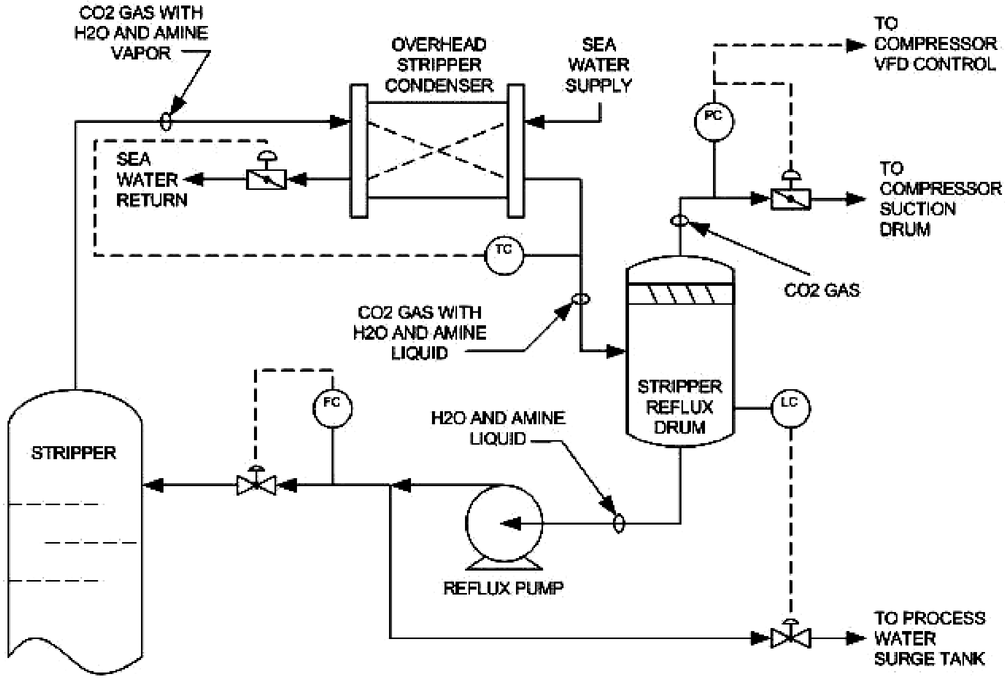


Figure 9.2-2 Stripper Reflux System

Gas leaving the stripper reflux drum goes to the CO_2 compression system. A constant backpressure in the stripper reflux drum (and consequently the stripper) is maintained by the compressor speed.

The inlet to each stage of the CO_2 compressor has a knockout drum to remove condensed liquid from the gas stream. The liquid is recycled to the process water system in a sequential let-down scheme that minimizes any venting of CO_2 gas from the storage tank.

The CO_2 gas from each compressor stage passes through a steam generator, where it is cooled and used to heat LP condensate, creating interstage steam. The interstage steam is used to generate the semi-lean amine. The steam generators are controlled at a constant level and pressure.

Intercoolers at the inlet of the second and third compressor stages maintain the required CO_2 temperature entering each stage.

Prior to entering the compressor third stage, the CO_2 gas enters the CO_2 dryers to remove moisture to <50 ppm (wt). The output from the dryers is monitored by redundant analyzers, and an alarm is activated if moisture levels approach the required product specification. The CO_2 product is also monitored by redundant moisture and O_2 analyzers. If the levels exceed the required product specification at either location, the CO_2 product send-out pumps are stopped and the CO_2 product shutdown and control valves are closed. The CO_2 is vented from the CO_2 surge drum until the product quality meets the required specification.

After leaving the final stage of the compressor, the CO_2 product is cooled to a liquid in the CO_2 cooler and sent to the CO_2 surge drum. Noncondensable gases in the CO_2 surge drum are vented to the top of the absorbers by the vent valve on high pressure in the drum.

The CO_2 product send-out pumps forward the CO_2 product to the battery limit as a supercritical fluid. The flow to the pipeline is controlled at a steady rate, with reset from the CO_2 surge drum level.

The reclaiming process is initiated by the operator when it is determined by analysis that the amount of degradation products in the lean amine is too high. The process can be carried out via the DCS either manually or with an automatic sequence. High pressure (HP) steam and soda ash are used to recover water and amines, which are flashed off and sent back to the stripper as vapor.

9.2.4 Human Factors

9.2.4.1 Human Machine Interface

The DCS has a human-machine interface (HMI) in the CCR. Preliminary considerations for the CCR human factors include the following.

9.2.4.1.1 Hardware

- Dual-screen operator station and engineering workstation (EWS)
- Single-screen historian and CGMS DAHS

9.2.4.1.2 Operational Control

- Automatic control of CCC Plant (Manual control is not normally required.)
- Unit startup and shutdown (intermittently) via automatic sequence. Manual control is not normally required.

9.2.4.1.3 Operational Functions

- Alarm monitoring and acknowledgement (including the ESD, PSD, and F&G detection systems)
- Historian/historical data retrieval, if required for operating purposes
- Log printing
- Primary fault finding
- Tagging out/coordinating permit recording functions (if assigned to the operator or shift supervisor)

9.2.4.1.4 Engineering Functions

- EWS software, including configuration (logics and graphics)
- Alarm setup and management
- Detailed fault finding
- Historian maintenance (including DVD and storage media replacement)
- Serial link and Ethernet link configuration
- Periodic updates of anti-virus software
- User account management
- Information management system (IMS) server configuration

9.2.4.2 Operations During Upset Conditions

The plant is designed for fully automatic control during normal operation. During an upset, automatic overrides attempt to correct the problem prior to reaching PSD conditions. Further, redundant backup pumps automatically start on loss of the primary pump. Manual control may also be possible.

In the event of a PSD, the affected process is isolated. In some cases, the plant may continue operating; in other cases, it shuts down. Activity falls to fault finding by the operator and Engineering.

9.2.4.3 CGMS Shelter and Compressor Building Analyzer Room

The CGMS shelter and compressor building analyzer room are normally unmanned. The two main activities in these locations include analyzer system maintenance and grab sampling.

9.2.4.3.1 Maintenance

- Troubleshooting failed calibration of O_2, H_2O, CO, and CO_2 analyzers (infrequent)
- Fourier transform infrared (FTIR) spectroscopy analyzer calibration (very rare)
- Periodic calibration of conductivity, pH, DO, and silica analyzers (weekly or monthly)
- Online gas chromatograph (OGC) maintenance (infrequent)
- Replacement of calibration gas cylinders (infrequent)

9.2.4.3.2 Centralized Grab Sampling

Infrequent grab sampling of centralized liquids and gases is anticipated because the required analyses for operation are automated with online analyzers. The sampling system's design provides centralized access in the compressor building analyzer room for the most commonly sampled streams. For a list of centrally analyzed streams and analyzers, refer to Subsection 9.6.2.

High temperature samples are cooled in the sample panel. Sampling is controlled in a fume hood with closed sampling points and sample bottles for hazardous samples, and open sampling points for nonhazardous samples. An example of a prepackaged closed loop sampler that may be used in the sample panel is the Dopak®[1] DPM (see Figure 9.2-3).

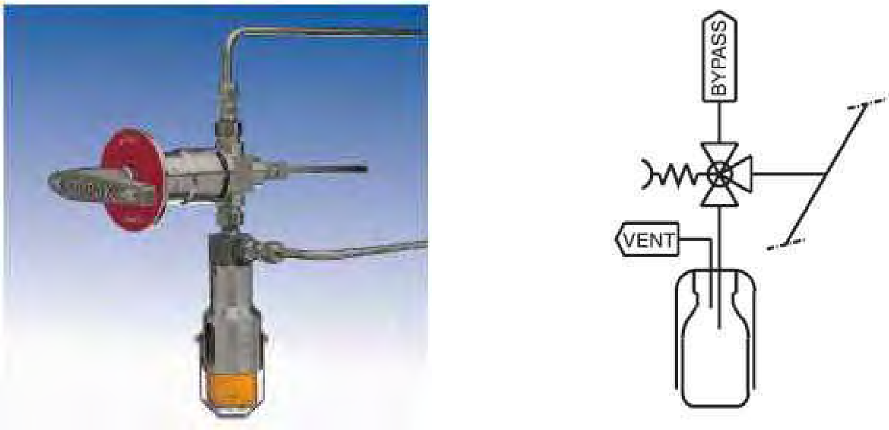


Figure 9.2-3 Grab Sampling – Example of Closed Grab Sample Point (Dopak Model DPM)

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[1] Dopak is a registered trademark of Dovianus BV

Centralized grab sampling reduces any variation between grab samples that results from plant fluctuations because the samples are taken over a shorter overall time frame than if the operator walks to each point locally. This also facilitates more frequent sampling if required for a particular operating scenario. The time required to take the samples and the potential exposure of the operator to hazards are also minimized because it is not necessary for the operator to climb the columns or be in direct contact with process equipment in the course of taking the samples.

9.2.4.3.3 Local Grab Sampling

Infrequent local grab sampling is anticipated. The primary sampling requirement comes from the amine waste and wastewater sumps.

Where local grab sampling is required and the sample is at a high temperature, cooling is necessary to prevent potential injury to the operator taking the sample. A sample cooler is included in the system design. An example of a prepackaged closed loop sampler with integrated cooling that may be used in the detailed design is the Dopak Model S23 (see Figure 9.2-4).

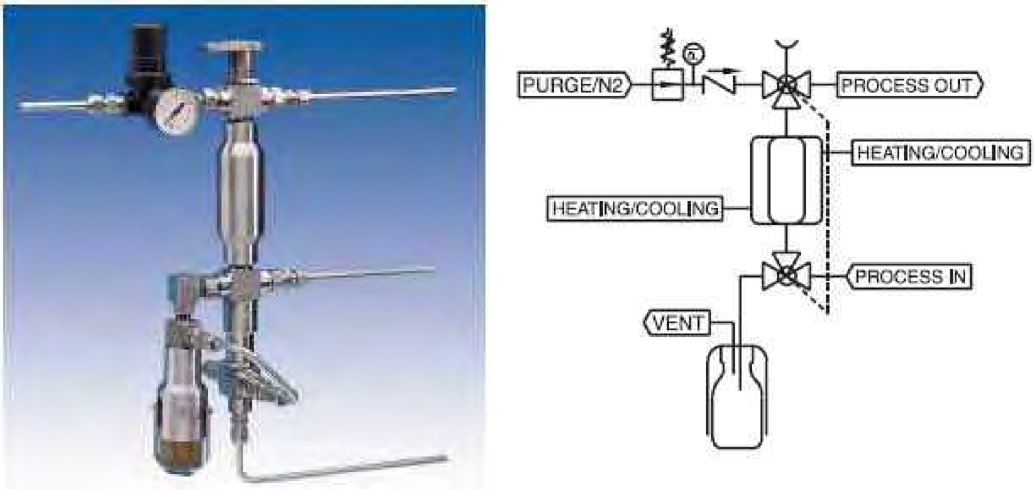


Figure 9.2-4 Grab Sampling – Example of Closed Grab Sample Point With Cooling (Dopak Model S23)

Local grab samples are provided at the points listed in Table 9.2-1.

Table 9.2-1 Local Grab Sample Points

Grab Sample Point Description	Grab Sample Point Type
Stripper Reflux Water	Standard grab point
Amine Waste Sump	Standard grab point
Reclaimer Vapor	Closed grab sample with cooling
Reclaimer Waste	Closed grab sample with cooling
CO_2 Compressor 1st Stage Inlet	Closed grab sample
CO_2 Compressor 2nd Stage Inlet	Closed grab sample

Grab Sample Point Description	**Grab Sample Point Type**
CO_2 Compressor 3rd Stage Inlet	Closed grab sample with heating
CO_2 Surge Drum Vapor	Closed grab sample with heating
ME-101 Seawater Outlet	Standard grab point
ME-102 Seawater Outlet	Standard grab point
ME-104 Seawater Outlet	Standard grab point
ME-111A Seawater Outlet	Standard grab point
ME-111B Seawater Outlet	Standard grab point
ME-111C Seawater Outlet	Standard grab point
ME-111D Seawater Outlet	Standard grab point
ME-113 Seawater Outlet	Standard grab point
ME-115 Seawater Outlet	Standard grab point
ME-117 Seawater Outlet	Standard grab point
Process Water Surge Tank	Standard grab point
Wastewater Sump	Standard grab point
Wastewater Outfall	Standard grab point
ME-112 Blowdown	Standard grab point
ME-114 Blowdown	Standard grab point
ME-116 Blowdown	Standard grab point
Lean Amine Storage Tank	Standard grab point
Amine Storage Tank (Concentrated)	Closed grab sample

9.3 Plant Communication Systems

9.3.1 Telephone System

The CCC Plant's telephone system is a modern, state-of-the-art, hybrid private automatic branch exchange (PABX) system. The system includes an integrated intercom system that allows direct two-way communication between the CCR and selected places in the plant, voice recording system, and public telephone interface. The conceptual block diagram is shown in Figure 9.3-1.

9.3.2 Public Address System

The PA system allows audible broadcast of announcements and alarms throughout the plant. The system is a duplicated system that consists of handsets, speakers, and orange beacons (for high noise areas). The block diagram for each of the duplicated systems is shown in Figure 9.3-2.

9.3.3 Closed Circuit Television System

The CCTV system provides direct video monitoring within the plant at specific locations. The system is controlled by the operator from the

CCR. Video can be displayed on the CCTV control server or the large-screen video display unit (VDU). The system includes various fixed and pan-tilt-zoom (PTZ) cameras, digital video recorder (DVR), global positioning system (GPS) time server interface, and interfaces to control systems within the plant and neighboring facilities. The conceptual block diagram is shown in Figure 9.3-3.

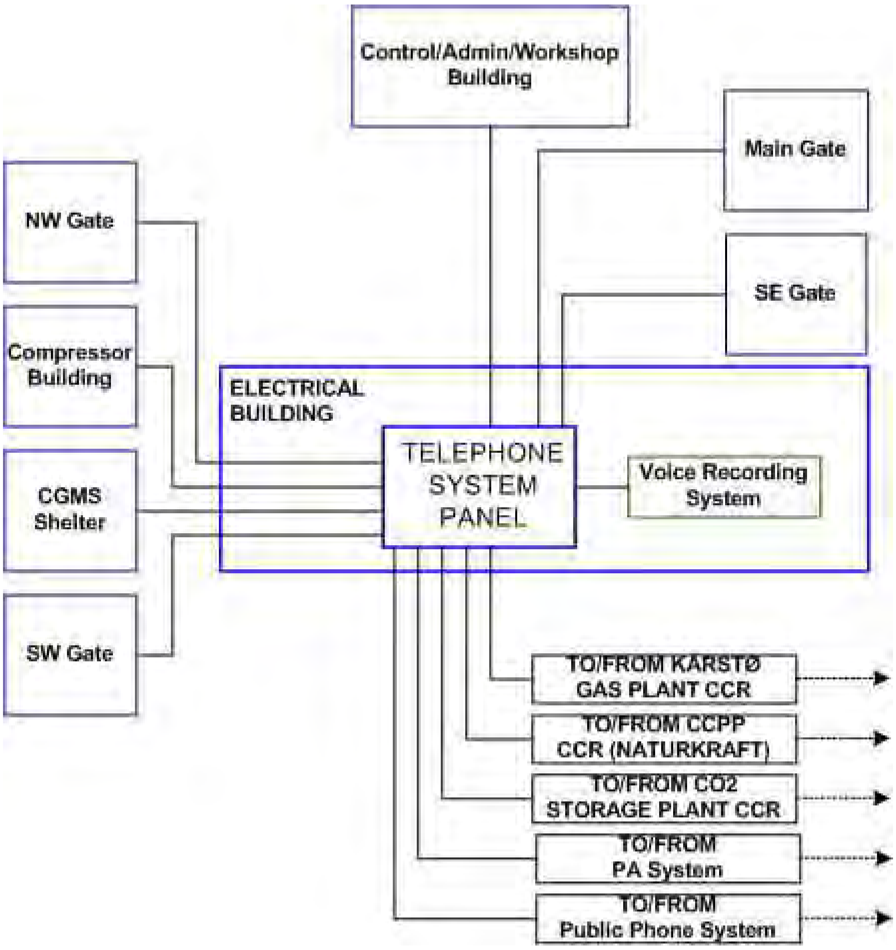


Figure 9.3-1 Conceptual Block Diagram for Telephone System

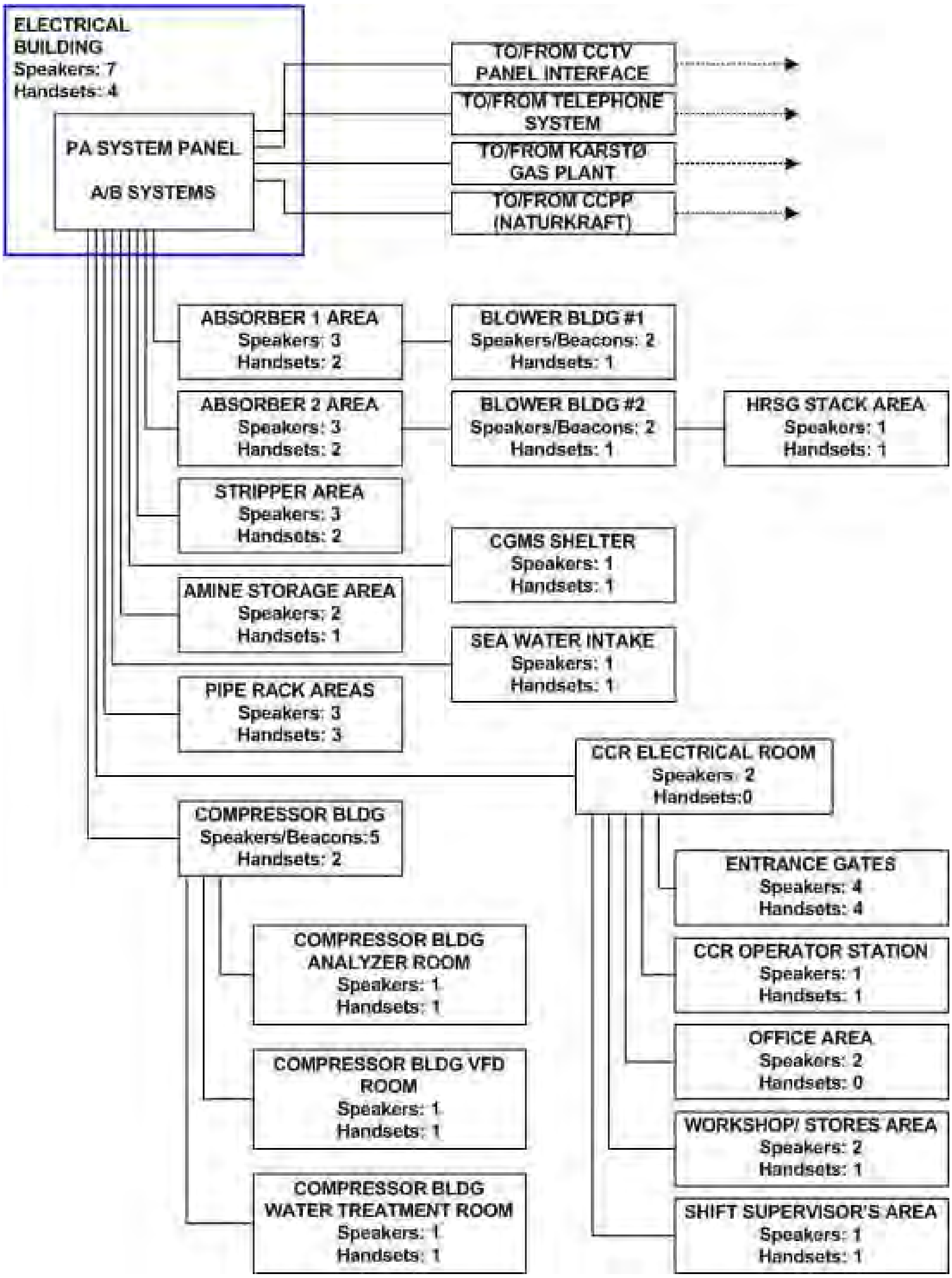


Figure 9.3-2 Conceptual Block Diagram for PA System

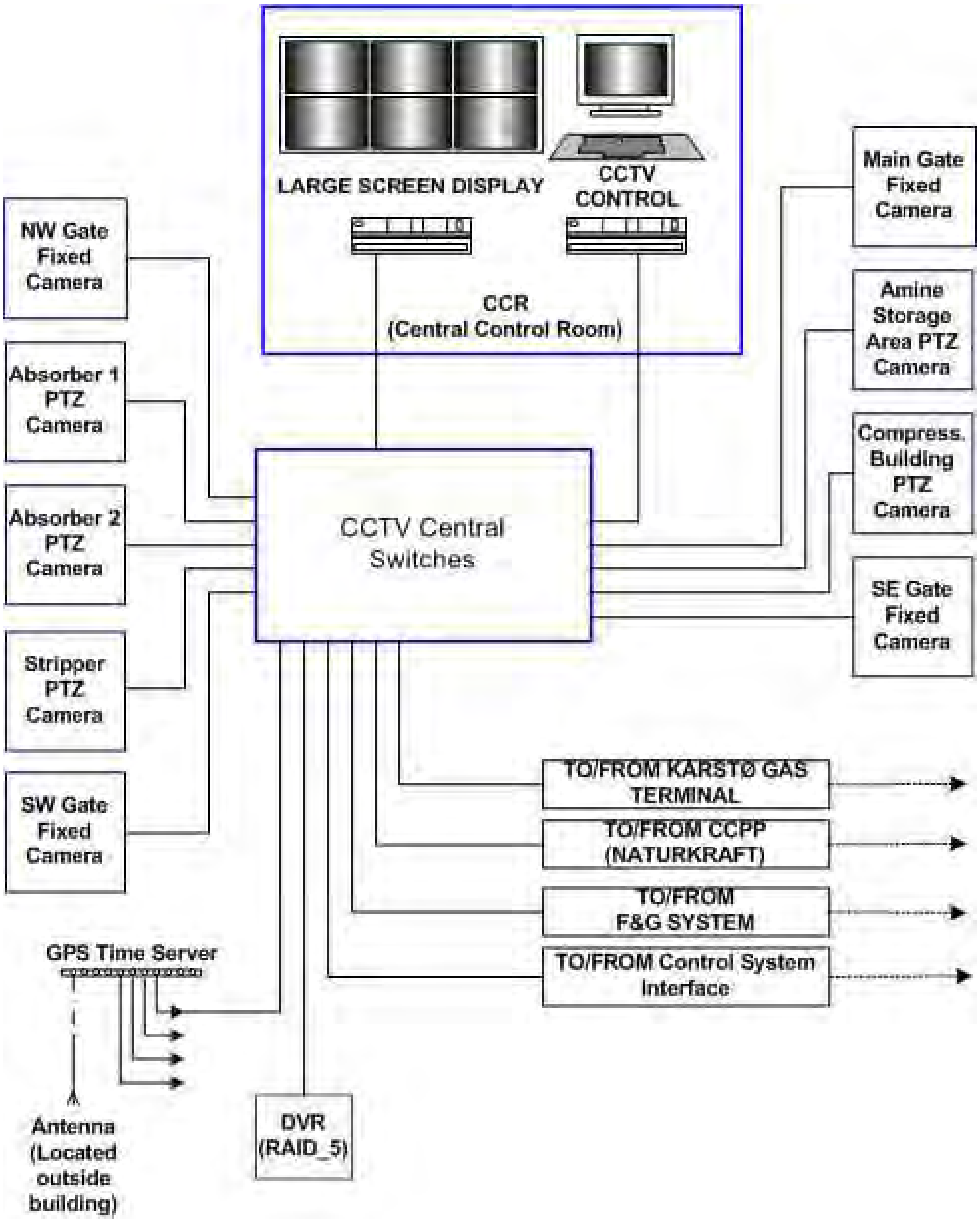


Figure 9.3-3 Conceptual Block Diagram for CCTV System

9.3.4 Portable UHF Radio System

The portable UHF radio system consists of a central unit located in the CCR, portable hand sets with shoulder-strap carrying cases, charging units at various locations such as the CCR, and repeater if needed to achieve complete radio coverage within the plant. The supply of this system is outside the plant battery limit (B/L) to facilitate obtaining the necessary frequency spectrum permits.

9.4 Safety and Shutdown Analysis and Provisions

The CCC Plant has an ESD system, a PSD system, and an F&G detection system.

9.4.1 Emergency Shutdown System

The ESD system essentially safely actuates the appropriate PSD sequence(s), de-energizes the necessary electrical equipment, and depressurizes the unit (e.g., CO_2 compression system). The ESD functions are manually initiated by the operator, usually as the result of a fire, major spill, combustible gas detection, etc.

The ESD system is safety-programmable logic controller (PLC) based. The system is designed to meet SIL 1, 2, or 3 (as determined for each control loop) according to IEC 61508 and IEC 61511.

For situations not requiring immediate action, an audible and visible alarm is given in the CCR and also locally. Alarms are sent to, handled by, and presented in the DCS alarm system.

For a detailed list of causes of ESD initiation and actions, refer to the ESD/PSD Cause & Effect Diagram, 10112936-PB-I-DGM-0001 (25474-000-J4-JD-00001).

9.4.2 Process Shutdown System

The PSD system ensures that process conditions do not exceed specified process safety limits. The PSD system is functionally independent of the process control function but is implemented in the same DCS hardware with dedicated controllers and input/output (I/O) cabinets (see above description of the DCS structure and function).

In the event of abnormal operating conditions that could cause permanent damage to the plant, endanger human safety, or exceed operating limits to the detriment of plant life, the PSD system automatically shuts down discrete equipment, a system, or the CCC Plant, in a safe and controlled manner.

For a detailed list of causes of PSD initiation and actions, refer to the ESD/PSD Cause & Effect Diagram, 10112936-PB-I-DGM-0001 (25474-000-J4-JD-00001).

9.4.3 Fire and Gas Dectection System

The F&G detection system is largely an alarm system, but it is also able to take certain actions other than activating remote or local area alarms devices, such as shutting off heating, ventilating, and air-conditioning (HVAC) systems upon combustible/toxic gas detection; starting HVAC systems upon CO_2 detection; etc., in case of fire or gas and spill detection. The system layout is shown in Figure 9.4-1.

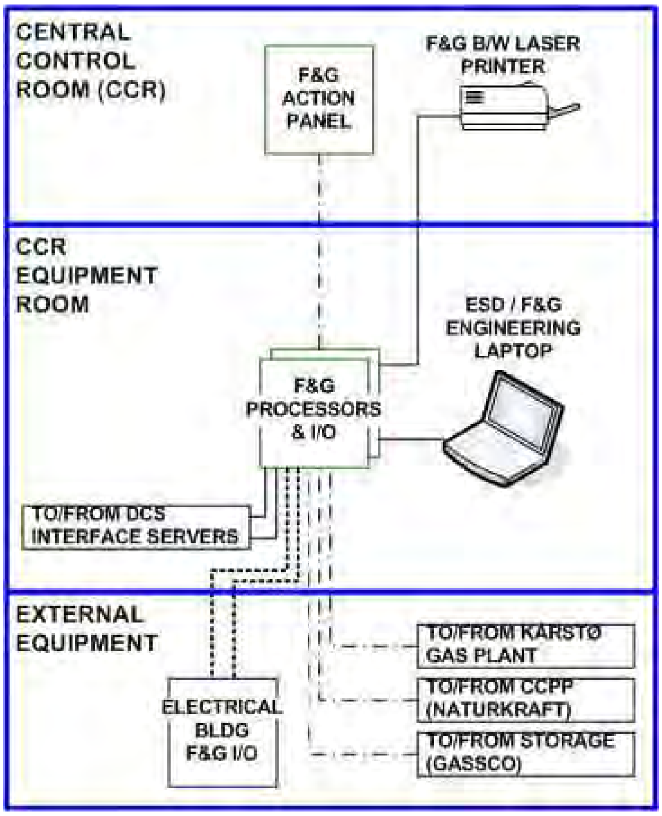


Figure 9.4-1 Conceptual Block Diagram for F&G Detection System

The F&G detection system is safety-PLC based. The system is designed to meet SIL 2 according to IEC 61508 and IEC 61511.

The F&G detection system interfaces to the neighboring facilities for exchange of alarms throughout the Kårstø site.

For a detailed list of causes of fire and gas detections and actions to be taken, refer to the Fire & Gas System Cause & Effect Diagram, 10112936-PB-I-DGM-0002 (25474-000-J4-JD-00002).

9.5 Safety and Automation System

The purpose of the CCC Plant's DCS-based safety and automation system (SAS) is to safely and efficiently control and monitor plant equipment and processes.

The DCS provides integrated modulating control, sequential control, and data acquisition for both normal operation and the PSD system.

The DCS controls, monitors and records physical and electrical parameters associated with the CCC Plant. The system provides interface with the ESD, F&G, continuous emissions monitoring system (CEMS), CCTV, and PA systems and with existing installations. The DCS allows full operation from the CCR.

The DCS processors are centrally located in the CCR equipment room for safety and accessibility. Remote I/O is used for interface with field devices. The conceptual block diagram of the DCS is shown in Figure 9.5-1. Further details of the hardware are provided in Subsection 9.8.

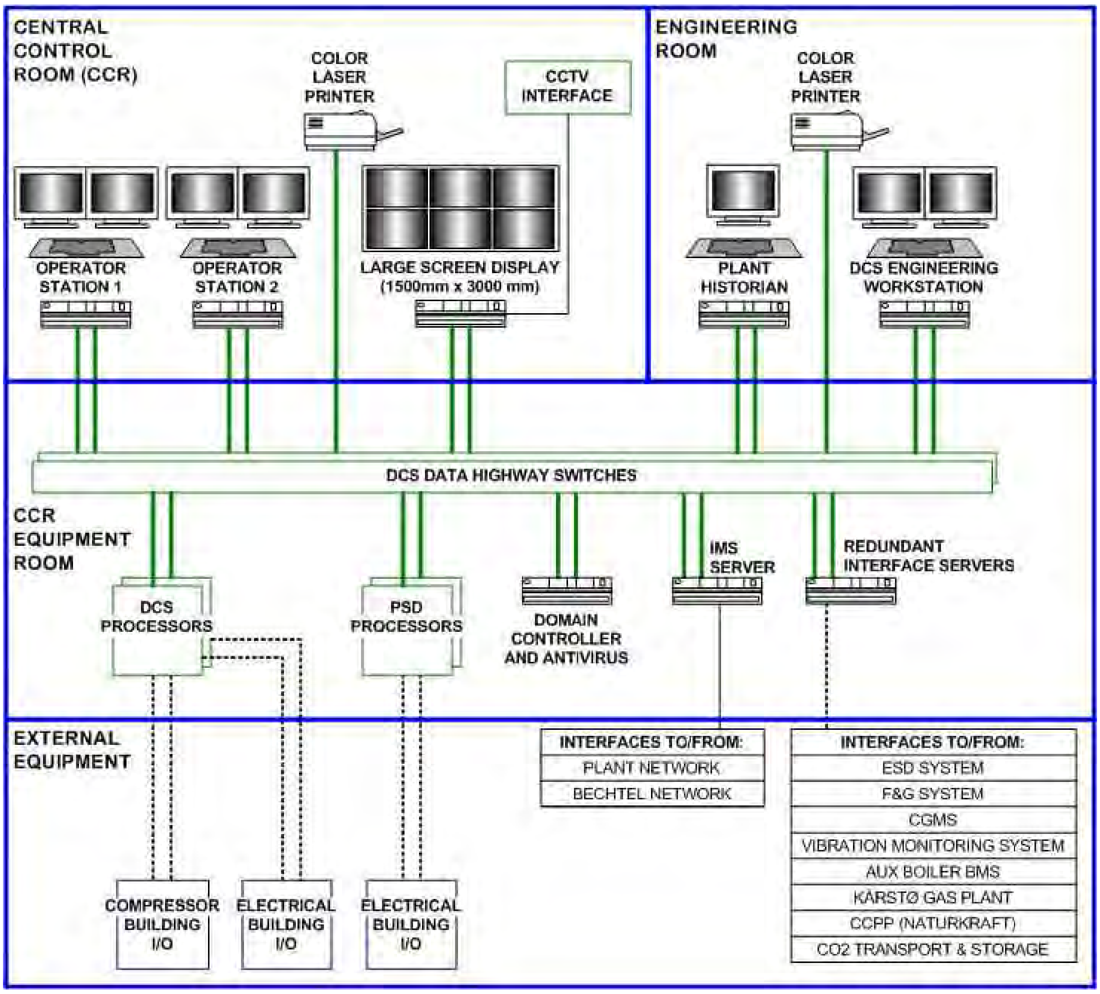


Figure 9.5-1 Conceptual Block Diagram for DCS and PSD System

9.6 Gas and Emissions Monitoring and Metering

9.6.1 Continuous Gas Monitoring System

The purpose of the CCC Plant's CGMS is to sample, measure and analyze incoming flue gas from the Naturkraft combined cycle power plant (CCPP), absorber off-gas emissions, and the CO_2 product stream, and then calculate, record, report, and archive these emissions for use by both the SAS and plant management in reporting environmental compliance to the competent Norwegian Pollution Control Authority (SFT).

The CGMS for the CCPP incoming flue gas and each absorber's off-gas is located between the absorbers in the CGMS shelter. The gas monitoring equipment for the CO_2 product is located in cabinets in a separate analyzer room in the compressor building. The CGMS interfaces to the DCS for exchange of control and reporting data. The conceptual block diagram is shown in Figure 9.6-1.

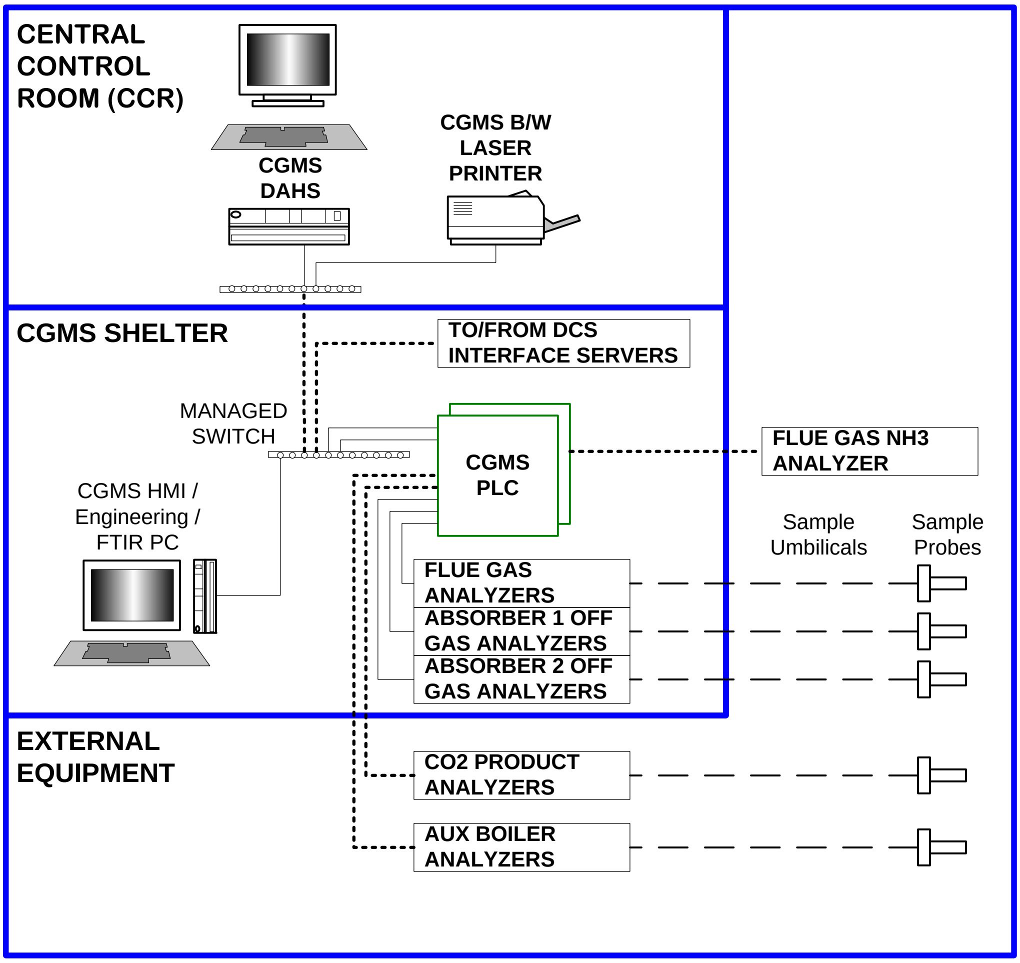


Figure 9.6-1 Conceptual Block Diagram for CGMS System

Although no air permit specific to the CCC Plant has been issued to date, certification is to European Union (EU) regulations.

The CGMS is a direct-extractive sampling system. Separate, dedicated CO_2 analyzers are included on the flue gas and absorber off-gas streams for the CO_2 master control. Ammonia in the flue gas from the CCPP is measured in situ to avoid potential transport problems associated with the long sample line. Redundant H_2O analyzers are provided on both the CO_2 dryer outlet and the CO_2 product stream, and redundant O_2 analyzers are provided on the CO_2 product stream to ensure that the product meets the required quality. Table 9.6-1 lists the measured components and analysis method for each monitored process stream within the plant.

Table 9.6-1 Gas Analysis Parameters and Analyzer Type

Component → Sample ↓	**Amine (MEA)**	**Carbon Dioxide (CO_2)**	**Carbon Monoxide (CO)**	**Ammonia (NH_3)**	**Nitrogen Oxides (NO_x)**	**Water (H_2O)**	**Oxygen (O_2)**	**Analyzer Type**
Flue Gas from CCPP	--	X	--	--	X	X	--	FTIR
	--	--	--	X	--	--	--	IR or TDLAS (in situ)
	--	--	--	--	--	--	X	ZrO_2 or Para-magnetic
	--	X	--	--	--	--	--	NDIR
Off Gas (each Absorber)	X	X	--	X	X	X	--	FTIR
	--	--	--	--	--	--	X	ZrO_2 or Para-magnetic
	--	X	--	--	--	--	--	NDIR
CO_2 Product	X	X	--	--	--	X	--	FTIR
	--	--	--	--	--	X	--	IR
	--	--	--	--	--	--	X	ZrO_2 or Para-magnetic
	--	--	--	--	--	--	X	ZrO_2 or Para-magnetic
Auxiliary Boiler	--	X	--	--	--	--	--	NDIR
	--	--	X	--	--	--	--	GFC or NDIR

9.6.2 Liquid Emissions

Samples from throughout the plant are routed to the sample panel where they are conditioned and distributed to the required analyzers and grab sample points. The particular samples, measured variables, and analyzers are shown in Table 9.6-2.

Table 9.6-2 Online Liquid Analysis

Sample	**Measured Variable**	**Analysis Method**
Absorber #1 Wash Water	% MEA	Shared OGC
Absorber #2 Wash Water	% MEA	Shared OGC
Rich Amine	% MEA and % CO_2	Shared OGC

Sample	Measured Variable	Analysis Method
Lean Amine	% MEA and % CO_2	Shared OGC
Semi-Lean Amine	% MEA and % CO_2	Shared OGC
LP Steam Inlet	Cation conductivity	Online analyzer
	pH	Online analyzer
	Silica	Shared online analyzer
HP Steam Inlet	Cation conductivity	Online analyzer
	pH	Online analyzer
	Silica	Shared online analyzer
LP Condensate	Cation conductivity	Online analyzer
	pH	Online analyzer
	Silica	Shared online analyzer
	Dissolved O_2	Online analyzer
Seawater Inlet	Cation conductivity	Online analyzer
	pH	Online analyzer
Seawater Discharge	Amine concentration	Online analyzer
	pH	Online analyzer

To minimize MEA and water loss from the system, all of the samples except the seawater samples are pumped back to the absorber after analysis. The seawater samples are sent back to the wastewater system, where they are returned to the seawater discharge.

The seawater discharge is monitored for the presence of amine in the event that a leak occurs in one of the heat exchangers. The exact method of monitoring is to be determined during detailed design once specific limits have been defined. On high amine concentration, an alarm is annunciated. At this point, grab samples from each heat exchanger outlet can be analyzed via the online gas chromatograph or other method to determine the exact source of the leak. On high-high concentration, another alarm is annunciated, the seawater pumps are tripped, and the heat exchanger discharge valves are automatically closed to avoid possible discharge of contaminants to the sea. This results in an overall plant shutdown due to lack of cooling water to the equipment.

The seawater return line from each heat exchanger and the plant discharge seawater line are also monitored for temperature and provided with high and high-high alarms.

The amine waste sump can be tested via grab sample for quality. If the quality is acceptable, the waste is recycled to either the lean amine solvent tank or either of the rich amine pump suctions.

The wastewater sump can likewise be tested via grab sample for quality. If the quality is acceptable, the waste can be pumped via the oil/water interceptor to the seawater discharge.

Reclaimer sludge liquid is drained to a tote for offsite disposal.

9.7 Startup and Shutdown Considerations

9.7.1 Startup

9.7.1.1 Startup Sequence

The CCC Plant can be started manually or via automatic sequence. If started automatically, the sequence is initiated by the operator, and the sequencer guides the system through unit startup up to admission of flue gas. The general sequence is as follows:

- Makeup is added to the absorber and stripper bottom levels, water wash chimney tray, condensate blowdown tank, and compressor steam generators as needed.
- Seawater pumps are started.
- The auxiliary boiler start sequence is initiated.
- The LP steam line is warmed via the drain line until the minimum required superheat is reached. Steam is then admitted to the reboiler, and the drain valve is closed.
- The reflux and stripper are brought to operating pressure, and reflux flow is established.
- The lean amine, rich amine, and flash drum pumps are started in recirculation mode.
- Minimum lean/rich amine flow is established. At this point, CO_2 loading in the rich amine flow is minimal due to zero flue gas flow through the absorbers.
- The wash water pump is started, and wash water flow is established.
- The compressor is started at minimum speed in recirculation mode.
- The CCC Plant isolation dampers are opened.
- The flue gas blower for the first absorber is started at minimum speed.
- The CO_2 master output gradually increases from zero, admitting flue gas to the first absorber.
  - At first, the blower damper controls flow until it reaches maximum throttling position, at which point it goes open and the blower speed increases to take more flue gas flow.
  - The HRSG stack damper is modulated to maintain steady pressure in the HRSG/CCC Plant duct.
  - Lean amine flow to the absorber is controlled by the CO_2 master.
  - Steam to the reboiler increases as amine flow increases.

  - At first, the stripper reflux drum pressure control valve keeps constant pressure in the stripper. As CO_2 flow increases, the pressure control valve fully opens and the compressor speed is used to control constant stripper pressure.

- The CO_2 master output is fixed to a minimum load until the CO_2 product system has been filled and started and the pipeline has been filled and is in service.
  - As CO_2 begins to fill the surge drum, air vents from motor-operated valves located on the CO_2 product send-out pumps and piping upstream of the CO_2 product control valve.
  - Once the system is vented, the motor-operated valves close and a CO_2 product send-out pump starts.
  - Flow to the CO_2 pipeline is strictly controlled until the pressure in the pipeline approaches operating pressure (details to be determined during final design with input from outside the B/L).
- The CO_2 master output begins to increase again.
- After the first absorber takes approximately 50% of the combustion turbine exhaust flow, the second absorber is started in the same sequence as outlined above. The HRSG stack damper goes fully closed during this step.
- Once the unit has stabilized, the CO_2 master is released for fully automatic control.
- Flow is established through the carbon filter package after the system is fully stabilized.
- Semi-lean amine flow to the absorber is controlled in proportion to the rich amine flow.

9.7.1.2 First Startup

The first startup of the unit after the system is completely drained requires additional manual steps as follows:

- Operators must verify manual valve and equipment line-up.
- The seawater system piping may not be completely full if it was drained. The system should be filled in a controlled manner to preclude water hammer.
- A 35% amine solution may need to be created if insufficient level exists in the lean amine solvent storage tank. The tank is filled with process water and then concentrated amine added to make 35% MEA. A grab sample is taken and manually injected into the online gas chromatograph to confirm the proper amine concentration.

- The lean/semi-lean/rich amine system piping and pumps are filled and vented using the 35% amine and a lean amine solvent fill pump.
- The wash water system piping and pumps are filled and vented using process water and an absorber makeup water pump.
- The stripper reflux system piping and pumps are filled and vented using process water and an absorber makeup water pump.
- The CO_2 product send-out system piping and pumps are filled and vented as determined during final design with input from outside the B/L.

Additional considerations for the automatic sequencing tasks are as follows:

- The 35% amine makeup to the unit is more than normal. The condensate blowdown tank fills to ensure an adequate water supply for the LP steam desuperheater until the system reaches equilibrium. Condensate may be rejected until the initial fill from the process water system is rejected back to the process water surge tank.
- The auxiliary boiler drum may not be full. It is recommended that the operator fill the drum prior to starting; however, the automatic sequencer performs this task if not already done.

9.7.1.3 Startup After Short Downtime

After a short downtime (hot start where the CCPP is already running), the shutdown sequence outlined in Subsection 9.7.2 is normally executed, but equipment is already filled, vented, and ready for restart. Steps 1-8 and 13 of the automatic sequencer may already be satisfied, shortening the overall startup time. The startup sequencer checks each step in order and continues to the next step if already completed.

9.7.1.4 Startup After Long Downtime

After a long downtime (cold start where the CCPP is already running but the shutdown condition has crossed shift change), the shutdown sequence outlined in Subsection 9.7.2 is normally executed, but equipment is already filled, vented, and ready for restart. After an outside plant operator verifies the manual valve and equipment line-up checking, the control room operator initiates the normal startup sequence.

9.7.1.5 Restart Following Trip

After diagnosing and troubleshooting the cause of the trip, the operator can, in many cases, restart the unit using the startup sequencer. Refer to the Control Philosophy, 10112936-PB-I-PAL-0001 (25474-000-J0Y-JD-00001), for detailed explanation of full and partial trip situations.

9.7.2 Shutdown

9.7.2.1 Normal Shutdown

The CCC Plant can be shut down manually or via automatic sequence. If shut down automatically, the sequence is initiated by the operator, and the sequencer guides the system through unit shutdown. The general sequence is as follows:

- CO_2 master automatic control is deactivated and flue gas flow is slowly reduced to zero, at first by reducing blower speed and then by the blower damper. One absorber is shut down at a time. The HRSG stack damper opens to maintain a stable pressure in the HRSG and CCC Plant duct.
- HP steam to the reclaimer is shut down (if in operation).
- The auxiliary boiler is shut down.
- LP steam to the reboiler is shut down after the CO_2 in the rich amine has been removed.
- Semi-lean amine flow is stopped.
- The reflux and stripper are slowly depressurized.
- The compressor is stopped several minutes after CO_2 production stops.
- Flow is circulated until the stripper bottom temperature drops below 65 °C.
- Flow through the carbon filter package is stopped.
- Absorber, flash drum, stripper bottom, and reflux drum levels are decreased to minimum level by rejecting amine to the lean amine solvent storage tank (TK-102).
- The wash water pump is stopped.
- The reflux pump is stopped.
- The lean and rich amine pumps are stopped.
- The CCC Plant isolation dampers are closed.

The seawater pumps are stopped manually after the operator confirms that all equipment is shut down and there are no further cooling requirements.

9.7.2.2 Extended Shutdown

If the unit is to be shut down for an extended period of time (>24 hours), the amine is drained manually from the absorbers to the amine waste sump and forwarded to the lean amine storage tank to avoid oxygen degradation of the MEA.

9.7.2.3 Emergency and Process Shutdown

A number of situations may result in an emergency or process shutdown. For a detailed list of causes of ESD and PSD initiation and actions, refer to the ESD/PSD Cause & Effect Diagram, 10112936-PB-I-DGM-0001 (25474-000-J4-JD-00001). For a description of the effects of these major upsets to the process, refer to the Control Philosophy, 10112936-PB-I-PAL-0001 (25474-000-J0Y-JD-00001).

9.8 Primary Control System and Equipment

The CCC Plant's primary control system is the DCS. The conceptual block diagram is shown in Subsection 9.5. For the detailed block diagram, refer to the SAS Architecture Diagram, 10112936-PB-I-DRW-0001 (25474-000-JD-JD-00001), and for a detailed description of components refer to the Safety and Automation System Narrative, 10112936-PB-I-DRW-0002 (25474-000-3YD-J01G-00002).

The major components of the DCS are as follows:

- Operator stations (2)
- Large-screen VDU
- EWS
- Plant historian
- IMS server
- Domain controller and anti-virus server
- Interface server
- Controller cabinets
- Remote I/Os and remote I/O cabinets
- I/O cards
- Data highway
- GPS-based clock system
- Color laser printers

Redundant components include the data highway, controllers, power feeds, and power supplies.

9.9 Central Control Room Layout

Central operation of the CCC Plant is provided from the CCR located in the control/workshop/stores building. The conceptual layout for the CCR is shown in Figure 9.9-1.

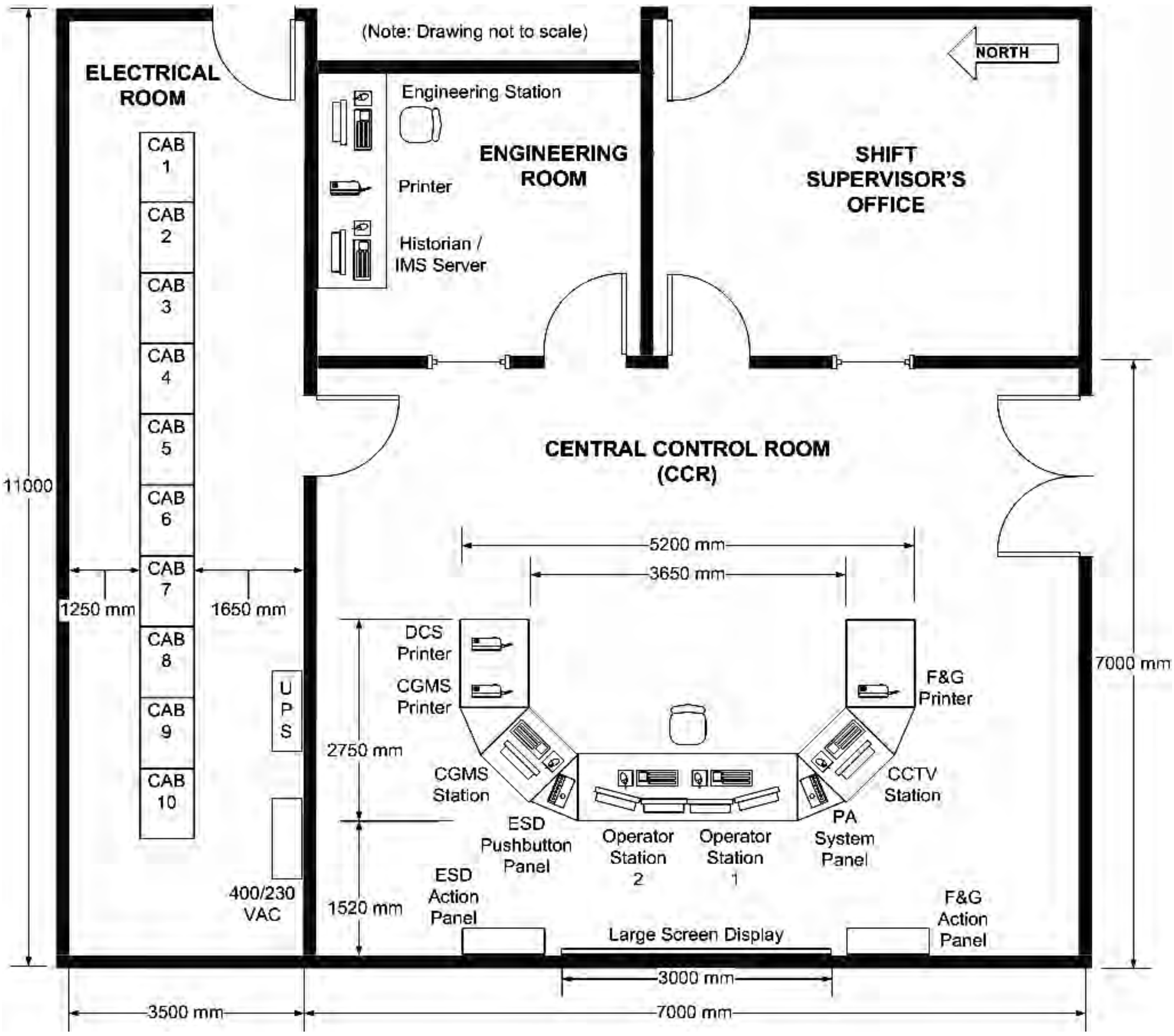


Figure 9.9-1 Conceptual Control Room Layout (not to scale)
(Drawing 10112936-PB-I-DRW-0004 [25474-000-J0-3110-00001])

The CCR has a U-shaped console where the operator sits facing two operator stations on the console and a large-screen VDU and emergency system action panels against the back wall. The operator has access to all other required central control functions on the sides of the console.

Rooms with functions associated with central operations and the DCS are arranged around the perimeter of the CCR. The engineering room contains the DCS and equipment associated with administering the system. The electrical room has processors and servers for the DCS, PSD, ESD, and F&G detection systems, along with the support equipment such as network switches and the plant GPS time server. The shift supervisor's office can also be accessed via the CCR.

9.10 Local Equipment/Instrument Room Layouts

Analysis equipment is located in two local equipment/instrument rooms on the site. The CGMS shelter is centrally located between the two absorbers, and the compressor building analyzer room is located on the west side of the compressor building.

DCS, PSD, and F&G detection system equipment is also located in the electrical building. Refer to Subsection 8.1 for the electrical building layout.

9.10.1 CGMS Shelter

The CGMS shelter is a prefabricated building that houses the gas analysis equipment for the flue gas, Absorber 1 off-gas, and Absorber 2 off-gas samples. The shelter includes analyzers as outlined in Subsection 9.6.1. A separate room is located at the west end of the shelter for calibration gas bottle storage. The conceptual layout is shown in Figure 9.10-1.

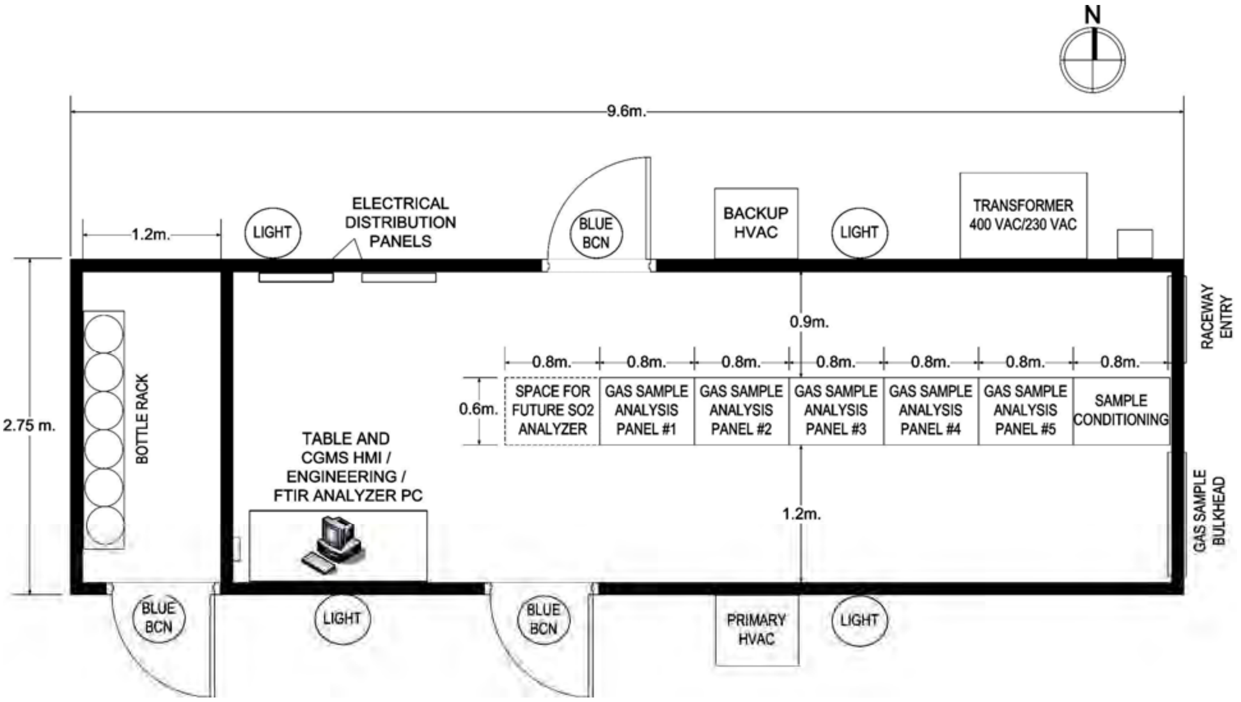


Figure 9.10-1 Conceptual CGMS Shelter Layout (not to scale)
(Drawing 10112936-PB-I-DRW-0006 [25474-000-J0-4410-00001])

9.10.2 Compressor Building Analyzer Room

The compressor building analyzer room contains equipment for sampling and analysis of the CO_2 product stream, equipment for sampling and analysis of the liquid process streams throughout the plant, and DCS remote I/O cabinets. A separate room is located at the south end of the analyzer room for calibration gas bottle storage. The conceptual layout is shown in Figure 9.10-2.

The CO_2 product stream equipment is located in the south end of the room and includes analyzers as outlined in Subsection 9.6.1. The liquid process analysis equipment is located in the north end of the room as outlined in Subsection 9.6.2.

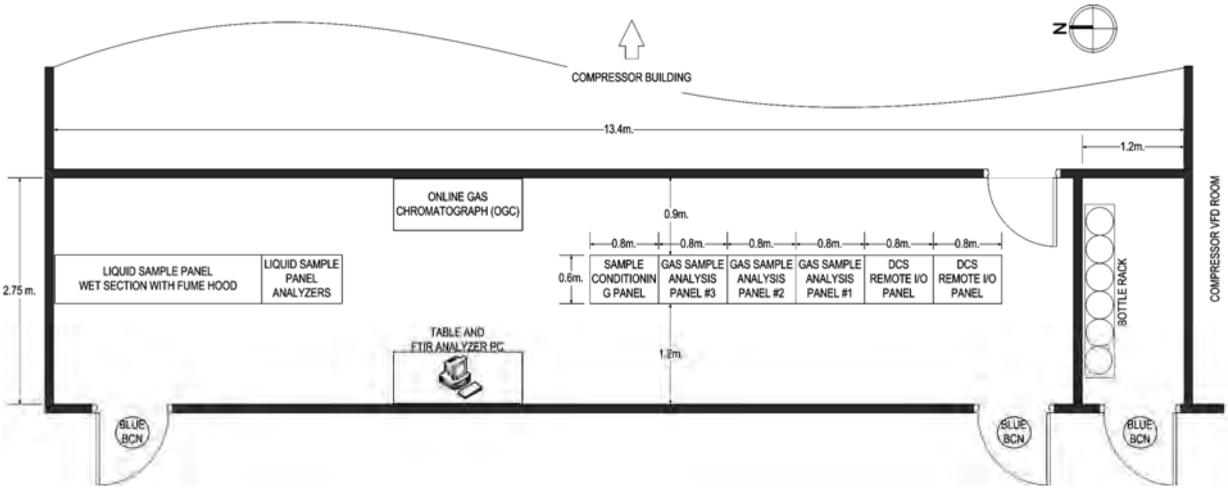


Figure 9.10-2 Conceptual Compressor Building Analyzer Room Layout (not to scale) (Drawing 10112936-PB-I-DRW-0005 [25474-000-J0-4010-00001])

9.11 Packaged Equipment Controls Interface

The DCS interfaces with packaged systems within the plant via redundant interface servers and managed Ethernet switches. This interface allows the operator in the CCR to monitor and/or control these systems. The DCS interfaces with the PLCs of the ESD, F&G detection, CGMS, and auxiliary boiler BMS systems. It also interfaces with the Bentley Nevada VMS processors.

9.12 Field Instruments and Devices

Foundation Fieldbus digital bus instruments are used where practicable. HART smart, loop-powered, 4-20mA dc instruments are used where Fieldbus cannot be used due to speed of response, safety requirements, etc.

The signal transfer to the medium voltage switchgear and low voltage motor control centers is also by digital bus communication.

Field instrumentation that remain powered after gas is detected is intrinsically safe, certified for explosion group IIA, temperature class T2. Foundation Fieldbus instrumentation operates using FISCO (Fieldbus Intrinsically Safe Concept).

Vibration monitoring is provided on the flue gas blowers, CO_2 compressor, CO_2 product send-out pumps, and seawater pumps. X/Y radial vibration is monitored on each pump/blower, gearbox, and motor bearing; thrust bearing position is monitored on each thrust bearing; and a key phasor is installed for each different shaft speed.

9.13 External Controls Systems Interfaces

The DCS interfaces with external controls systems via the redundant interface servers and managed Ethernet switches. The DCS interfaces include Kårstø Gas Plant, CCPP, and CO_2 transport and storage system. These signals are exchanged with the systems at the neighboring facilities for communication of critical alarms and/or process parameters that may affect the other facilities. The detailed Signal Exchange List, 10112936-PB-I-LST-0001 (25474-000-J0-JD-00002), lists the signals that are exchanged.

10.0-Civil, Structural, and Architectural Features

10.0 Civil, Structural, and Architectural Features

10.1 Civil/Structural Design Criteria

10.1.1 Site Work

Site preparation for the Kårstø CO_2 Capture and Compression (CCC) Plant is not within the study scope. Additional excavation complies with the requirements in Civil Specification 10112936–FI–B–CON–0244. Erosion control and sediment control are considered minimal due to the rock fill material used in finished grading; however, sediment control is considered in the development of drainage swales. Grading and pavement designs comply with the applicable codes and standards, national highway regulations, and requirements of the Design Philosophy and Acceptance Criteria for Civil Works 10112936–PB–C–TED–0002.

10.1.2 Foundations

Reinforced concrete foundations are based on methods prescribed in EN 1992-1-1 and EN 1997-1. Reactions at the base of the superstructure are transferred directly to the supporting foundations. To withstand horizontal loads on the superstructure due to an accident (thermal, impact, explosion), connections at the base of the superstructure are fixed. The foundations are designed to resist the moment that develops at the base of the superstructure.

10.1.3 Structural Steel Design

Structural and miscellaneous steel and accessories are in accordance with the requirements established in the Structural Steel and Aluminum Requirements 10112936–FI–B–CON–0245. Steel is used for the design and construction of structural members, connections, and "outfitting" structures or miscellaneous members. Aluminum is not used for these items. The structural steel design is based on methods prescribed in EN 1990 and EN 1993-1. Steel design conforms to EN 10025.

10.1.4 Architectural Criteria

The CCC Plant is designed to accommodate staff for full plant operations. The plant consists mainly of equipment buildings and the control/workshop/stores building.

The design approach for the control/workshop/stores building considers flexibility of workspace, plant views from the building, and explosion-resistant design. This building continues its function even during emergency evacuation. The proposed building materials for this facility are compatible with and complement the existing Naturkraft buildings at the site. The building is designed with steel frames, precast concrete panels, and concrete roof meeting the explosion criteria requirements.

The equipment buildings are designed to enclose the equipment. These buildings are steel framed and enclosed with insulated metal panels and insulated metal roof, which is traditional material for an industrial building. The flooring for equipment buildings is sealed concrete with hardener.

10.2 Foundations and Geotechnical Features

10.2.1 Geotechnical Features

Geotechnical Report 10112936–FI–B–CON–0121 and supplemental data to that report do not provide geotechnical information for the area denoted on the Appendix E2.1 plan as the CCC Plant B/L (Drawing 10112936–0078-GAD). An additional soil investigation is necessary during the project's engineering, procurement, and construction (EPC) phase.

10.2.1.1 General Site Information

The CCC Plant terrain is that of a fully leveled industrialized site and consists of leveled crushed rock with variable depth to bedrock. The existing site elevation, as provided from an independent source, is +6 meters above mean sea level (MSL). The base elevation of the site, or the finished ground/grade elevation, is set at an average of +7 meters. The reference level at Kårstø is 2.29 meters above MSL.

10.2.1.2 Groundwater Table

Based on the provided geotechnical report, groundwater is not a consideration in the design of structures and their foundations. The elevation of the groundwater table is taken to be approximately at sea level.

10.2.2 Foundations

The major foundations bear on rock-fill or directly on rock. Based on site grading as indicated in the tender documents, the west side is in cut and the east is in fill. While there is no specific geotechnical data for the area inside the B/L, the adjacent profiles indicate that there is weathered rock at the ground surface.

The allowable bearing pressure for shallow foundations is 190 kN/m². For foundations on rock, it is 380 kN/m².

Materials used to support footings are compacted to a minimum of 95% of the modified Proctor (NS-EN 1997-1) maximum dry density.

The bottoms of all foundations supporting major equipment or piping are a minimum of 0.9 meter below finished grade for frost protection.

A detailed specific site investigation is required for the design phase, to refine design pressures.

10.3 Underground Utilities Considerations

Table 10.3-1 summarizes CCC Plant underground utility considerations.

Table 10.3-1 Major Subsurface Utilities

System	Standards		Bedding	
	Material	**Design**	**Material**	**Design**
Seawater Piping	Glass fiber reinforced epoxy resin	ASTM D2996 GR. RTRP-11FE	Sand or lean concrete*	EN 1997-1 and AWWA M45
CO_2 Piping	Stainless steel	ASTM A312 GR. TP304	Compacted granular material	EN 1997-1
Cable Culverts	Pre-cast concrete	EN 1992-1-1	Compacted granular material	EN 1997-1
Storm water Piping	Pre-cast concrete	EN 1916	compacted granular material	EN 1997-1
Fire Water Piping	Glass fiber reinforced epoxy resin	ASTM D2996 GR. RTRP-11FE	Compacted granular material	EN 1997-1
Potable Water Piping	High density polyethylene	ASTM D3350	Compacted granular material	EN 1997-1

*The seawater line is encased in lean concrete in the area beneath the pipe rack to protect the line during rack installation.

10.3.1 Additional Considerations for Cable Culverts

Electrical and instrument cables are placed in concrete culverts. Sidewalls have blockouts for cable inlets and outlets. The number and positions of blockouts are to be specified. In offsite areas, direct-buried cable trenches may be considered. Culvert walls and top covers are designed to sustain the pressure from backfilling and imposed loads, if any. The culverts are completely filled with sand. Bottom slabs have adequate drainage holes to facilitate surface and ground water movement.

10.3.2 Additional Considerations for Piping

Underground piping systems are discussed in the mechanical section. If sleepers are required, the design is to be based on geometry and loads (pressure, thermal, etc.) provided by the discipline designing the piping system. Wind loading is a consideration for the sleeper design only if the bottom of the pipe is more than 1 meter above finished grade. Sleepers are to include an embedded steel profile (hot dip galvanized), as support for the pipes.

10.4 Structural Materials Selections

10.4.1 Concrete and Grout

Preferred concrete grades for the CCC Plant are shown in Table 10.4-1

Table 10.4-1 Concrete Materials

Minimum Grade	Usage	Durability Class	Chloride Class
B30	Blinding layers underneath foundations	M60	C1 1.0
B35	Concrete structures	M45	C1 0.1

10.4.2 Reinforcing Steel

Reinforcing steel is deformed bars of billet steel, conforming to NS 3576-3/B500C. Reinforcing and accessories are in accordance with the requirements established in the Civil Specification for the CCC Plant.

10.4.3 Anchor Bolts and Embedments

Anchor bolts and embedments are cast-in-place. The anchor bolt assembly includes a square anchor plate fixed with bolt, square washer, and two nuts. Requirements and tolerances are listed in Tables 10.4-2 and 10.4-3, respectively.

Table 10.4-2 Requirements for Anchor Bolts and Embedments

Anchor Bolts			Embedments		
Part	**Standard**	**Coating**	**Part**	**Standard**	**Coating**
Bolt	NS-ISO 4014, Grade 8.8	Mechanically galvanized, NS-EN ISO1461	Steel plate	NS-EN 10025-2-S235J0+N	One coat of two-pack inorganic zinc-silicate weldable primer
Square Washer	NS 5277	Mechanically galvanized, NS-EN ISO1461			
Nut	NS-ISO 4032, Grade 10	Mechanically galvanized, NS-EN ISO1461			

Table 10.4-3 Tolerances for Anchor Bolts and Embedments

Anchor Bolts		Embedments	
Side deviation, complete bolt group	±3 mm	Side deviation	±10 mm
Side deviation between bolts in bolt group	±3 mm	Height deviation	0 mm to –6 mm
Side deviation, single bolt*	±3 mm	Slope deviation*	±3%
Height deviation	+15 mm to –2 mm	Deviation from plane (curvature)*	maximum (L/1000, 3 mm)
Side deviation, top bolt	Maximum (bolt height/250, 2 mm)		

* Note: The plate length/width gives the number of lines where slope deviation and deviation from plane are to be documented:

L = 0–500 mm	2 places (both edges)
L = 500–1500 mm	3 places (edges plus centerline)
L ≥ 1500 mm	4 places (edges plus two lines on plate)

10.4.4 Structural and Miscellaneous Steel

Preferred steel grades are shown in Table 10.4-4.

Table 10.4-4 Steel Materials

Location	**Grade**
Main members in modules and lift beams	S355J2+N
Secondary steel, angle bracing Miscellaneous pipe supports; site-erected steelwork Outfitting structures (ladders, handrail, etc.)	S235JR
Square hollow sections	S355J2+N

10.5 Buildings and Enclosures Design Criteria

Proposed buildings are designed to house the needs of CCC Plant equipment and to accommodate staff for full plant operation. The plant consists of mainly equipment buildings, a control/workshop/stores building, and support structures for process piping and ductwork.

10.5.1 Pre-Engineered Structures

The continuous emissions monitoring system (CEMS) building, storage sheds, and equipment skids are miscellaneous unmanned steel structures and frames provided to house or support equipment and instrumentation and store nonchemical items. Buildings and structures are designed with regard to the need for inspection, maintenance, cleaning, and repair.

10.5.2 Support Structure for Modified HRSG Stack

The CCC Plant's support structure for the modified heat recovery steam generator (HRSG) stack is an unmanned steel structure, as illustrated in Figure 10.5-1. This structure provides strength and stability for the existing HRSG stack as the stack is modified to introduce a new alternative flue gas duct path. The steel structure also supports the new ductwork plenum that is attached to the modified HRSG stack.

A three-dimensional frame structure is employed to support a large ductwork plenum and the upper portion of the HRSG steel stack. Moment-resisting trusses transfer gravity loads and overturning moments from the stack to the frame's columns.

Along with these trusses, a single braced bay is constructed on the southern side of the frame to transfer all lateral and longitudinal horizontal loads (from wind, temperature, etc.) into the existing foundation as well as additional footings for columns bearing outside the HRSG stack foundation mat.

10.5.3 Ductwork

The CCC Plant's ductwork is supported by an unmanned steel structure designed to support the flue gas ductwork extending from the modified HRSG stack to the blowers/flue gas absorbers as illustrated in Figure 10.5-2. The steel structure also supports two isolation dampers, a fogger injection system, small piping and instrumentation for the flue gas system, and electrical cable tray for multiple project purposes. Access is provided to the dampers and fogger system by ladders, platforms, and walkways. Duct supports consist of long-span prefabricated bridges and support towers that allow the duct to span across existing buildings and roads while maintaining clearances.

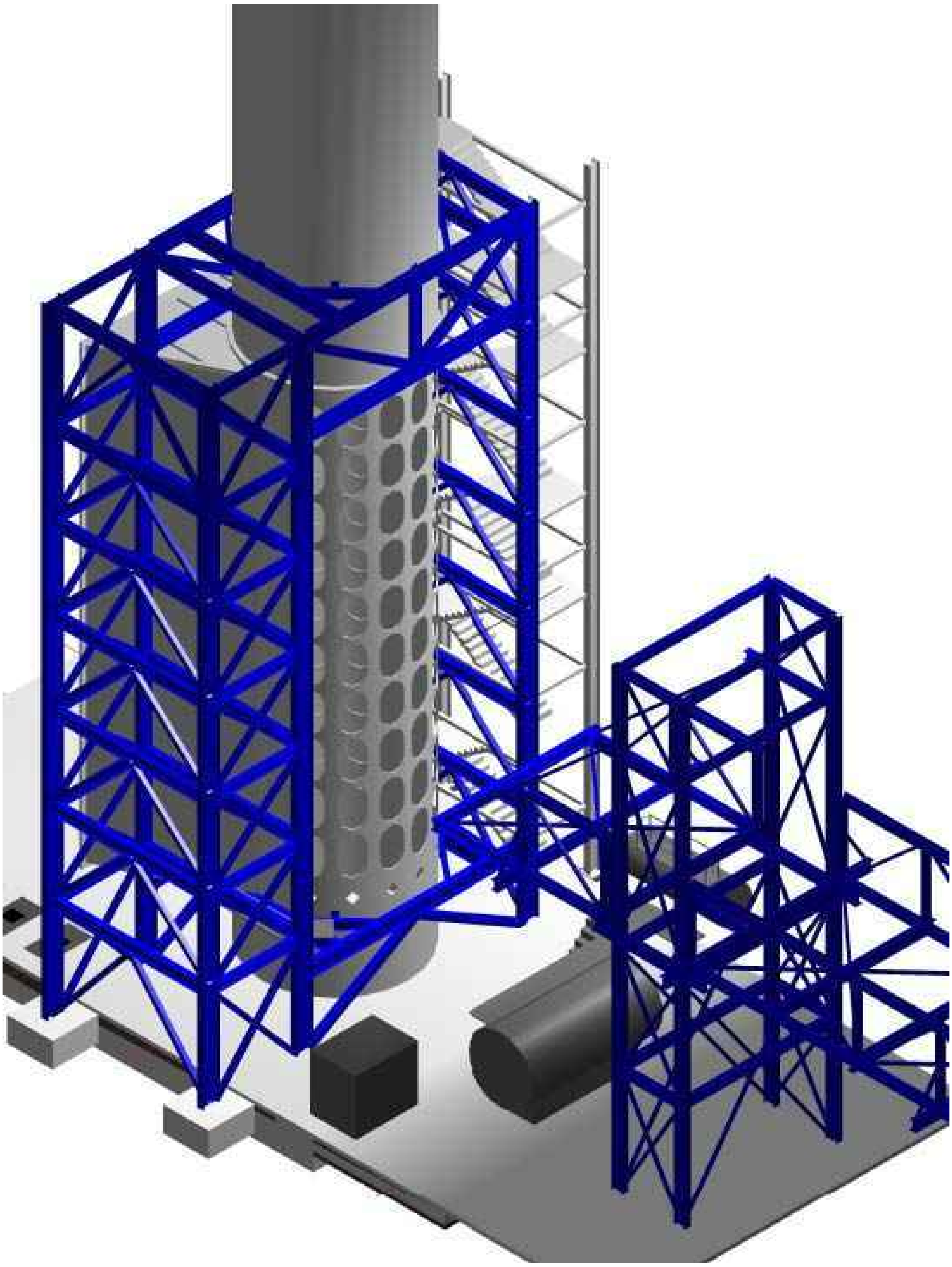


Figure 10.5-1 Flue-Gas Tie-in

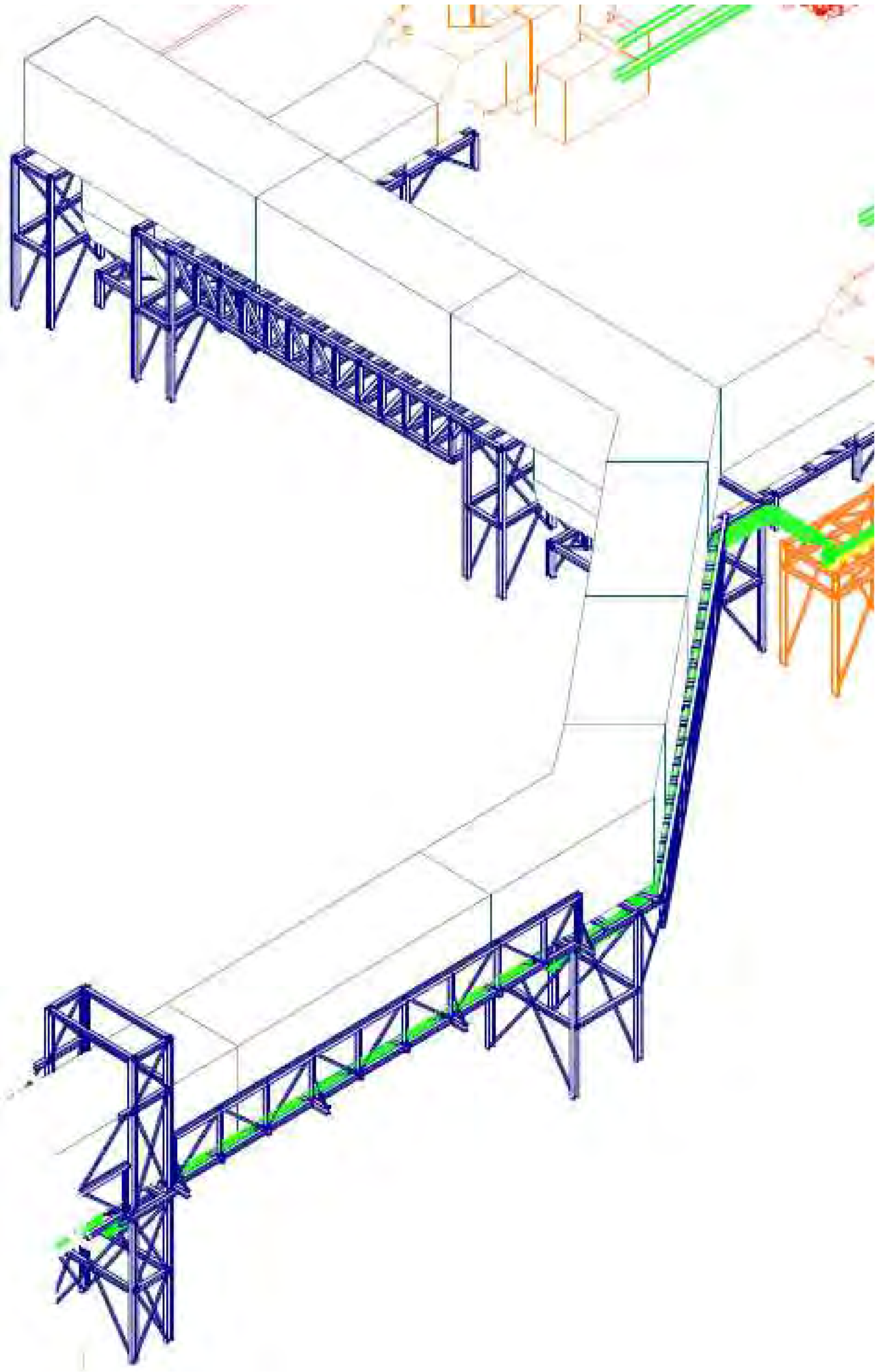


Figure 10.5-2 Ductwork Layout with Support Steel Structure

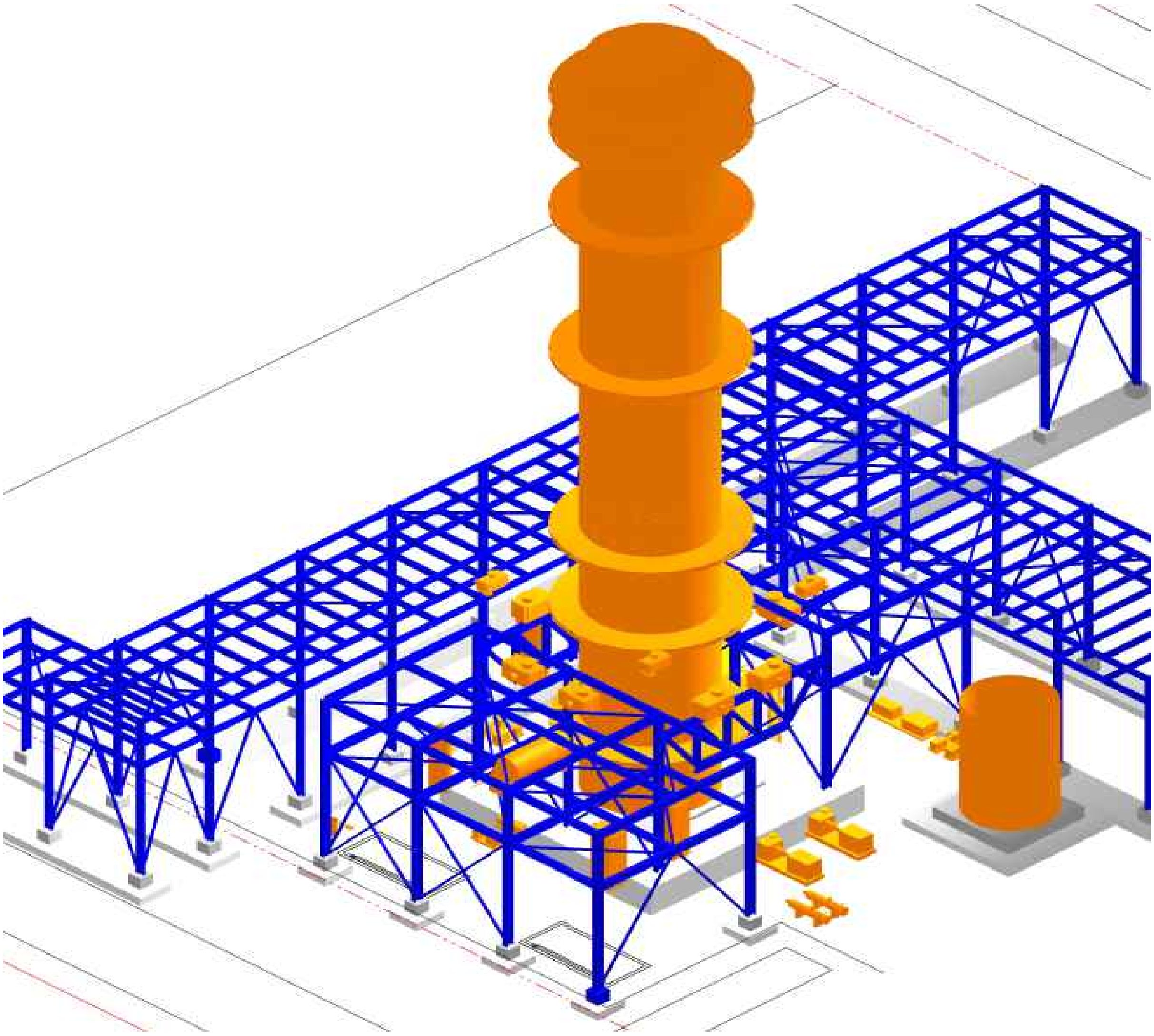


Figure 10.5-3 CO_2 Stripper Column with Supporting Steel

For the structural steel design, an analytical model is to be constructed using "beam" elements to represent beams/truss chords and columns and "truss" elements to represent vertical and horizontal bracing (members with axial load only).

Manufactured expansion joints are installed periodically to thermally isolate modular duct sections, and ducts are supported in a way that allows thermal movements without over-constrained loads.

10.5.4 Pipe Rack

The CCC Plant's pipe rack is an unmanned steel structure designed to support multiple levels of piping along with electrical cable tray extending from the battery limit and servicing the test facility. The structure is stick built on site. In addition, access and egress for a catwalk located on the uppermost level are provided for personnel to access equipment, piping, and instrumentation.

Structural arrangements, including locations of expansion joints and anchor bays in the superstructure, suit their locations in piping. Braced bays transfer all longitudinal horizontal loads from wind, temperature, pipe anchors, etc., to the foundations.

10.5.5 Compressor Building

The compressor building is capable of housing equipment such as the compressor, storage drums, and pumps and is required for noise reduction. Acoustical walls, roof insulation, and acoustical louvers are provided for noise reduction. Laydown areas are provided to enable easy handling/transportation during maintenance and repair. Overhead cranes or hoists are provided as required for maintenance. Internal and external explosions are taken into account.

10.5.6 Flue-Gas Blower Enclosures

The flue-gas blower enclosures are buildings with flat roofs capable of housing the blowers and ancillary equipment. The enclosures are intended for noise reduction.

10.5.7 Control/Workshop/Stores Building

The control/workshop/stores building is a single-story structure with a flat roof that houses control equipment, offices, meeting room, consumable and spare part (nonchemical) storage items, document storage room, and mechanical and other workshop areas. The building also houses the central control room (CCR) and rest rooms, including the kitchen/canteen facilities. The CCR and other rooms for installation of electrical/instrumentation cabinets are designed with a false floor. The CCR is designed to withstand accidental loads from explosions and earthquakes.

10.5.8 Electrical Building

The electrical building is a two-story structure with a flat roof and an elevated concrete floor that houses the electrical switchgear. Switchgear and other electrical equipment are located on the elevated floor, and a cable spreading room occupies the ground floor.

Oil-filled transformers are supported on reinforced concrete foundations located outside the building and are separated by a fire wall. The foundation supporting the transformers incorporates transformer rails (when applicable) for ease of transportation and placement. Transformers are fixed to the foundations with anchor bolts. Each transformer foundation slopes and has raised borders that enclose an oil pit in which the oil content of the transformer can be carried in the event of an oil leak. Above the oil pit, a minimum 20 cm thick gravel layer on a steel grating is provided. The oil pits drain into a central oil-collecting pit with integrated oil separator. The oil collecting pit is sized to hold the oil capacity of the largest transformer.

10.5.9 Tank Bund Area

The bund area is a reinforced concrete structure providing a diked area for chemical storage. The area is capable of collecting the larger of 110% of the inventory of the largest tank within the bund or 25% of the volumes of all the tanks within the bund.

10.6 Building and Enclosure Layouts

The CCC Plant is laid out to accommodate the spaces required for equipment access and to maintain and operate the plant. Access aisles and clearances are provided to accommodate operations and maintenance and equipment removal. The plant includes paved roads to access the buildings. Roof access is provided for equipment maintenance purposes only.

Provisions are also made for personnel walkways to equipment (for routine maintenance only), doors, stairs/fixed ladders, and other access points. Vertical access hatches are located to facilitate moving equipment and materials. Fire separation walls and floors are provided in accordance with code requirements. Plant security and life safety features are also considered in the plant layout. Recommended building and enclosure sizes are listed in Table 10.6-1.

Table 10.6.1 Buildings and Enclosure Sizes

Building/ Enclosure	Dimensions			Exterior Envelope	
	Length	Width	Height	Wall	Roof
Control/ Workshop/ Stores	63.4 m	22.2 m	9.5 m/ 5.0 m	Pre-cast concrete/ concrete masonry	Membrane roofing with concrete roof deck
Flue Gas Blower buildings	20.8 m	20.0 m	10.0 m	Insulated metal siding with interior liner panels	Membrane roofing over metal deck with insulation
CO_2 Compressor Building	45.0m	20.0 m	10.0 m	Insulated metal siding with interior liner panels	Insulated standing-seam metal panels
Electrical building	27.0 m	20.0 m	6.0 m	Same as CO_2	Same as CO_2

10.7 Building Architectural Features

The CCC Plant is located on a site surrounded by an industrial complex and in proximity to the ocean and hills. The proposed plant is to be built east of an existing plant. The design and selection of the exterior envelope, including texture and colors for the buildings, is to blend with the existing facility and surrounding nature. The new plant is to exhibit subtle differences to reflect its special characteristics.

The exterior color for the equipment buildings is shades of blue to complement the existing equipment buildings. For the control/ workshop/stores building, the pattern of precast concrete panels, with variance in textures and combination of horizontal and vertical bands of different color, enhances the visual aesthetics of the building and blend with existing buildings at the site.

The CCR and administration areas have wide corridors and clear exits designed in simple linear formation to make emergency evacuation easier. The control/workshop/stores building is designed in full compliance with accessibility requirements. The office spaces used by permanent staff are designed with permanent partitions, and open offices are designed with system furniture for plant employees and visitors. The office floor has carpet and tile, and the CCR has recessed access flooring. Kitchen, restrooms, showers, and lockers have ceramic tile flooring. The workshop and stores area and the mechanical room have sealed concrete flooring with hardener.

Table 10.7-1 indicates the recommended finishes for the main areas.

Table 10.7-1 Interior Finishes

Area	Floor	Walls		Ceiling	
		Material	Finish	Material	Height
Administration Area	Carpet	Drywall	Paint	Acoustical ceiling tile	2.75 m
Conference Room	Carpet	Drywall	Paint	Acoustical ceiling tile	2.75 m
Offices	Carpet	Drywall	Paint	Acoustical ceiling tile	2.75 m
CCR	Access Floor	Drywall	Paint	Acoustical ceiling tile	2.75 m
Canteen/Staff/ Social Room	Vinyl tile	Drywall	Paint	Acoustical ceiling tile	2.75 m
Kitchen	Unglazed Ceramic tile	Drywall	Ceramic tile/paint	Acoustical ceiling tile	2.75 m
Toilet/Shower/Lockers	Unglazed Ceramic Tile	Drywall	Ceramic tile	Drywall ceiling	2.75 m

		Walls		Ceiling	
Mechanical/ Maintenance Area	Concrete Floor	CMU/ drywall	Paint	Exposed	–
Workshop/Store Area	Concrete Floor	CMU/ drywall	Paint	Exposed	–
Equipment Buildings	Concrete Floor	Interior line	Paint/ prefinished	Exposed	–

10.8 Building HVAC, Utilities, and Services

10.8.1 Ventilation and Heating

10.8.1.1 Compressor Building

The CCC Plant's CO_2 compressor building has wall-mounted ventilation supply fans. Air is exhausted through the wall-mounted back-draft dampers. The air circulation is from an upper building elevation out through the exhaust dampers located near grade. Each supply fan assembly consists of an inlet hood, motorized intake louver, replaceable filter (if required), differential pressure switch, and thermostat. The fan automatically cycles from the thermostat setting.

Thermostatically controlled electric unit heaters are provided to maintain the indoor temperature at 10 °C during the winter.

In the event of a fire or combustible gas detection, the supply air fans automatically trip. Also, the electric unit heaters remain in their previous operating state. In the event of a CO_2 leak, the supply air fans continue to operate or are automatically started to aid in venting the building of CO_2. Reference the Fire and Gas System Cause and Effect Diagram 10112936-PB-I-DGM-0002 (25474-000-J4-JD-00002).

10.8.1.2 Flue-Gas Blower Enclosures

The flue gas blower buildings have wall-mounted ventilation supply fans. Air is exhausted through wall-mounted back-draft dampers. Each supply fan assembly consists of an inlet hood, motorized intake louver, replaceable filter (if required), differential pressure switch, and thermostat. The fan automatically cycles from the thermostat setting.

Thermostatically controlled electric unit heaters are provided to maintain the indoor temperature at 10 °C during the winter.

In the event of a fire or combustible gas detection, the supply air fans automatically trip as noted in the Fire and Gas System Cause and Effect Diagram 10112936-PB-I-DGM-0002 (25474-000-J4-JD-00002). Also, the electric unit heaters remain in their previous operating state.

10.8.1.3 Control/Workshop/Stores Building

The workshop and stores areas of the control/workshop/stores building have wall-mounted ventilation supply fans. Air is exhausted through wall-mounted back-draft dampers. Each supply fan assembly consists of an inlet hood, motorized intake louver, replaceable filter (if required), differential pressure switch, and thermostat. The fan automatically cycles from the thermostat setting.

Thermostatically controlled electric unit heaters are provided to maintain the indoor temperature at 10 °C during the winter.

In the event of a fire or combustible gas detection, the supply air fans automatically trip as noted in the Fire and Gas System Cause and Effect Diagram 10112936-PB-I-DGM-0002 (25474-000-J4-JD-00002). Also, the electric unit heaters remain in their previous operating state.

10.8.2 Heating, Ventilating, and Air Conditioning

10.8.2.1 Control/Workshop/Stores Building

The CCR and administrative areas of the control/workshop/stores building have 2 x 100%, thermostatically controlled, packaged heating, ventilating, and air-conditioning (HVAC) units. Each unit consists of a condensing unit, an air-handling unit, an electric heater, and an intake filter assembly. The conditioned air is supplied through a network of ductwork, dampers, and supply diffusers/registers grills. The return air from the CCR and offices is routed back to the HVAC unit through return air ductwork. Air from areas such as the locker rooms, toilets, kitchen, mechanical room, instrumentation and controls shop, etc., is not included in the return air ducting back to the HVAC units. The air-conditioned areas are maintained at 25 °C ±1.7 °C and 60% relative humidity (summer) and 21 °C 1.7 °C and 60% relative humidity (winter).

In the event of a fire, combustible gas, or CO_2 gas detection, the HVAC system automatically shuts down. Reference the Fire and Gas System Cause and Effect Diagram 10112936-PB-I-DGM-0002 (25474-000-J4-JD-00002).

10.8.2.2 Electrical Building

The electrical building has 2 x 100%, thermostatically controlled, packaged HVAC units. The air-conditioned areas are maintained at same conditions as stated in Subsection 10.8.2.1. The HVAC supply is ducted to the low and medium voltage equipment areas, uninterruptible power supply (UPS), and battery charger area, as well as the adjacent battery room. The battery room also has 2 x 100% exhaust fans. The entire supply air from the battery room is exhausted outside. The fans are sized to limit the hydrogen concentration below 2% by volume. A fan malfunction alarm is provided in the plant DCS.

In the event of a fire, combustible gas or CO_2 gas detection, the HVAC system automatically shuts down. Reference the Fire and Gas System Cause and Effect Diagram 10112936-PB-I-DGM-0002 (25474-000-J4-JD-00002).

10.9 Access, Paving, and Landscaping

10.9.1 Access Roads and Paved Areas

The CCC Plant site is located at Kårstø in the municipality of Tysvær on the southwest coast of Norway. The CCC Plant B/L extends 221 meters by 100 meters, with the southwest corner of the plot located at N4900 and E20552 on the Kårstø site local coordinate system. There are four means of access and egress for the site, which are designated in the Access Road and Finish Grading Plan 10112936–PB–C–TED–0005.

Table 10.9-1 indicates the types of roads and paved surfaces within the B/L. The designs, cross-section(s), materials, and compaction requirements comply with recommendations contained in Section 5.2 of the Design Philosophy and Acceptance Criteria for Civil Works 10112936–PB–C–TED–0002.

Table 10.9-1 Type of Roads and Paved Surfaces

Type	Material	Description
Main Plant Access Road	Asphalt gravel	Main plant access roads serve as through roads as specified by the plant layout.
Main Service Road	Asphalt gravel	Main service roads provide primary access to the process areas, buildings, and equipment.
Module Road	Asphalt Concrete	Module roads provide transport for modules and other heavy equipment.
Service Road	Asphalt gravel	Service roads provide secondary access to the process areas, buildings, and equipment.
Walkways	Concrete	Walkways provide access, by foot, along all main plant access roads and between plant facilities.
Light-duty Paving	Concrete	These are paved areas subject to chemical spillage; they include retention curbs.
Parking Areas	Asphalt gravel	There are a minimum of 12 parking places within the CCC Plant area.

10.9.2 Landscaping

The site is to be landscaped with trees, shrubbery, and bushes to enhance the plant appearance and improve building appearance from the road. The west elevation of the control/workshop/stores building is to have paved sidewalk and be landscaped with shrubs.

10.10 Painting and Coating Requirements

Table 10.10-1 summarizes CCC Plant painting and coating requirements.

Table 10.10-1 Painting/Coating Recommendations

Description	Primer	Finish Coat	Color
Outdoor structural and miscellaneous steel, including platforms, pipe racks, and support structure for ductwork	75–125 μm of ethyl silicate inorganic zinc	100 μm of epoxy and 75 μm of polyurethane	Shades of blue
Indoor structural and miscellaneous steel	75–125 μm of ethyl silicate inorganic zinc	N/A	Shades of gray
Outdoor carbon steel hangers and supports exposed to water immersion or splash and spillage <50 °C	150–200 μm of high-build catalyzed epoxy	150–200 μm of high-build catalyzed epoxy	Shades of blue
Control building: precast concrete wall panels	N/A	N/A	Shades of beige and blue
Control building: roof	N/A	N/A	Black
Equipment buildings: wall panels (prefinished PVDF2)	N/A	N/A	Shades of blue
Equipment buildings: roof panels (prefinished PVDF2)	N/A	N/A	Black
Doors and windows and trim	Tie coat of universal primer	Polyurethane finish	Shades of off white

11.0-Overall Facility Performance

11.0 Overall Facility Performance

11.1 CCC Plant Reliability, Availability, and Maintainability Analysis

The methodology used to assess the reliability of the Kårstø CO_2 Capture and Compression (CCC) Plant is based on the traditional reliability, availability, and maintainability (RAM) analysis provided for power plants. The plant is first divided into systems, and a reliability block flow diagram is constructed to depict the system configuration. Each block is then further broken down into components. Figure 11.1-1 is the overall reliability block flow diagram for the proposed plant. The plant is divided into seven systems as follows:

- Direct contact cooler
- Flue gas blowers
- Absorber tower
- Stripper tower
- Compressor and dryer
- Send-out pumps
- Balance of plant

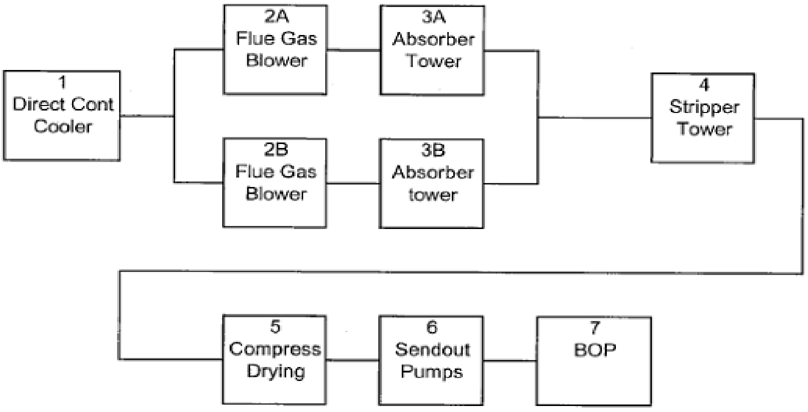


Figure 11.1-1. Overall Reliability Block Flow Diagram

The reliability of each system is calculated based on its configuration and component reliability data. The reliability of the entire plant is the aggregate of all seven systems.

Based on the RAM analysis, the single equipment item that has the largest potential reliability loss is the CO_2 compressor. Due to the high cost of this equipment, a redundant compressor has not been provided. If the 1 week of scheduled outage every 2 years is scheduled to coincide with the power plant scheduled outage, the overall CO_2 plant reliability is 99.33%. This high reliability is the result of having 100% installed redundancy for all pumps, including the CO_2 send-out pumps. If the scheduled outage is included in the availability losses, the availability is reduced to 98.39%.

11.2 Emissions

The CCC Plant employs a 35% (wt) aqueous solution of monoethanolamine (MEA) to capture CO_2 gas from the diverted flue gas stream of a combined cycle, natural-gas-fired turbine power plant.

MEA and ammonia emissions from the absorber outlet are 2.99 and 4 ppm, respectively, which are less than the 5 ppm limit stipulated in the owner's design basis. The process configuration could be modified to reduce these emissions further with some additional capital expenditure. These options are to be pursued in the engineering, procurement, construction, and installation (EPCI) phase.

The plant is expected to generate airborne, liquid, and solid wastes under normal operating conditions. The amine system emissions are summarized in Table 11.2-1.

Table 11.2-1 Exhaust and Emissions Summary

Emission	Flow Rate	Flow Type	Annually Emitted Quantity
Airborne			
Oxygen	182,472 kg/h	Continuous	3.197E+09 kg
Nitrogen	932,643 kg/h	Continuous	1.634E+10 kg
Water	65,918 kg/h	Continuous	1.155E+09 kg
Carbon Dioxide	10,961 kg/h	Continuous	1.920E+07 kg
Sulfur Dioxide	0.28 kg/h	Continuous	4.872E+03 kg
MEA	7.79 kg/h	Continuous	1.364E+05 kg
Argon	15,206 kg/h	Continuous	2.664E+08 kg
NO	4.23 kg/h	Continuous	7.406E+04 kg
NO_2	1.06 kg/h	Continuous	1.851E+04 kg
Ammonia	2.99 kg/h	Continuous	5.246E+04 kg
Liquid			
Lubricating Oil	To be determined in EPCI phase	Intermittent	To be determined in EPCI phase
Solid			
Reclaimer Waste (3)	225 kg/h	Intermittent	1.971E+06 kg
F-101 Filter Cartridges (4)	14 elements/change	Intermittent	28 elements
F-102 Filter Cartridges (4)	57 elements/change	Intermittent	114 elements
F-105 Filter Cartridges (4)	57 elements/change	Intermittent	114 elements
Activated Carbon	21,736 kg/month	Intermittent	2.608E+05 kg

Emission	Flow Rate	Flow Type	Annually Emitted Quantity
Desiccant (5)	3,835 kg total for both vessels	Intermittent	(5)

Notes:

1. Emissions from the absorber towers are expected to contain small amounts (< 1 ppmv per component) each of piperazine, formaldehyde, and acetaldehyde. These are decomposition products of amine degradation reactions that occur in the circulating process streams over time.
2. Annually emitted quantity is based on 8,760 hours per year operation for continuous operations.
3. Figure is based on 170.5 kg/hr of sludge on a dry basis. Additional quantity includes flushing water. Annually emitted quantity is based on 8,760 hours per year operation for continuous operations. Waste is emitted intermittently.
4. Filters are changed semi-annually.
5. Desiccant run length is between 3 and 5 years.

11.3 Noise

11.3.1 Plant Noise Requirements

The environmental noise emissions from the CCC Plant comply with an overall A-weighted sound power level of 113 dBA. During night-time operation, the noise emissions comply with a sound pressure level of 40 dBA at the nearest residential property, which is located approximately 700 meters toward the northeast from the CCC Plant.

Noise exposure limits are based on a LAeq8 ≤ 85 dB(A). The working environment area noise limits are assessed based on NORSOK standard S-002 recommended values.

11.3.2 Noise Assessment

The noise emission solely from the CCC Plant at the nearest residential property (700 meters toward the northeast from the CCC Plant) was assessed based on the contribution from major noise producing equipment. See the Coarse Noise Evaluation Report document number 10112936-PB-S-HSE-0012 (25474-000-U0Y-0000-00004). The following major noise sources were identified and are considered in the noise study:

- Heat recovery steam generator (HRSG) outlet
- Flue gas blowers
- CO_2 compressors
- Building ventilation
- Seawater pumps

The following noise transmission paths are also identified and accounted for in the noise assessment:

- In-duct noise from the HRSG outlet and flue gas blowers transmitted through the flue gas ductwork, absorber shells, and absorber stack exits
- Casing-radiated acoustic energy from blowers and compressors transmitted though building walls, roofs, and ventilation openings

11.3.3 Noise Mitigation

To meet the sound power level of 113 dBA for the CCC Plant, the following noise mitigation requirements are identified for the major noise emitting equipment:

- Acoustic lagging of flue gas ductwork
- Acoustic lagging of absorber shells
- Acoustic silencer on absorber stack exit
- Acoustical wall and roof assemblies for blower buildings
- Acoustical wall and roof assemblies for compressor building
- Low noise ventilation fans
- Acoustical building ventilation louvers
- Low noise emergency diesel generator
- Low noise auxiliary boiler

11.4 Guarantees on Key Parameters

11.4.1 Limits by Design

The following limits by design are identified:

- There is an emission limit of 5 ppmvd amine from the absorbers, and trace amounts of other constituents are permitted. No permit limits have been established since the Owner is in process of preparing the permit application.
- Design complies with the limit for a maximum seawater discharge temperature of 21°C.
- Far-field noise limit for the CCC Plant only is 40 dBA at 700 meters from the nearest receptor. Near-field equipment design limit is 85 dBA at 1 meter.

11.4.2 Guarantees—Expected for EPCI Phase

No performance guarantees are provided. These can be addressed after the contract terms and liquidated damage (LD) levels are established.

- Availability (currently a minimum of 97% by contract)
- CO_2 capture rate (currently a minimum of 85% by contract)
- CO_2 purity (currently a minimum of 99.6% by contract)
- Overall solvent loss
- Steam consumption
- Electric power consumption
- Sea water consumption
- Emissions to air
- Emissions to sea water
- Hazardous waste level and quantity
- Liquid effluent discharges

No NO_x, SO_x, CO, CO_2, or any other CCPP exhaust gas emission limits are expected to be imposed on the CCC Plant.

12.0-Materials Technology

12.0 Materials Technology

12.1 Corrosion Evaluations

The purposes of the corrosion evaluations are to determine the corrosivity of the fluids in the Kårstø CO_2 Capture and Compression (CCC) Plant's main process systems and to indicate the materials of construction and the paints and coatings to be specified for items of equipment and piping in these systems to mitigate against the effects of corrosion. The systems addressed are:

- Amine service
- CO_2 service
- Utility services

12.1.1 Amine Service

12.1.1.1 Pressure Boundaries, Internals, Piping, and Valves

Due to the corrosivity of amines, particularly the rich amine streams containing a high loading of CO_2, solid Type 304L stainless steel (SS) is recommended for all pressure-boundary and internals materials for all vessels, drums, heat exchangers, and pumps exposed to amines. This recommendation also applies to all amine service piping and valves. However, depending on vessel, drum, or heat exchanger shell thickness, it may be more cost-effective to use carbon steel clad with 1/8 inch of Type 304L SS. For non-welded internals or other non-welded components, Type 304 SS is acceptable and may be used. Substituting Type 316L/316 SS for Type 304L/304 SS is acceptable because of the superior corrosion resistance of Type 316L/316 SS.

12.1.1.2 Heat Exchangers

Plate heat exchangers in amine service cooled with seawater must be fabricated from titanium plate materials. Due to the high chloride content of seawater, the use of any of the 300 Series stainless steels is unacceptable. These materials are susceptible to pitting, crevice corrosion, and chloride stress corrosion cracking in chloride-bearing media like seawater.

Plate exchangers that are strictly in amine service, such as the rich/ lean exchangers, may be fabricated from Type 304 or 316 SS.

12.1.1.4 Pumps

Amines, and particularly rich amine, are corrosive and become even more corrosive as fluid velocity increases. Therefore, amine service pumps and piping must be constructed of stainless steel materials. Cast material shall conform to grade CF8 or CF8M (CF3 or CF3M if welded and not solution-annealed after weld repair), and wrought material shall conform to Type 304 or 316 SS (Type 304L or 316L SS if welded).

12.1.1.5 Towers

Towers like the CO_2 stripper are in very corrosive service because the rich amine is flashed as it enters the tower and the amine is further stripped by steam. The released CO_2 is free to combine with water vapor as it moves up the tower, and it forms carbonic acid in the tower and overhead system. The tower and all equipment and piping in the overhead system are exposed to carbonic acid and must be fabricated from Type 304L SS.

12.1.1.6 Absorber

The lean amine stream from the CO_2 stripper is recycled back to the absorber. While most of the CO_2 has been removed from this stream, the lean amine still contains some CO_2 and amine degradation compounds and thus is corrosive; consequently the absorbers must be fabricated from Type 304L SS. The lean amine that is recycled back to the absorber combines with the CO_2 from the flue gas to form a corrosive rich amine in the absorber. Both the absorber tower and the equipment and piping handling the rich amine stream that leaves the tower for the CO_2 stripper must be fabricated from Type 304L SS.

12.1.2 CO_2 Service

12.1.2.1 Vessels, Drums, Shells, and Piping

When saturated CO_2 condenses in the overhead system, it forms carbonic acid. Carbonic acid is very corrosive toward carbon steel. Therefore, vessels, drums, exchanger and condenser shells, and piping in CO_2 service, such as the overhead system of the CO_2 stripper, are fabricated from Type 304L SS.

12.1.2.2 CO_2 Compression Section

To combat carbonic acid in the CO_2 compression section, carbon steel is recommended for the shell-side of the steam generators, with stainless steel for the tube-side materials. In the seawater-cooled intercoolers, titanium, Sea-Cure, or AL6XN alloy is recommended for the tubes to resist seawater corrosion, and stainless steel (Type 304L SS) is recommended for the shell-side materials for carbonic acid resistance. Piping and drums in the compression section in contact with saturated CO_2 or carbonic acid are fabricated from stainless steel to resist carbonic acid corrosion.

12.1.2.3 Drying and Compression Section

In the drying and compression section, the recommended materials of construction for the steam generators, seawater-cooled intercooler, drums, and piping are the same as specified above. Because the gas has been dried in this portion of the system, stainless steel is specified for low-temperature service due to the potential for depressurization and auto-refrigeration should the system develop a leak.

12.1.3 Utility Services

12.1.3.1 Steam, Condensate, and Nitrogen Service Piping

Steam, condensate, and nitrogen service piping is recommended to be ASTM A106 Gr. B or ASTM A53 Gr. B, with 1.2 mm (0.050 inch) corrosion allowance. Valves must have a cast steel body, ASTM A216 WCB, with F6 valve trim.

12.1.3.2 Compressed Air, Process Water, Amine Waste, and Wastewater Piping

The material for compressed air, process water, amine waste, and wastewater piping is recommended to be ASTM A106 Gr. B or ASTM A53 Gr. B, with a corrosion allowance of 3 mm (1/8 inch). Instrument air piping must be Type 304/304L SS.

12.1.3.3 Fire Water, Seawater Cooling Water, and Potable Water Piping

Fire water and seawater cooling water piping is recommended to be glass-reinforced plastic (GRP). Potable water piping is recommended to be polyvinyl chloride (PVC) or chlorinated PVC (CPVC). For outdoor exposure, ultraviolet (UV)-resistant grades are used.

12.1.4 Paints and Coatings

Table 12.1-1 Paintings and Coatings

Description	Surface Preparation	Primer	Finish Coat
1.0 Structural and Miscellaneous Steel			
1.1 Platform steel, pipe, and cable racks – indoor	SP 10/SA 2.5	75–125 μm of ethyl silicate inorganic zinc	N/A

Description	**Surface Preparation**	**Primer**	**Finish Coat**
1.2 Platform steel, pipe, and cable racks – outdoor	SP 10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	100 µm of epoxy and 75 µm of polyurethane
1.3 High strength (A-490) nuts and bolts – indoor	N/A	100 µm epoxy mastic	N/A
1.4 High strength (A-490) nuts and bolts – indoor	N/A	75 µm epoxy mastic	75 µm of epoxy and 75 µm of polyurethane
1.5 Miscellaneous nuts and bolts other than A-490 – indoor	N/A	hot-dip galvanized ASTM A 123, or mechanically galvanized per ASTM B695	N/A
1.6 Miscellaneous nuts and bolts other than A-490 –outdoor	N/A	mechanically galvanized per ASTM B695	75 µm of epoxy and 75 µm of polyurethane
1.7 Carbon steel surfaces exposed to splash and spillage <50 °C – indoor or outdoor	SP 10/SA 2.5	150–200 µm of high-build catalyzed epoxy	150–200 µm high-build catalyzed epoxy
1.7 Carbon steel surfaces exposed to water immersion <60 °C	SP 5/SA 3	250–375 µm of high-build catalyzed epoxy	250–375 µm high-build catalyzed epoxy
2.0 Piping and Valves			
2.1 Non-insulated carbon steel piping and valves, including hangers and supports, <400 °C – indoor	SP10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	N/A
2.2 Non-insulated carbon steel piping and valves, including hangers and supports, <104 °C – outdoor	SP10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	75 µm of epoxy and 75 µm of polyurethane
2.3 Non-insulated carbon steel piping and valves, including hangers and supports, >104 °C to <400 °C – indoor/outdoor	SP10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	two coats, 25–40 µm per coat, of high-temperature silicone
2.3 Non-insulated stainless steel piping and valves <104 °C – outdoor (hangers and supports per 2.1)	sweep blast (SP 7)	150–200 µm of high-build catalyzed epoxy	optional 75 µm of polyurethane
2.4 Non-insulated stainless steel piping and valves <104 °C – indoor (hangers and supports per 2.1)	SP10/SA 2.5	N/A	N/A
2.5 Insulated stainless steel piping and valves <121 °C – outdoor (hangers and supports per 2.1)	sweep blast (SP 7)	150–200 µm of high-build catalyzed epoxy	N/A
2.6 Insulated stainless steel piping and valves <121 °C – indoor (hangers and supports per 2.1)	N/A	N/A	N/A
2.6 Insulated carbon steel piping and valves >121 °C to <400 °C – indoor (hangers and supports per 2.1 or 2.2)	mfr std	mfr std	N/A
2.7 Insulated carbon steel piping and valves <121 °C – outdoor (hangers and supports per 2.1 or 2.2)	SP10/SA 2.5	150–200 µm of high-build catalyzed epoxy	N/A

Description	Surface Preparation	Primer	Finish Coat
2.8 Insulated carbon steel piping and valves >121 °C to <400 °C – outdoor (hangers and supports per 2.1 or 2.2)	SP10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	N/A
3.0 Mechanical Equipment			
3.1 Non-insulated large (>5 m^2) carbon steel mechanical equipment and associated components, including supports, <104 °C – indoor or outdoor	SP10/SA 2.5	100–15 0 µm rust-inhibitive catalyzed epoxy primer	75–100 microns of epoxy intermediate and 75–125 µm of polyurethane
3.2 Non-insulated large (>5 m^2) carbon steel mechanical equipment and associated components, including supports, >104 °C to <400 °C – indoor or outdoor	SP10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	two coats, 25–40 µm per coat, of high-temperature silicone
3.3 Non-insulated stainless steel mechanical equipment and associated components, including supports, <104 °C –outdoor	SP 10/SA 2.5	150–200 µm of high-build catalyzed epoxy	optional 75 µm of polyurethane
3.4 Non-insulated stainless steel mechanical equipment and associated components, including supports – indoor	N/A	N/A	N/A
3.5 Non-insulated small (<5 m^2) carbon steel mechanical equipment and associated components, including supports, to <400 °C – indoor/outdoor	mfr std	mfr std suitable for exposure conditions	mfr std suitable for exposure conditions
3.6 Non-insulated amine and other chemical skid steel – indoor/outdoor	SP 10/SA 2.5	250–300 µm of chemical-resistant coatings	250–300 µm of chemical-resistant coatings
3.7 Insulated carbon or stainless steel mechanical equipment and associated components, including supports, to <400 °C – indoor	mfr std	mfr std	mfr std
3.8 Insulated carbon or stainless steel mechanical equipment and associated components including supports <121 °C – outdoor	SP 10/SA 2.5	150–200 µm of high-build catalyzed epoxy	N/A
3.9 Insulated carbon or stainless steel mechanical equipment and associated components, including supports, >121 °C to <400 °C – outdoor	mfr std	mfr std	mfr std
4.0 Tanks and Vessels			
4.1 Non-insulated shop fabricated carbon steel tanks and vessels <104 °C – outdoor	SP10/SA 2.5	100–150 µm rust-inhibitive catalyzed epoxy primer	75–100 microns of epoxy intermediate and 75–125 µm of polyurethane
4.2 Non-insulated shop fabricated carbon steel tanks and vessels <104 °C –indoor	SP10/SA 2.5	100–150 µm rust-inhibitive catalyzed epoxy primer	75–125 µm of polyurethane
4.3 Non-insulated field erected carbon steel tanks and vessels <104 °C – outdoor	SP10/SA 2.5	100–150 µm rust-inhibitive catalyzed epoxy primer	75–100 microns of epoxy intermediate and 75–125 µm of polyurethane

Description	**Surface Preparation**	**Primer**	**Finish Coat**
4.4 Non-insulated shop fabricated stainless steel tanks and vessels <104 °C – outdoor	sweep blast (SP 7)	150–200 µm high-build catalyzed epoxy	optional 75 µm of polyurethane
4.5 Non-insulated shop-fabricated stainless steel tanks and vessels – indoor	N/A	N/A	N/A
4.4 Insulated shop-fabricated carbon steel tanks and vessels <121 °C – indoor	mfr std	mfr std	mfr std
4.5 Insulated shop-fabricated carbon steel tanks and vessels <121 °C – outdoor	SP 10/SA 2.5	150–200 µm high-build catalyzed epoxy	N/A
4.6 Insulated shop-fabricated stainless steel tanks and vessels <121 °C – outdoor	SP 10/SA 2.5	150–200 µm high-build catalyzed epoxy	N/A
4.7 Insulated shop-fabricated carbon steel tanks and vessels >121 °C to <400 °C – outdoor	SP10/SA 2.5	75–125 µm of ethyl silicate inorganic zinc	N/A
4.8 Interior of carbon steel tanks and vessels	corrosion-resistant coating materials or alloy materials suitable for the design conditions		
5.0 Pumps and Motors			
5.1 Non-insulated pumps, motors, and supports <104 °C – outdoor	SP10/SA 2.5	75–100 µm rust-inhibitive catalyzed epoxy primer	75–100 µm of epoxy intermediate and 75–125 µm of polyurethane
5.2 Non-insulated pumps, motors, and supports <400 °C –indoor	mfr std	mfr std	mfr. std
5.3 Insulated pumps <121 °C – indoor or outdoor	SP10/SA 2.5	150–200 µm high-build catalyzed epoxy	N/A
6.0 Electrical and Control			
6.1 Switchgear, motor control centers, chargers, inverters, switchboards, local devices, local control panels and cabinets, etc.	mfr std	manufacturer's standard primer and finish or 125–175 µm powder coatings suitable for service and environmental conditions	
6.2 Boards/consoles and other associated components	mfr std	manufacturer's standard primer and finish or 125–175 µm powder coatings suitable for service and environmental conditions	
6.3 Miscellaneous electrical and control instruments	mfr std	manufacturer's standard primer and finish or powder coatings suitable for service and environmental conditions	
6.4 Power transformers, enclosure/modules, and large (>5 m^2) electrical equipment	SP10/SA 2.5	75–100 µm rust-inhibitive catalyzed epoxy primer	75–100 µm of epoxy intermediate and 75–125 µm of polyurethane
6.5 Cable trays, cable tray supports, pull boxes, conduits	N/A	galvanized with plastic coating or powder coating or optional FRP or PVC (conduits and pull boxes)	
6.6 Electrical motors – indoor or outdoor	mfr std	epoxy primer and epoxy or polyurethane topcoat	
7.0 Miscellaneous Steel			
7.1 Outdoor platform grating, stair grating, toe plates, etc. – indoor or outdoor	per code	hot-dip galvanized to a minimum of 705 g/m^2 per ASTM A123 or equivalent ISO standard	N/A

Description	Surface Preparation	Primer	Finish Coat
7.2 Platform handrails, stair steel, and ladders – indoor	SP10/SA 2.5	hot-dip galvanized to a minimum of 705 g/m² per ASTM A123 or equivalent ISO standard	N/A
7.3 Platform handrails, stair steel, and ladders – outdoor	SP10/SA 2.5	hot-dip galvanized to a minimum of 705 g/m² per ASTM Aa123 or 75–100 µm rust-inhibitive catalyzed epoxy primer	75–100 µm of epoxy intermediate and 75–125 µm of polyurethane
7.4 Grating for chemical trench and sump (non-vehicular traffic)	FRP		

12.2 Durability Report

This section outlines the philosophy employed in specifying metallic materials of construction and paint/coating materials for equipment and piping for the CCC Plant.

12.2.1 Materials of Construction

12.2.1.1 Amine Service

The specific metallic materials of construction for equipment and piping in amine service depends on the specific amine chosen to selectively remove CO_2 and the design temperature/pressure conditions necessary in the process to optimize amine performance.

For this particular project, Type 304/304L SS was selected as the minimum required material of construction for all items of equipment and piping in amine service. Depending on the specific amine, for example monoethanolamine (MEA) or diethanolamine (DEA), carbon steel materials with post-weld heat treatment (PWHT) and specified corrosion allowances can also be used. But even with these amines, stainless steel material is often required for the rich-amine service portion of the process, depending on temperature and amine loading. To provide maximum flexibility and the ability to accommodate the use of any amine package, stainless steel materials of construction have been recommended. It is important to note that in welded applications, Type 304L SS is required. The use of L-grade material minimizes sensitization of the weld heat-affected zone (HAZ) during fabrication, resulting in welds that maintain the required corrosion resistance.

12.2.1.2 Seawater Cooling Water Service

For seawater, using the standard 300 Series stainless steels is not viable because these materials are susceptible to severe pitting and crevice corrosion in the marine environment. These materials are also susceptible to chloride stress corrosion cracking when temperatures exceed 50 °C. Numerous duplex and super-austenitic stainless steel materials exhibit excellent resistance to pitting and stress corrosion cracking in the marine environment, but these alloys are expensive. It is proposed that GRP piping be used in firewater and cooling water service. An epoxy-resin-based material with an epoxy-rich internal chemical-resistance barrier should provide adequate resistance for the life of the plant.

Where metallic materials must be used, for example in the seawater-cooled plate exchangers, titanium is recommended. It is resistant to stress corrosion cracking, pitting, and crevice corrosion and provides superior performance in service.

12.2.1.3 Steam Condensate and Utility Services

Standard carbon steel materials of construction are suitable for equipment and piping in steam and condensate services. Carbon steel is also suitable for plant air, nitrogen, and process water service. Instrument air piping is usually specified to be stainless steel or copper piping. These materials are specified to eliminate the risk of having corrosion product adversely affect instrumentation performance.

12.2.1.4 Carbon Dioxide Service

The recommended material of construction for vessels and piping in CO_2 service at the saturation temperature is Type 304L SS. Any subsequent condensation from the saturated vapor results in the formation of carbonic acid, which is very corrosive toward carbon steel.

12.2.1.5 Demineralized and Potable Water Services

Demineralized water that contains dissolved oxygen is very aggressive and corrodes carbon steel. Consequently, Type 304L SS materials are recommended and routinely used in demineralized water service.

Depending on water quality, carbon steel is suitable for potable water service. However, plastic materials such as PVC and CPVC have been found to be suitable for a wide range of potable water qualities, are relatively simple to install, and provide satisfactory performance. Consequently PVC and CPVC are recommended. UV-resistant grades are required for outdoor exposure.

12.2.2 Paints and Coatings Selection

Coatings are selected based on their ability to provide sustained corrosion protection for the design life of the plant, as well as an aesthetically appealing facility. Refer to Table 12.1-1 for specific applications.

12.2.2.1 Surface Preparation

SSPC SP10 was chosen for surface preparation because it is recommended by paint manufacturers. It is an industry standard practice for seacoast environments because it increases the long-term efficiency, sustainable performance, and protection of the coating, yielding a life expectancy of at least 20 years with routine maintenance as required.

12.2.2.2 Stainless Steel

To coat the outside diameter (OD) surfaces of stainless steel exposed to the marine environment, 150–200 µm of catalyzed epoxy with an optional 75 µm polyurethane topcoat is recommended. The coating acts as a barrier and minimizes the risk of chloride stress corrosion cracking and pitting of stainless steel on OD surfaces due to external chloride contamination. Note that inorganic zinc silicate or galvanized coatings are prohibited on stainless steel.

12.2.2.3 Insulated Steel Outdoors (Carbon and Stainless Steel)

Both carbon and stainless steel surfaces having a surface temperature less than 121 °C (250 °F) are coated with 150–200 µm of catalyzed epoxy to prevent corrosion (pitting, rust, etc.) under the insulation and to prevent stress corrosion cracking of stainless steel.

12.2.2.4 Insulated Steel Indoors (Carbon and Stainless Steel)

Manufacturers' standard coatings are specified for carbon and low-alloy steel equipment and piping to provide sufficient corrosion protection during transport to and storage at the site prior to use. Insulated and uninsulated stainless steel surfaces located indoors are not coated.

12.2.2.5 Uninsulated Outdoor Exposure

The marine environment is very harsh and causes severe corrosion of uninsulated carbon and low-alloy steel equipment, tanks/vessels, piping, valves, and structural and miscellaneous steel exposed to the very humid, chloride-bearing environment. The coating systems for these components were selected to maximize their corrosion protection. The prime coat shall consist of 75–125 µm of ethyl silicate inorganic zinc or rust-inhibitive epoxy, followed by 100 µm of epoxy top-coated with 75 µm of polyurethane. Note that the external coating requirements for stainless steel exposed to the marine environment are covered separately above.

12.2.2.6 Indoor Structural Steel

Inorganic zinc silicate coating is selected based on its outstanding protective properties, which include its sacrificial corrosion protection properties in combination with its barrier properties and physical characteristics. For indoor exposure, this coating should last for the design life of the plant. It is unaffected by weather, sunlight, UV radiation, rain, dew, bacteria, and temperature and does not chalk. It has a very good chemical resistance to pH levels between 5 and 9.

Hot-dipped galvanized coatings are also suitable for structural elements for indoor service. The minimum and maximum coating weights provided by a typical hot-dip galvanizing specification are 320 g/m^2 (1 oz/ft^2) to 705 g/m^2 (2.3 oz/ft^2), which translates into a maximum coating thickness of about 100 µm. This coating weight range per m^2 is sufficient to provide corrosion protection for the design life of the plant. Hot-dip galvanized coating was chosen for bolts, nuts, gratings, ladders, handrails, etc., because hot-dip galvanizing is an economical process for efficiently coating fasteners and small structural components.

13.0-Occupational Health and Safety

13.0 Occupational Health and Safety

13.1 Occupational Health Assessment

NORSOK S-002 standards and health, safety, and environmental (HSE) requirements outside the Kårstø CO_2 Capture and Compression (CCC) Plant battery limit (B/L) mandate that the working environment (WE) be assessed and analyzed during the engineering project development life cycle. The overall purpose of assessing occupational health in the WE is to ensure that the design of the installation promotes a quality WE during a facility's operational phase. This is consistent with the overall HSE philosophy of providing a "zero harm" WE for all personnel working at the facilities.

NORSOK S-002, Clause 4.4.2.0-1, Working Environment, establishes the normal review cycle expectations for revising a "concept Working Environment Impact Assessment (WEIA)." A WEIA is normally prepared during the concept selection phase (pre-front-end engineering and design [FEED]), and updated as the project progresses through FEED. The concept selection phase WEIA was not available as an input to the FEED Study update.

On this basis, a concept WEIA was completed during the FEED Study as a new document in compliance with the requirements of NORSOK S-002, Section 4.4.2. It includes the following impact assessment areas:

- Job hazard/risk of occupational injuries
- Ergonomics/prevention of musculoskeletal strains and injuries
- Ergonomics/human factors in work systems
- Hazardous chemicals
- Noise and vibration control
- Illumination
- Outdoor operations – cold stress
- Outdoor operations – precipitation and shelters
- Outdoor operations – flaring
- Constructability

While not a specific NORSOK S-002 WEIA FEED stage requirement, chemical risk assessment is a fundamental requirement for the CCC Plant. Therefore, the supplied documentation includes an appendix section entitled Framework Chemical Health Risk Assessment. This document serves as input to the detailed engineering phase WE risk analysis, which is a requirement of NORSOK S-002.

In support of the FEED stage WE assessment, worker exposure to hazards and working environment area limits for occupational settings were evaluated. Detailed working environment area charts (WEACs) were prepared for specific work areas (FEED stage) to address reasonable and foreseeable WEs. The form depicted in NORSOK S-002, Annex E, Working Environment Area Chart, was used as the template.

This information is available in document 10112936-PB-S-HSE-0007, Occupational Health Area Charts.

13.2 Fire and Explosion Strategy

A fire and explosion strategy (FES) was developed in accordance with ISO 13702 to examine fire and explosion hazards associated with the CCC Plant. The design objectives of the FES are to:

- Provide direction to project management in controlling fire and explosion (F&E) hazards associated with this project
- Establish a strategy to ensure that the identified F&E hazards associated with the operational development phases are addressed

13.2.1 Fire and Explosion Hazards

The CCC Plant is considered to consist of three main zones for the development of the FES:

- Flue gas tie-in area (blower and quench section)
- CO_2 compression and drying section
- Amine process and storage areas

13.2.1.1 Flue Gas Tie-in Area

The potential for F&E in the blower and quench section is minimal due to the nature of the process materials (water and flue gas).

13.2.1.2 CO_2 Compression and Drying Section

The potential for F&E in the CO_2 compression and drying section is minimal due to the nature of the process and the materials handled. However, there is a potential for a fire involving the CO_2 compressor and flue gas blower lube oil skids. Lube oil fires are considered a hazard that is addressed in a hazard and operability (HAZOP) study for consideration in the design.

Available research indicates that a boiling liquid/expanding vapor explosion (BLEVE) is unlikely to occur with the supercritical CO_2 present in the CCC Plant. While there may be a rapid release with some pressure rise, such an event is not followed by a vapor cloud explosion, as could be the case with flammable liquids.

13.2.1.3 Amine Process and Storage Areas

The main CCC Plant fire hazards involve the amine processing and storage areas, which can be subdivided into the following process sections:

- CO_2 absorption
- Heat integration
- CO_2 stripping
- Amine reclamation
- Amine storage

For FEED, amine solutions in water are treated as combustible mixtures in the compositions used in the design. Further study of aqueous amine solutions to confirm flammability could result in an optimized design in which reduced flammability is verified.

13.2.2 Ignition Source Control

The potential for ignition is minimized since all outdoor equipment is suitable for Zone 2, Group IIA, and temperature Class T2 hazardous area classification as a minimum. Equipment and piping surface temperatures are well below the air inlet temperature of monoethanolamine (MEA) (410 °C).

Other plant areas are non-classified by design or spatial separation.

Hot surface, electrostatic, lightning, and hot work ignition sources are well controlled due to features incorporated into the design.

13.2.3 Fire and Gas Detection

The fire and gas (F&G) detection system has various detectors within the CCC Plant B/L to detect the presence of CO_2, combustible gas, smoke, and fire.

The F&G detection system status is shown and alarms are annunciated at the distributed control system (DCS) operator stations.

A manual operator response is required for F&G alarms. Some automatic actions are taken by the system, such as shutting down ventilation inside a building on combustible gas detection, discharging extinguishing agent, etc. Automatic actions in response to F&G detection are described in the cause and effect charts.

F&G detection philosophy, detector location, and alarm levels comply with provisions described in document 10112936-FI-B-CON-0140-05, Exhibit E8.1—HSE Requirements.

The F&G system complies with the requirements of document 10112936-FI-B-CON-0094-01, Exhibit E4.4—General Technical Requirements, Fire and Gas Monitoring and Alarm System.

13.2.4 Depressurizing

The CCC Plant contains CO_2 at supercritical conditions. If a leak or equipment failure occurs, the released CO_2 falls to extremely low temperatures, causing a hazard to surrounding equipment and personnel. Additionally, the CO_2 concentrations in the local atmosphere may reach dangerous levels.

Depressurizing facilities are installed after the final stage of the compressor to ensure that the plant can be depressurized to mitigate the impact of containment loss. The depressurizing rate, valve, and piping need to be carefully designed to prevent excessively low temperatures and dry ice formation.

The plant depressurizing design basis is fully elaborated in the depressurizing philosophy narrative prepared during FEED.

13.2.5 Active Fire Protection

The existing fire water network at the Naturkraft combined cycle power plant (CCPP) site supplies fire water requirements for the CCC Plant.

The specification of system components for firefighting complies with document 10112936-FI-B-CON-0140-05, Exhibit E8.1 – HSE Requirements, Clause 3.8 (all sub-clauses).

CCC Plant workers do not approach structural fires. All buildings are fitted with full fire detection and alarming facilities and/or automatic suppression systems.

The CCC Plant design includes a full perimeter, underground fire ring main tied to the Kårstø site fire water system.

Further evaluation is needed during detailed engineering to consider the application of specialized, self-contained, high-momentum water mist extinguishing to provide fire suppression for specific hazards (e.g., lube oil systems, stationary diesel engine bays).

13.2.6 Passive Fire Protection

The reduced combustibility of aqueous amine solutions limits the dimensioning of fire events under leakage conditions. Equipment survivability under foreseeable fire conditions determines the need for passive systems. Consistent with the specified functional requirements, active means of protection are to be sought and implemented in the design before passive protection schemes are applied (e.g., fireproofing with cementitious materials).

The FEED design considers passive fire protection on pipe rack structures and skirts for the absorber towers and stripper column.

13.2.7 Emergency Power Systems

Emergency power supply requirements are provided by a dedicated emergency diesel generator located within the CCC Plant B/L.

All critical systems (e.g. safety and automation system [SAS], emergency shutdown [ESD], process shutdown [PSD], F&G detection, alarms) are to be arranged to supply power from the emergency bus under primary power failure conditions to ensure control and monitoring integrity without interruption.

13.2.8 Drainage Systems

The CCC Plant design employs both open and closed drainage systems and bunding in specific areas to contain potential spills of amine and required process chemicals to minimize the potential for dimensioning of a spill condition.

The open drain system is used primarily for rain and surface water runoff, which is normally processed through an oily water interceptor before it is discharged to the sea.

The closed drain system is used for amine processing area discharge and system drain-down. The design intent is to recycle amine discharges to the process to prevent effluent.

Pumps in amine service employ high integrity seal technology to minimize leakage risk.

13.3 Escape, Evacuation, and Rescue Strategy

The escape, evacuation, and rescue strategy (EERS) prepared for the project describes the provisions to be implemented for the escape and mustering of personnel from the CCC Plant plot space. The EERS documentation was developed in accordance with the requirements of the NORSOK S-001 and ISO-13702 standards.

The EERS addresses issues such as organization, procedures, information, training, and emergency response, which are necessary to achieve a successful EER process.

13.3.1 Escape Strategy

If a hazardous incident occurs, the FEED escape route arrangements ensure that personnel may leave areas using at least one safe route. FEED planning and development must ensure that personnel can reach the designated mustering area from any part of the plant.

Escape route planning and preparation consider the following plant and plant systems design elements and interfaces:

- Equipment layout
- Public address (PA), alarm, and emergency communication
- Emergency power and lighting
- Passive fire protection
- Structural integrity

The FEED design considers an appropriate temporary muster point for escaping workers to go to during a called emergency. For this purpose, the main stores area is designated as the temporary muster point, (designated as TR) to ensure that a complete head count of all personnel can be made.

Escape may be triggered by an escape call from the plant control room, from the site-wide central control room (CCR), or in response to a local fire or gas alarm annunciator.

The designated muster point is reflected on the applicable escape route drawings. All escape routes employ normally used paths of travel and are signed in accordance with all regulatory requirements. Permanently and intermittently manned areas are arranged with at least two means of egress.

Appropriate emergency lighting and alarm communication systems (including voice PA) are provided so that personnel can effectively execute emergency duties. In the case of a site-wide escape call, a worker can escape to the site-wide muster point designated as M1.

13.3.2 Evacuation Strategy

The CCC Plant is an onshore facility. The design of the plant and process fluids do not present a credible risk for fire, toxic gas, or explosions that can escalate to the muster area under a single failure event, e.g., localized spill or leak.

Evacuation provisions do not need to be included for all facility personnel. Once the facility personnel have mustered in the designated temporary muster point (TR), they can escape to the designated Kårstø site-wide muster point (M1) under the direction of the site-wide CCR staff and/or emergency services personnel.

13.3.3 Rescue Strategy

The CCC Plant is an onshore facility that does not present a risk of fire, toxic gas, or explosions (see Subsection 13.4.2). Therefore, formal vehicle-based rescue provisions (as normally required for an offshore platform) are not required.

After the facility personnel arrive at the designated temporary muster point (TR), they can escape to the designated Kårstø site-wide muster point (M1) under the direction of the site-wide CCR staff and/or emergency services personnel.

Due to the operational requirement to perform field maintenance and intermittent work in confined spaces or above grade, rescue means need to be in place in the event of personnel injury. This emergency extrication planning is addressed in the job hazards analysis (JHA) process developed during detailed engineering.

The coordinated emergency response plan includes safety showers, safety cabinets, first-aid kits, and provisions to ensure that personnel can be safely removed for examination, first-aid, and transport to medical facilities.

13.4 Observations and Recommendations

13.4.1 Observations

HSE requirements for the overall Kårstø site, including requirements covering the owners of the gas plant and CCPP, have not been defined to the degree possible for conditions common to process plant environments.

Routinely coordinating HSE planning activities benefits the overall risk profile of a site that has the complexities of Kårstø. Further definition of site-wide HSE practices must be a design absolute during the detailed engineering process.

Sufficiently detailed FEED-level hazard identification (HAZID) and process hazards analysis (PHA) (FEED stage HAZOP) studies have been completed. Design optimization of the proposed CCC Plant is possible through careful and considered implementation of the action items issued as a result of these risk analyses.

A fundamental conclusion of the assembled HAZID and FEED stage HAZOP teams is that, if the action items are implemented successfully, all identified risks can be mitigated to a level considered as low as reasonably practicable (ALARP).

Further study of the F&E properties of amine/water solutions is required at the outset of detailed engineering to conclusively determine their thermophysical characteristics. A determination of reduced combustibility may yield considerable opportunities to reduce active and passive fire protection requirements, extent of hazardous area classifications, and potential for additional unclassified areas.

Amine/water solutions under leakage conditions are not considered to present a credible explosion hazard or a potential for pool fire scenarios, except in concentrated form.

There is a significant risk to workers during a leakage in which CO_2 loss of containment occurs. Although extensive gas monitoring and PSD/ESD systems are employed, the CCC Plant represents a "first in kind" facility (in terms of size and scale) employing supercritical CO_2. The limited research available suggests that both thermal and toxic effects expose workers to potentially hazardous working conditions.

The CCC Plant FEED design includes features to monitor and manage emissions to the land, water, and air. The design considers the recycling of effluents to the process to minimize waste. Laboratory facilities need to be provided in the design to ensure that regulatory requirements documented in the Environmental Impact Assessment (EIA) and regulatory permits are adhered to.

13.4.2 Recommendations

FEED-stage recommendations offered for consideration during the detailed engineering stage are described in the following subsections.

13.4.2.1 Working Environment (i.e., Occupational Health)

The following additional assessment and narratives should be performed during detailed engineering:

- Occupational health risk analyses (JHA, chemical health risk assessment, comparison risk analysis)
- Ergonomic analyses (task analysis, crisis intervention and operability, valve and instrument access and operability)
- Occupational health design review report
- Material handling (cranes, hoists, etc.) assessment
- Illumination design philosophy
- Alarm management narrative

A formal Working Environmental Risk Assessment (WERA) study is also required, including an update of all WEACs resulting from actions identified in the WERA.

A full chemical risk analysis study is a design absolute during the appropriate phase of detailed engineering. The presence of amine degradation products and hazardous wastes creates an exposure risk to workers that must be fully evaluated to establish the appropriate risk level and to document and validate the preliminary labeling requirements of various wastes anticipated in the operation of the CCC Plant.

13.4.2.2 Noise and Vibration

Further detailed noise studies/assessments are needed during detailed engineering to model noise emissions that could endanger workers or the environment or affect permits for facility operations.

Established working environment area limits (WEALs) must be updated through the EPC phase and validated during the commissioning phase. Applicable limits for worker exposure are reflected on the FEED-stage WEACs.

13.4.2.3 Fire and Explosion Strategy

CCC Plant staffing is limited. Therefore, the FES does not envision plant employees serving in a firefighting role beyond providing incipient response or triggering manual call points located throughout the facilities.

Use of CCC Plant fire hydrants is restricted to the main Kårstø fire brigade, and all structural and large-scale firefighting activities must be coordinated through main site fire and emergency services.

Fire protection impairment management procedures and coordination with the main Kårstø site requirements require further definition during detailed engineering.

The response time and manpower from site-wide professional firefighting services must be further defined and documented in the FES when it is revised. For FEED, it is assumed that professional firefighting services are available for possible fire events and can respond with a trained fire brigade to a fire call in less than 5 minutes.

To address specific fire potentials (e.g., lube oil fire) consideration must be given to using prepackaged, skid-mounted fire suppression systems, such as high-momentum water mist for ordinary combustibles and liquid fires and inert gas systems for high-value concentration electronic equipment.

13.4.2.4 Escape, Evacuation, and Rescue Strategy/Escape Routes

The escape route arrangements for FEED must be validated with the site-wide EERS plans. This validation must ensure that the planning and development activities completed for FEED allow personnel to reach the designated mustering area from any part of the CCC Plant. Where gaps exist in this initial planning, corrections must be made.

Escape from elevated work surfaces requires further study during detailed engineering to establish the most effective and efficient means for workers to travel to grade and move to a safe distance from a developing event in a timely fashion. The overall philosophy should continue to employ the CCC Plant ring road as a primary egress path.

The coordination and triggering of a CCC Plant escape to the designated temporary muster point (TR) and a site-wide escape call from the CCR must be validated and documented.

The availability of emergency services (medical and extrication teams) must be confirmed during the initial stages of detailed engineering. The coordinated emergency response plan must include provisions to ensure that personnel can be safely removed for examination, first-aid, and transport to medical facilities.

Escape directions are considered preliminary and must be validated. The availability of egress to the CCPP Plant and site-wide muster point M6 must be ascertained and documented as soon as practicable during detailed engineering.

Due to operational requirements to perform field maintenance and intermittent work in confined spaces or above grade, rescue means need to be in place in the event of personnel injury. This emergency extrication planning is addressed in the JHA process developed during detailed engineering.

13.4.2.5 HAZID and FEED HAZOP (PHA)

All actions and recommendations entered into the recommendation registers for the HAZID and FEED HAZOP studies must be reviewed during the initial stages of detailed engineering to confirm that FEED recommendations have been closed out. Outstanding items on both registers must receive prompt attention for closure as soon as practicable.

13.4.2.6 Layout Safety (Issue for FEED Plot Plan)

Additional optimization of the layout should focus on further segregation of hazardous (i.e., amine/CO_2) process areas from unclassified (e.g., electrical building, control/workshop/stores building) and permanently/intermittently manned areas (e.g., control/workshop/stores building).

13.4.2.7 Hazardous Area Classification/Ignition Source Control

The likelihood of fire within the battery limits of the CCC Plant is greatly limited due to the limited combustibility of the MEA, concentrations present in the amine sections of the plant.

The plant preliminary area classification is based on application of classified equipment to gas Group IIA, temperature Class T2, specifications for all outdoor equipment. This classification needs to be validated during detailed engineering when absorption solvent thermophysical properties at process concentrations are confirmed.

The auxiliary boiler envisioned in the FEED design is considered a strong ignition source in the context of area classification. The availability of an additional steam supply (as a commodity) from a source outside the B/L and design optimization for when the boiler is no longer required must be studied to reduce the release level ignition probability to Level I per IP15, 3rd edition.

13.4.2.8 Emissions and Discharge

Feedback is required from the EIA conclusions to further define emissions and discharge limitations for CCC Plant operations.

Due to the plant's scale, additional process modeling of amine degradation products and wastes needs to be completed during the early stage of detailed engineering to more accurately determine the expected amine waste composition and quantities.

Additional emissions modeling is required to determine the effects of absorber exhaust stack emissions and fugitive sources to ensure that levels are below regulatory limits covering both the environment and worker exposure.

Open and closed drainage systems for spill and precipitation management must be validated during detailed engineering to ensure that the sizing requirements and treatment levels permit discharge to the seawater return point.

The site-wide disposal procedures (per Statoil Hydro document WR1839) must be coordinated to ensure that nonhazardous wastes are handled in a manner consistent with site requirements.

14.0-Operations and Maintenance

14.0 Operations and Maintenance

14.1 Operations Philosophy

The Kårstø CO_2 Capture and Compression (CCC) Plant system controls are accessible through the distributed control system (DCS) workstations located in the central control room (CCR). The control system design includes automatic control, with interlock functions to minimize operator actions. Operators are able to manually perform startup, operation, and shutdown functions, with sufficient interlocks to prevent unsafe operation. Abnormal or unsafe operating conditions initiate appropriate alarms, followed by subsequent plant shutdown. Restart requires operator initiation.

Plant operations are controlled from the CCR. The following key operator actions are required:

- System line-up and verification that equipment is ready for service prior to system start
- Line-up of off-line equipment
- Verification of manual valve (non-actuated) positions
- Verification of tank and vessel levels via sight glass or level gauge
- Operator initiation of plant start after trip or from standby condition
- Operator initiation of plant shutdown for standby (other than permissive/interlock condition)

The control room operator (CRO) operates the plant from the CCR. The CRO's duty station is normally at the main CCR control console. Shift operators assist in verifying system line-ups and equipment conditions as required and directed by the CRO.

14.2 Operations Training and Staffing

14.2.1 Training

The CCC Plant training program addresses the operation of the supplied equipment, including applicable theory. The training program is all-inclusive, addressing all plant systems and equipment, and provides the operating personnel with the required knowledge to operate the systems and the maintenance personnel with the required knowledge to properly maintain them. Personnel selected to participate in the program are generally limited to those who need such training to perform their duties. The typical training duration is approximately 4 weeks.

14.2.2 Operating Staff

CCC Plant operations are handled by shift operators, the CRO, the shift supervisor, and backup operators (shift positions). Additionally, the operations staff is complemented by a support staff (non-shift positions) handling plant administrative activities such as engineering; laboratory services; warehousing; accounting; human resources; and environmental, safety, and health.

The shift operators operate the physical plant equipment, including lining up systems (verifying valve positions for operation), verifying readiness of equipment, placing local control equipment in and out of service, and taking direction from the CRO for placing large equipment and systems in and out of service. Additionally, the shift operators assist in collecting data, administering the clearance program, doing light equipment maintenance (lubrication, strainer cleaning, general cleaning), and performing overall housekeeping.

The CRO operates and controls the overall plant, placing equipment and systems in and out of service via the DCS, directing shift operators with regard to systems operation, maintaining the detailed operations log, coordinating CCC Plant operation with the Naturkraft combined cycle power plant (CCPP), advising the CCPP of CCC Plant conditions, logging CCC Plant conditions, taking appropriate actions as necessary, administering the lock-out/tag-out (LOTO) and safety system, and issuing work authorizations and lockout tags and locks (clearances).

The shift supervisor manages the CRO and the operator mechanics, along with managing and administering day-to-day plant activities, including managing the schedule, procuring materials, preparing daily reports, approving logs, and so forth. The shift supervisor must be capable of performing the duties of the CRO and the shift operators and filling in on such duties when the need arises.

The plant engineer is a degreed chemical engineer who assists in interpreting supplier information, specifications, operating procedures, and additional instructions to the operators if deficiencies in such are found, as well as providing technical guidance in resolving identified problems. The plant engineer also provides guidance with respect to process details such as required chemicals, solvent conditions, and information on handling various chemicals and materials.

Refer to Figure 14.2-1, Kårstø Plant Staffing Chart.

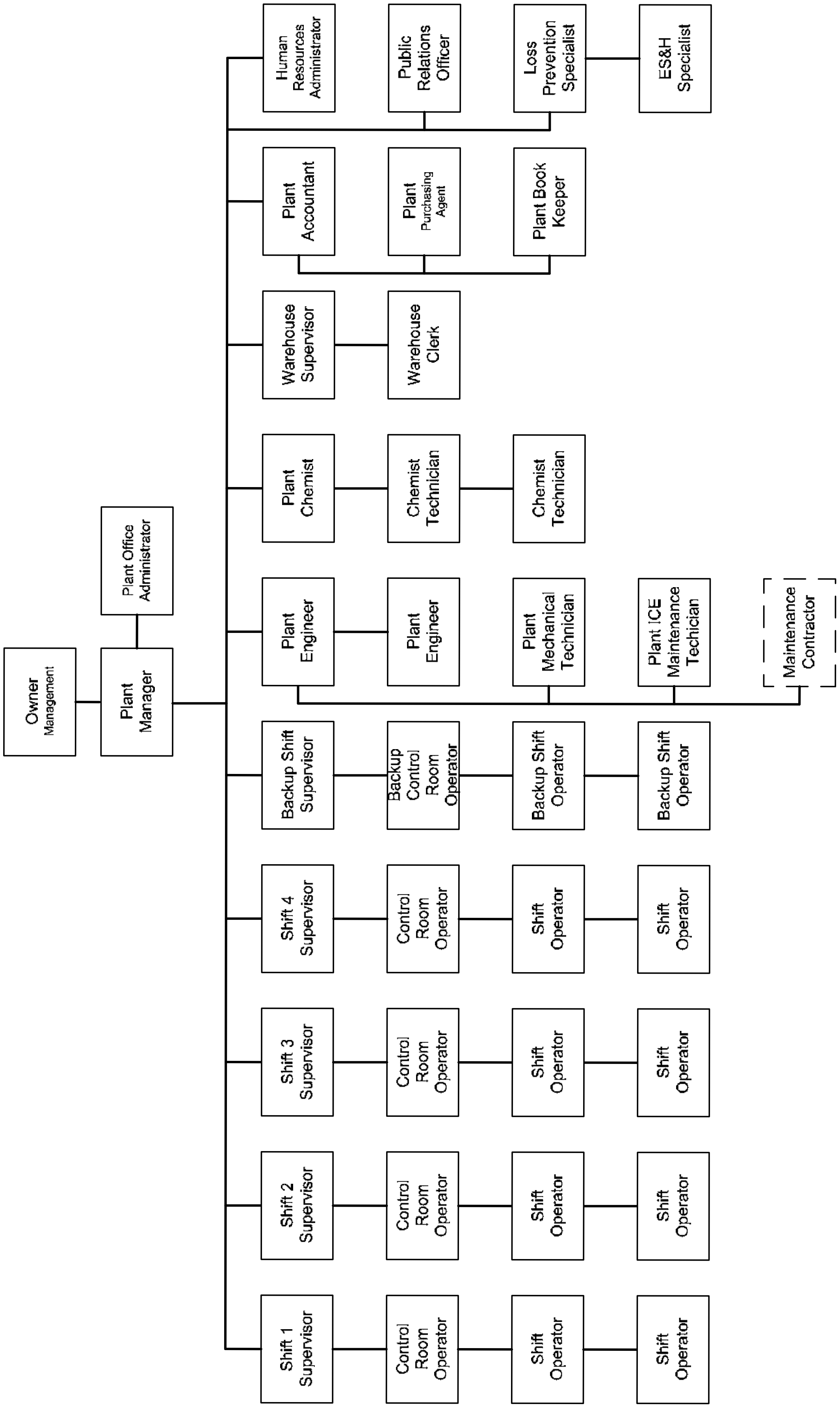


Figure 14.2-1 Kårstø Plant Staffing

14.3 Operations Particular Requirements

CCC Plant operational prerequisites are discussed in this subsection.

A LOTO and safety system for issuing system lockout tags and locks (clearances), work authorizations, and administration thereof, must be in place. The exact nature of the system is worked out by the parties involved, both inside and outside the plant battery limit (B/L).

Additional required administrative control procedures specific to operations and maintenance include:

- *Confined space entry*—This procedure covers monitoring hazardous materials and atmospheres in combined spaces, controlling and accounting for persons entering, and the safety measures that are to be in place.
- *Job hazard analysis*—This procedure covers the step-by-step analysis of potential hazardous tasks and the step-by-step mitigating measures to be taken.
- *Materials handling plan*—This procedure covers the measures to be in place to prevent spill or uncontrolled escape to the environment when handing chemicals, oils, waste, etc.

Experienced plant personnel who are outside the B/L must be trained in the plant-specific theory and operation of the equipment.

Plant equipment must be ready for operation, including turnover records documenting equipment commissioning. Monitoring equipment condition and maintaining equipment in a ready-to-operate condition are functions of personnel outside the B/L.

The CCPP and CCC Plant operations must be coordinated; this is an activity for personnel outside the B/L. Also, status data must be transmitted via link to the Naturkraft facility and the offshore injection wells.

14.4 Maintenance Philosophy

In general, planned CCC Plant maintenance is scheduled in accordance with original equipment manufacturer (OEM) recommendations. These recommendations are transferred from the supplier documentation to the maintenance list. The plant engineer is responsible for maintaining and updating the list with requirements as deemed appropriate by experience gained during operation.

In addition to their operations duties, the shift operators perform light-duty equipment maintenance (e.g., lubrication, cleaning, gasket replacement).

The personnel who perform routine maintenance are a mechanical technician for mechanical equipment and an instrumentation/ controls/electrical (ICE) technician for instrumentation and electrical items. Shift operators assist these technicians.

14.5 Maintenance Training and Staffing

Refer to Subsection 14.2.1 for a description of CCC Plant training.

The maintenance staff consists of the mechanical technician, the ICE technician, and the shift operators, who provide light maintenance and assist the technicians. Refer to Figure 14.2-1, Kårstø Plant Staffing Chart.

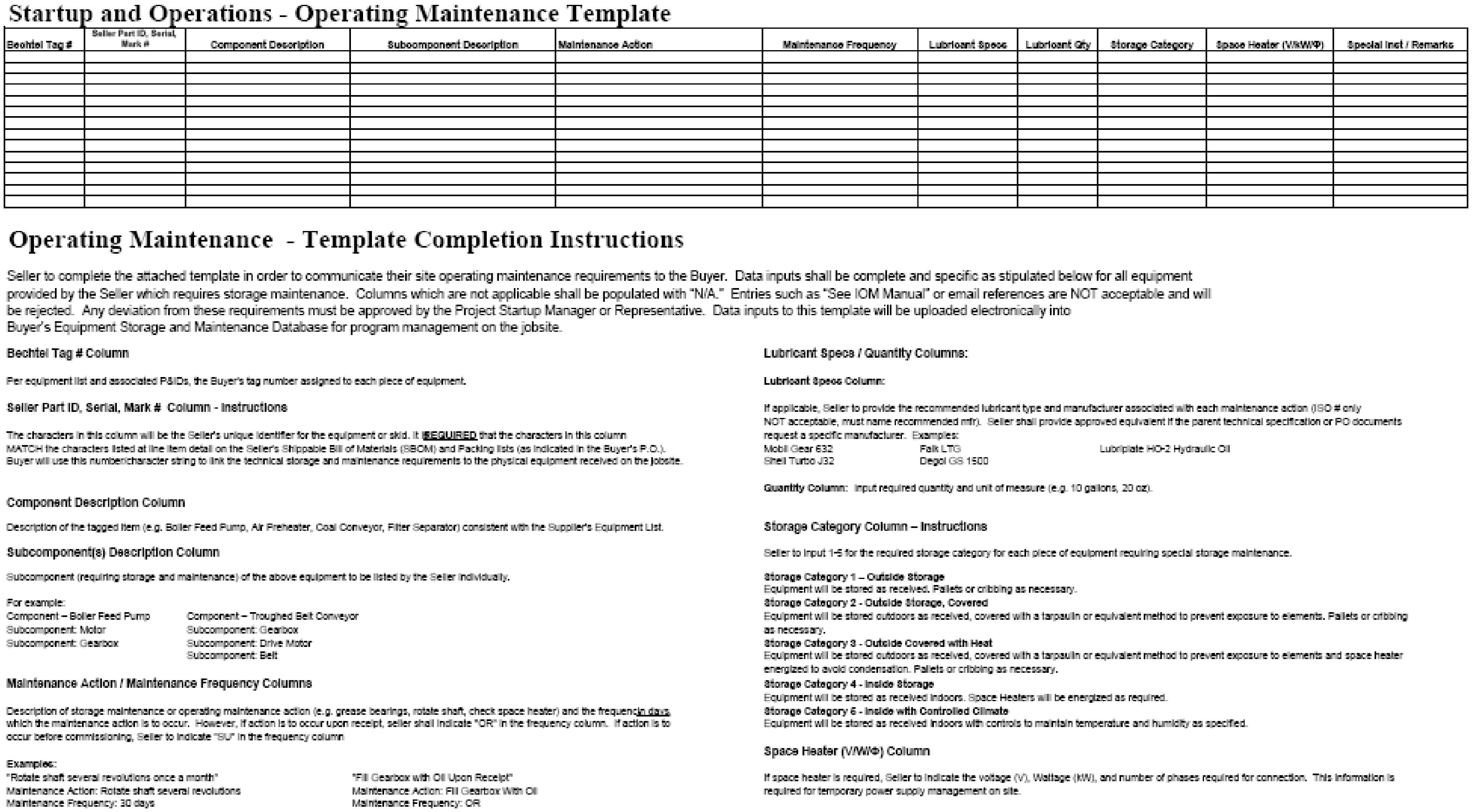
14.6 Maintenance Program Overview

In general, planned CCC Plant maintenance is scheduled in accordance with OEM recommendations. These recommendations are transferred from the supplier documentation to the maintenance list. The plant engineer is responsible for maintaining and updating the list with requirements as deemed appropriate by experience gained during operation. Refer to the sample maintenance template in Figure 14.6-1.

14.7 Spare Parts

Lists of recommended spare and wear parts for the CCC Plant are provided by the equipment suppliers within the B/L and are submitted for consideration of warehouse stock to be maintained outside the B/L. The exact format of the spare parts information collected is worked out by the parties involved, both inside and outside the B/L. Review of the recommended spare parts lists and purchase of parts in accordance with plant operation philosophy are outside the B/L.

Startup and commissioning spare parts necessary to commission the plant are provided inside the B/L through turnover to outside the B/L. In the project's interest, parts procured outside the B/L are generally made available for purchase or replacement in kind inside the B/L to supplement commissioning spares already available within the B/L.



Startup and Operations - Operating Maintenance Template

Bechtel Tag #	Seller Part ID, Serial, Mark #	Component Description	Subcomponent Description	Maintenance Action	Maintenance Frequency	Lubricant Specs	Lubricant Qty	Storage Category	Space Heater (V/kW/Φ)	Special Inst / Remarks

Operating Maintenance - Template Completion Instructions

Seller to complete the attached template in order to communicate their site operating maintenance requirements to the Buyer. Data inputs shall be complete and specific as stipulated below for all equipment provided by the Seller which requires storage maintenance. Columns which are not applicable shall be populated with "N/A." Entries such as "See IOM Manual" or email references are NOT acceptable and will be rejected. Any deviation from these requirements must be approved by the Project Startup Manager or Representative. Data inputs to this template will be uploaded electronically into Buyer's Equipment Storage and Maintenance Database for program management on the jobsite.

Bechtel Tag # Column

Per equipment list and associated P&IDs, the Buyer's tag number assigned to each piece of equipment.

Seller Part ID, Serial, Mark # Column - Instructions

The characters in this column will be the Seller's unique identifier for the equipment or skid. It **REQUIRED** that the characters in this column MATCH the characters listed at line item detail on the Seller's Shippable Bill of Materials (SBOM) and Packing lists (as indicated in the Buyer's P.O.). Buyer will use this number/character string to link the technical storage and maintenance requirements to the physical equipment received on the jobsite.

Component Description Column

Description of the tagged item (e.g. Boiler Feed Pump, Air Preheater, Coal Conveyor, Filter Separator) consistent with the Supplier's Equipment List.

Subcomponent(s) Description Column

Subcomponent (requiring storage and maintenance) of the above equipment to be listed by the Seller individually.

For example:

Component – Boiler Feed Pump	Component – Troughed Belt Conveyor
Subcomponent: Motor	Subcomponent: Gearbox
Subcomponent: Gearbox	Subcomponent: Drive Motor
	Subcomponent: Belt

Maintenance Action / Maintenance Frequency Columns

Description of storage maintenance or operating maintenance action (e.g. grease bearings, rotate shaft, check space heater) and the frequencin days, which the maintenance action is to occur. However, if action is to occur upon receipt, seller shall indicate "OR" in the frequency column. If action is to occur before commissioning, Seller to indicate "SU" in the frequency column

Examples:

"Rotate shaft several revolutions once a month"	"Fill Gearbox with Oil Upon Receipt"
Maintenance Action: Rotate shaft several revolutions	Maintenance Action: Fill Gearbox With Oil
Maintenance Frequency: 30 days	Maintenance Frequency: OR

Lubricant Specs / Quantity Columns:

Lubricant Specs Column:

If applicable, Seller to provide the recommended lubricant type and manufacturer associated with each maintenance action (ISO # only NOT acceptable, must name recommended mfr). Seller shall provide approved equivalent if the parent technical specification or PO documents request a specific manufacturer. Examples:

Mobil Gear 632	Falk LTG	Lubriplate HO-2 Hydraulic Oil
Shell Turbo J32	Degol GS 1500	

Quantity Column: Input required quantity and unit of measure (e.g. 10 gallons, 20 oz).

Storage Category Column – Instructions

Seller to input 1-5 for the required storage category for each piece of equipment requiring special storage maintenance.

Storage Category 1 – Outside Storage
Equipment will be stored as received. Pallets or cribbing as necessary.
Storage Category 2 - Outside Storage, Covered
Equipment will be stored outdoors as received, covered with a tarpaulin or equivalent method to prevent exposure to elements. Pallets or cribbing as necessary.
Storage Category 3 - Outside Covered with Heat
Equipment will be stored outdoors as received, covered with a tarpaulin or equivalent method to prevent exposure to elements and space heater energized to avoid condensation. Pallets or cribbing as necessary.
Storage Category 4 - Inside Storage
Equipment will be stored as received indoors. Space Heaters will be energized as required.
Storage Category 5 - Inside with Controlled Climate
Equipment will be stored as received indoors with controls to maintain temperature and humidity as specified.

Space Heater (V/W/Φ) Column

If space heater is required, Seller to indicate the voltage (V), Wattage (kW), and number of phases required for connection. This information is required for temporary power supply management on site.

Figure 14.6-1 Sample Maintenance Template

Spare parts are categorized into four classes:

- *Startup/commissioning spare parts* may be required at any time during equipment installation, precommissioning, commissioning, startup, and testing.
- *Operating spare parts* are required to maintain continuous operation of the supplied equipment and/or system and to replace those parts and components that fail due to operation. The operating spare parts cover the range of parts required to be on hand and available to effect highly reliable equipment operation for a period of 3 years.
- *Capital spare parts* are major parts and equipment components and subsystems required to provide reliable equipment operation throughout the plant life and have a significant lead time for manufacture and delivery. Capital spare parts are major replacement parts or complete units or sets of equipment essential to the continuity of operations. Capital spare parts are considered long-term investments and are not required to be available during the commissioning period. Capital spare parts are acquired outside the B/L on a case-by-case basis based on economic considerations.
- *Special tools* are tools, instruments, devices, human machine interfaces (HMIs), and software necessary to calibrate, set up, precommission, commission, start up, operate, and maintain the equipment within the scope of supply. Special tools do not include items found in a normal maintenance facility.

14.8 Consumables

The CCC Plant consumables listed in Table 14.8-1 include utilities and major materials. Not included is a breakdown of minor lubricants (such as for hinges, rollup doors, etc.), machining oils, incidental cleaning agents and solvents, rags, fasteners, gaskets, grinding disks, etc. The values in the table are preliminary pending detailed design after front-end engineering and design (FEED). The types, material specifications, condition specifications, additional requirements, etc., are also preliminary pending detailed design after FEED.

Table 14.8-1 List of Consumables

Description Consumable	Unit of Measurement	Estimated Consumption Rate	Intermittent/ Continuous	Remarks
Electrical Power	kW	~44,000	Continuous	Full production, maximum operation
Steam	tonnes/hr	200 LP	Continuous	165 LP from CCPP and 15 LP from CCC Plant auxiliary boiler

Description Consumable	**Unit of Measurement**	**Estimated Consumption Rate**	**Intermittent/ Continuous**	**Remarks**
Steam	tonnes/hr	12 HP	Intermittent	from CCPP auxiliary boiler
Seawater Cooling	m^3/hr	17,340	Continuous	
Fuel Gas	kg/hr	1,500	Continuous	
Compressed Air	Nm^3/hr	185	Continuous	Produced by onsite compressor
Amine Process Solvent	m^3/year	1,400	Continuous	Makeup for emission losses via makeup metering pump and storage tank
Amine Cartridge Filter Element	each/year	300	Intermittent	Change once per 3 to 6 months
Activated Carbon	tonnes/month	< 40	Intermittent	500 kg/m^3 bulk
Nitrogen Gas	Nm^3/hr	85	Continuous	
Soda-Ash Solution (106 G/Mole)	kg per reclaim batch	1700	Intermittent	When reclaimer is operated
Reverse Osmosis Antiscalant	kg/month	< 100	Continuous	For process demineralized water makeup from seawater
Reverse Osmosis Membrane Elements	each/3 years	approx. 30	Intermittent	48-in. SWRO elements
Reverse Osmosis Cartridge Filter Elements	each/year	30	Intermittent	Change once per 6 months
Diesel Fuel	liter/yr	< 1000	Intermittent	Backup generator use only; main consumption = monthly testing
Blower Fan Lubricant	liters/yr	< 500	Intermittent	
CO_2 Compressor Lubricant	liters/yr	< 1000	Intermittent	
Centrifugal Pump Bearing Case Lubricant	liters/yr	< 500	Intermittent	
Bearing/Joint Lubrication Grease	kg/month	< 10	Intermittent	Several types required
Miscellaneous Lubricant/Grease	kg/month	< 1	Intermittent	Several types required
Potable Water	m^3/day	5 to 10	Continuous	Potable users
Analyzer Reagents	lot	during detailed design	Intermittent	
Test Lab Reagents	lot	during detailed design	Intermittent	

15.0-Cost Estimate

COST INFORMATION REFERENCED IN THE EXHIBITS NOTED IN THIS SECTION CAN BE FOUND IN APPENDICES A, B, & C AT THE END OF THIS REPORT

15.0 Cost Estimate

15.1 CAPEX Estimate

15.1.1 General

The Capital Cost Estimate (CAPEX) is provided in document Number 10112936-PB-G-CRE-0001.

The estimate has been prepared in accordance with the requirements of the following Contract Documents:

- Exhibit E1.1: Requirements for Cost Estimates and Capture Cost Calculation
- Exhibit E1.2: Cost Breakdown Structure

The CAPEX has been prepared to an accuracy of ± 20% as required in the Contract documents. The Cost Breakdown Structure (CBS) described in document E1.2 was used.

A cost risk analysis was performed, and the summary is provided in the referenced document.

The following sections provide additional information on the CAPEX and risk analysis.

15.1.2 Pricing Basis

The estimate costs are based on 4th Quarter 2008 prices. Escalation through commercial operation is included.

15.1.3 Exchange Rate

The currency exchange rate used for the estimate is 1 USD = 5.3 NOK, which is in accordance with the requirements of Exhibits E1.1 and E1.2.

15.1.4 Contingency

Contingency is not included in the Contractors Cost. The Contingency analysis was undertaken as part of the risk analysis.

15.1.5 Qualifications and Assumptions for CAPEX

The following qualifications and assumptions apply to the CAPEX estimate:

- The site is clean, free of hazardous materials, level, and free of any obstructions above or below grade.
- The estimate is only for material within the plant battery limits (B/L) shown on the general arrangement drawing, except for the flue gas duct, electrical power tie-ins, seawater cooling pumps, and cooling water pipe.
- Since the site is an existing operating plant with a wharf, it is possible to receive shop-fabricated, large-diameter tanks and vessels. Access to the project site is possible without any modifications to the route.
- The existing stack can accept the modifications to support the CCC Plant flue duct and stack damper.
- The seawater pump structure accommodates the selected pumps, and the cooling water pipe connection design and routing can be accommodated.
- Construction power and water are to be provided by the Owner.
- Soils conditions allow for spread footing design.
- Adequate construction access is available on all sides of the proposed site except the west side.
- CCC Plant lighting and small power distribution are limited to the B/L.
- All pre-existing hazardous materials are to Owner's account.

15.1.6 Exclusions from CAPEX

The following items are excluded from the CAPEX cost estimate:

- Contingency
- Escalation
- Liquidated damages (LD) insurance
- Builders risk and marine cargo insurance
- Required payment securities
- Environmental wetland and endangered species protection is excluded.
- All construction and environmental permits (to be obtained by Owner)

- Camp costs
- Value-added taxes (VATs) and import duties, where applicable, which are pass throughs
- Licensing or royalty fees associated with proprietary processes/ equipment/chemicals (none identified for base case)
- Capital spare parts
- Work associated with demolition at the site
- Furniture or laboratory equipment
- Duties, permits, and taxes
- Modifications to existing utilities, equipment, and facilities
- Onsite accommodations for craft housing

15.1.7 CAPEX Cost Contingency and Risk Analysis

The Bechtel Risk Analysis Contingency (BecRAC) software was used for the contingency and risk analysis. The summary sheet of the results from the analysis is provided in document Number 10112936-P-G-CRE-0001.

The Contingency derived from the analysis is not included in the overall CAPEX estimate for the project.

15.2 OPEX Estimate

15.2.1 General

The OPEX estimate is provided in document Number 10112936-PB-G-CRE-0002.

The OPEX estimate was prepared in accordance with the requirements of the following Contract Documents:

- Exhibit E1.1: Requirements for Cost Estimates and Capture Cost Calculation
- Exhibit E1.2: Cost Breakdown Structure

The Operating Expenditure (OPEX) Cost Estimates has been prepared to an accuracy of ± 20% as required in the Contract documents.

15.2.1 Data used in developing OPEX

The following is a summary of the basis of the data used in the OPEX estimate:

- Average use time

  The average use time for utility consumption is estimated at 8105 hours per year. This includes allowances for CCPP outages and the 97% capacity factor for the CCC plant.

- Utility consumption

  Usage rates are based on the base case open-art design.

  Unit prices are provided from Gassnova except for the price of condensate, which is estimated based on our past experience.

- Consumables

  Usage rates are based on the base case open-art design.

  Unit prices are obtained from Bechtel pricing database.

- Staff

  Staffing levels are as outlined in the Bechtel[redacted] document submittal 10112936-PB-O-DOC-0004 (Operating Staff Concept).

- Maintenance cost

  This is estimated as a percentage of capital costs, as is typical for a FEED estimate.

- Spare and wear parts

  This is estimated as a percentage of equipment costs, except for absorber packing, which is estimated separately based on input from packing suppliers.

- Service cost to Gassco

  A cost of 8000,000 NOK/y is input per Section 2.0 of Exhibit E1.1.

- Special waste

  Usage for activated carbon and reclaimer sludge is based on the base case open-art design. Unit price is based on vendor pricing data.

- Service agreement with Naturkraft

  This cost is to be determined by Gassnova per Clause E2.2 of Exhibit E1.2.

- Taxes

  This cost is to be determined by Gassnova per Clause E2.2 of Exhibit E1.2.

- Land leasing cost

  This cost is to be determined by Gassnova per Clause E2.2 of Exhibit E1.2.

- Other costs

  An administration cost of 10,000,000 NOK/y is input per Section 2.0 of Exhibit E1.1.

15.2.2 OPEX Sensitivity/Risk Analysis

The data on the OPEX Sensitivity/risk analysis is included in the CO_2 Capture Cost Calculation, document Number 10112936-PB-G-CRE-0003

15.3 Input to CO_2 Capture Cost Estimate

15.3.1 General

The CO_2 Capture Cost Calculation is not a required deliverable in the Exhibit A1 contract documents. However, we believe it would be useful to Gassnova and have therefore prepared the calculation and issued it under document Number 10112936-PB-G-CRE-0003.

The CO_2 Capture Cost Calculation was undertaken using our own financial model. It uses an approach similar to the provisional calculation model provided by Gassnova as an attachment to Exhibit E1.1.

The calculation is undertaken for the base case open-art MEA design.

15.3.2 Information Included and Excluded from the Model

The model calculates the CO_2 capture cost (NOK/tCO_2) based on data from the following cost estimates for the CCC Plant:

- Capital cost (CAPEX)—See document Number 10112936-PB-G-CRE-0001
- Operating costs (OPEX)—See document Number 10112936-PB-G-CRE-0002

The following information is not included in the calculation:

- Gassnova's OPEX costs which are defined as "By Gassnova" in Exhibit E1.2

- Capital cost contingency and all other items excluded from the CAPEX estimate
- Insurance
- Capital or operating costs for any work to be performed outside of the B/L by Gassnova

15.3.3 Assumptions Used in Model

The following assumptions were used in creating the model:

- Project lifetime of 25 years
- Data provided in Exhibit E1.1 to determine the level of planned and unplanned outages for the Naturkraft CCPP. These vary year by year, and this is reflected in the model (for information, the availability averages 95.4% over the 25 year period).
- A capture plant on-stream factor of 97% for the design case (100% load of power plant) relative to the CCPP availability
- A production year of 8760 hours. Actual operation hours are calculated using CCPP availability and the CCC Plant on-stream factor for each year.
- Exchange rate of NOK/USD: 5.3 (per Exhibit E1.1)
- Discount rate (NPV) of 8%
- For simplicity, a construction schedule done on an annual basis. Because the NPV calculation is done on an annual basis, little is gained by splitting construction numbers into a monthly level of detail.
- Changes in working capital added to operating expenses to get a more accurate representation of cash flows. Working capital includes changes in operating cash and changes in accounts payable.

15.3.4 Sensitivity Analysis

Sensitivity analyses were performed for the NPV unit cost (NOK/t) and the NPV of total cost. The output is presented in terms of a "tornado" chart, with the higher impacts shown at the top of the chart.

The parameters listed in section 6 of Exhibit E1.1 were assessed along with other parameters identified by the Contractor.

16.0-Construction, Commissioning, and Execution

16.0 Construction, Commissioning, and Execution

16.1 Construction Approach and Overview

The overall construction methodology for the Kårstø CO_2 Capture and Compression (CCC) Plant can be described largely as a modularization approach with some preassembly and stick-built construction. Most of the plant equipment is a prime candidate for modularization. The approach for the tie-in work within the Naturkraft combined cycle power plant (CCPP)—a combination of preassembly and stick-built construction—is driven by the need to perform pre-outage work during CCPP operation.

Construction management services provide oversight of all construction operations. At peak, the management staff is composed of non-manuals who are a mix of expatriates and local resources. Qualified subcontractors execute the construction under the direction of the construction management team. This team and subcontractor personnel are housed in camp accommodations.

At notice to proceed, the site is assigned for initial civil earthwork activities. Clearing/grubbing and mass earthwork for the site are performed prior to mobilization. Although the site is provided at a designated elevation, the existing terrain requires rock blasting to excavate for the deep underground utilities. As blasting operations are completed and underground utilities are installed, the foundation form, rebar, embeds, and concrete placement (FREP) activities commence.

Pre-cast concrete cable trenches, manholes, and catch basins are used to the extent possible to minimize the amount of poured-in-place concrete required for these items. A mud mat of lean concrete is placed on the bottom of excavations for large foundations to provide protection from the weather and groundwater seepage, to provide a good working surface for anchoring formwork, and to provide a bearing surface for chairs to support the reinforcement steel. Enclosures such as tents are used for protection during winter weather concrete placements. A multi-use concrete forming system is used for all cast-in-place concrete. Anchor bolts, metal embeds, and reinforcement steel are detailed and prefabricated by vendors off site. In a preassembly area, rebar mats and cages are pre-tied and the formwork pre-ganged into the largest sections that can be safely handled and brought to the foundation for installation. A temporary concrete batch plant is used for concrete supply. The bulk of ready-mix concrete is placed by chute directly from trucks and supplemented by the use of buckets and/or concrete pumps for large or elevated placements. Admixtures such as fly ash, plasticizers, accelerators, and retarders are included in the mix designs to improve the workability of the concrete.

Prior to starting detail design, the Engineering and Construction groups assess the potential areas for modularization, along with the associated cost and schedule benefits. Long-lead critical path items such as the absorber and stripper columns are fabricated at an offsite manufacturing facility, then shipped to the Kårstø Gas Plant Anleggsdai Jetty. Each column arrives preassembled to the extent possible to minimize field erection time and permit immediate setting. The columns are offloaded using heavy shipping vessel cranes and delivered to the site via the designated module transport road. These large vertical columns are then dressed out with ladders, platforms, piping, instruments, lighting fixtures, and raceways to the extent possible at grade and set using heavy lift cranes.

Pipe racks are designed and procured in modularized sections. These modular units are delivered with piping, valves, hangers, and cable tray installed on the rack. The modules are shipped to the Anleggskai Jetty for transport along the module transport road via a self-propelled motorized transporter.

Miscellaneous structural steel is fabricated and painted at the steel supplier's fabrication facility. Structural steel requiring fireproofing is coated at the fabrication facilities, and touchup is performed after installation. Structural steel walkways and ladders are shipped with the steel to aid in erection.

The compressor building and flue gas blower enclosures are pre-engineered structures, whereas the electrical/switchgear and control buildings are design/install structures. These buildings require a stick-build construction approach.

The major mechanical equipment (reboiler, reclaimer, pumps, heat exchangers, tanks, filters) are designed and procured and issued to the construction subcontractor. Interconnecting piping, valves, hangers, electrical components, instruments, and other components are free-issued to the construction subcontractor. Installation of these components is sequenced in conjunction with the delivery of the absorber and stripper columns.

The tanks and analyzer building are also manufactured off site. The analyzer building is a prefabricated structure manufactured with all of its internal equipment installed at the manufacturing facility. The analyzer building and tanks are shipped to the Karsto Gas Plant Anleggskai Jetty for offloading and transporting to the site.

All equipment, including heat exchangers, pumps, compressors, motors, lube oil skids, and filters, is delivered to the jobsite, then assigned to the construction subcontractor to perform required preventive maintenance.

Large-bore-diameter welded piping is shop-fabricated, including welded attachments such as shoes and dummy legs, and, if required, finish painting is performed off site. The individual spools are preassembled at grade into the largest subassemblies that can be safely and efficiently handled. Most of the field welding of carbon steel and stainless piping uses the shielded metal arc welding (SMAW) process. The field welding of thin-wall and stainless steel piping uses the tungsten inert gas (TIG) process, supplemented by a flux-cored arc welding (FCAW) process for large-bore pipe. FCAW and/or SMAW are used for structural welding requirements. Welders are qualified in accordance with applicable codes. Nondestructive examination (NDE) work is coordinated with other activities to use breaks, lunch, and shift changes whenever possible. However, most of this work is performed during off hours, i.e., nights and weekends.

Electrical work, including final calibration and testing of the equipment, is performed at the jobsite. The plant lighting system is installed early and uses temporary power to provide lighting during construction. Inline instruments, such as control valves, orifice flanges, sight glasses, instrument bridles, and heat tracing, are installed with the piping. Instruments are factory calibrated by the vendor, have certification papers shipped with the instrument, and do not require field bench testing.

To minimize the use of scaffolding, manlifts are used to the extent possible. In addition, preassembly at grade is performed to the extent possible prior to equipment erection. Subcontractors are responsible for supplying and erecting their own scaffolding.

When construction is approximately 70% complete, the focus changes from construction by area to completion by system. The civil and structural work are substantially complete, the equipment is set, and most of the large-bore piping is installed. The project schedule is driven by the mechanical completion and precommissioning requirements. The startup coordinator, assisted by the project field engineer, defines, scopes, and assembles the system completion and turnover packages.

As the piping installation, hydrotesting, and equipment erection are completed and the density of craft personnel and construction equipment is reduced within each area, the balance of the painting and insulation work is completed. The pipe racks are completed first, followed by the process and utility areas. After the installation of the equipment and piping has been completed, the final road paving, site grading, and cleanup are done. The temporary construction facilities are demobilized progressively as they are no longer needed.

Startup and commissioning activities are performed with the assistance of subcontractor construction craft and/or specialized technicians. Design-related problems discovered during the mechanical completion, startup, and commissioning processes are resolved by the Engineering group. Subcontractors perform any required field modifications arising from the technical resolution of design-related problems.

16.2 Constructability Reviews

A construction representative was assigned to the CCC Plant FEED Study during preliminary design, and constructability reviews were initiated. The construction representative provides early detailed construction planning in coordination with engineering design and procurement activities. Front-end construction planning is the start of the constructability program that addresses and incorporates the following:

- Safety
- Quality
- Timely completion
- Productivity
- Environmental
- Cost-effectiveness
- Operability
- Maintainability
- Reliability
- Special project concerns

This front-end planning and integration of construction knowledge and experience into the planning, design, and engineering process are the greatest benefits of the constructability program.

Constructability reviews performed for the heat recovery steam generator (HRSG) stack tie-in determined that the limited 4-week outage window is not sufficient to complete the tie-in scope of work. Further reviews determined which construction activities can be performed prior to the outage. These are detailed in Constructability Study 10112936-PB-O-DOC-0001 (25474-000–4CR–T01G–00001).

Constructability reviews performed to ensure that no operational disruptions occur from working within the operating CCPP during pre-outage construction led to the decision to use a stick-build and preassembly approach as the preferred construction method.

Another key constructability issue related to the stack tie-in is the ability to isolate the flue gas ductwork system upstream of the absorber towers. An evaluation of the potential impacts to construction led to the decision to ensure that the guillotine dampers are installed during the pre-outage scope of work. The dampers are installed and tested pre-outage to ensure that the flue gas can be isolated once the tie-in is made. This permits construction and testing activities to continue on all equipment downstream of the dampers.

As preliminary design for the amine and compression portions of the plant proceeded, the Construction and Engineering groups jointly performed constructability reviews for these areas. Delivery dates have been established for the long-lead equipment, and the construction sequence is designed with the late deliveries in mind.

A significant activity during the civil phase of work is the removal of rock for seawater piping, foundations, and underground utilities. Rock blasting is a critical path activity. Constructability reviews of the seawater cooling line installation revealed the need to avoid planning for the use of heavy rigging cranes on top of these lines. Consequently, the heavy lift sequences have been modified to avoid the seawater lines.

The identification of delivery dates for the absorber and stripper towers allowed the rigging sequence for related ductwork and pipe racks to be established. Reviews of the ductwork and pipe racks confirmed that modularizing to the extent possible minimizes congestion within the construction area. Therefore, the rigging plans developed ensure that sufficient space is available to set each heavy lift. The constructability reviews also identified the need to install temporary haul roads along the north side of the site. These temporary modifications are required beyond the designated site boundary.

After the absorbers and stripper towers are set, the installation of large bore pipe commences. An important constructability issue is crane access around the towers during pipe installation. Therefore, areas with restricted access are a primary focus early in the piping phase. Piping around the absorber and stripper towers is sequenced prior to setting the pipe racks.

Through constructability reviews, a sequencing plan has been prepared for installing the modularized pipe racks once the platform, ladders, and down-comer piping are installed around the towers. The rack pipe and electrical commodities are interconnected as soon as the modules are set.

The modularized construction approach helps minimize the number of construction craft workers required on this restricted construction site. While the towers and racks are being modularized and shipped, the balance of plant facilities can be constructed. This includes the electrical switchgear building, control/workshop/stores building, and compressor building. The equipment is placed within each facility, and piping and cable pulling begins once the buildings are sufficiently enclosed.

The compressors are long-lead critical equipment. Constructability reviews revealed that the building design needs to accommodate late delivery of the compressors. Plant construction is complete before this equipment arrives. Compressor sections are transported into the building through the roll-up door and rigged onto the foundation. This approach permits the bulk of the building to be constructed without the compressors.

The final construction phase is construction testing of the various systems. A system turnover plan is developed early in the project, and the construction plan incorporates this turnover plan.

16.3 Commissioning Approach

16.3.1 Cold Commissioning

Once a system is mechanically complete, the Construction group turns it over to the Startup group to begin cold commissioning. A system's acceptance by Startup constitutes its mechanical completion and indicates that it is ready to be commissioned.

Once a system has been accepted by Startup, it is green-tagged, and cold commissioning activities then begin, followed by commissioning and startup (hot commissioning phase). This is also generally known as the startup phase.

The Project Startup Manual describes the startup process, including, but not limited to, administrative and technical procedures, detailed commissioning schedule, organization chart, and definition of the subdivision of the plant into discrete portions to facilitate phased turnover from Construction to Startup.

Standard test and commissioning procedures (STCPs) are used to perform cold commissioning, which is carried out in a manner compliant with NORSOK Z007 standard. Refer to Mechanical Testing and Completion Schedule 28474-000-583-U07G-00001.

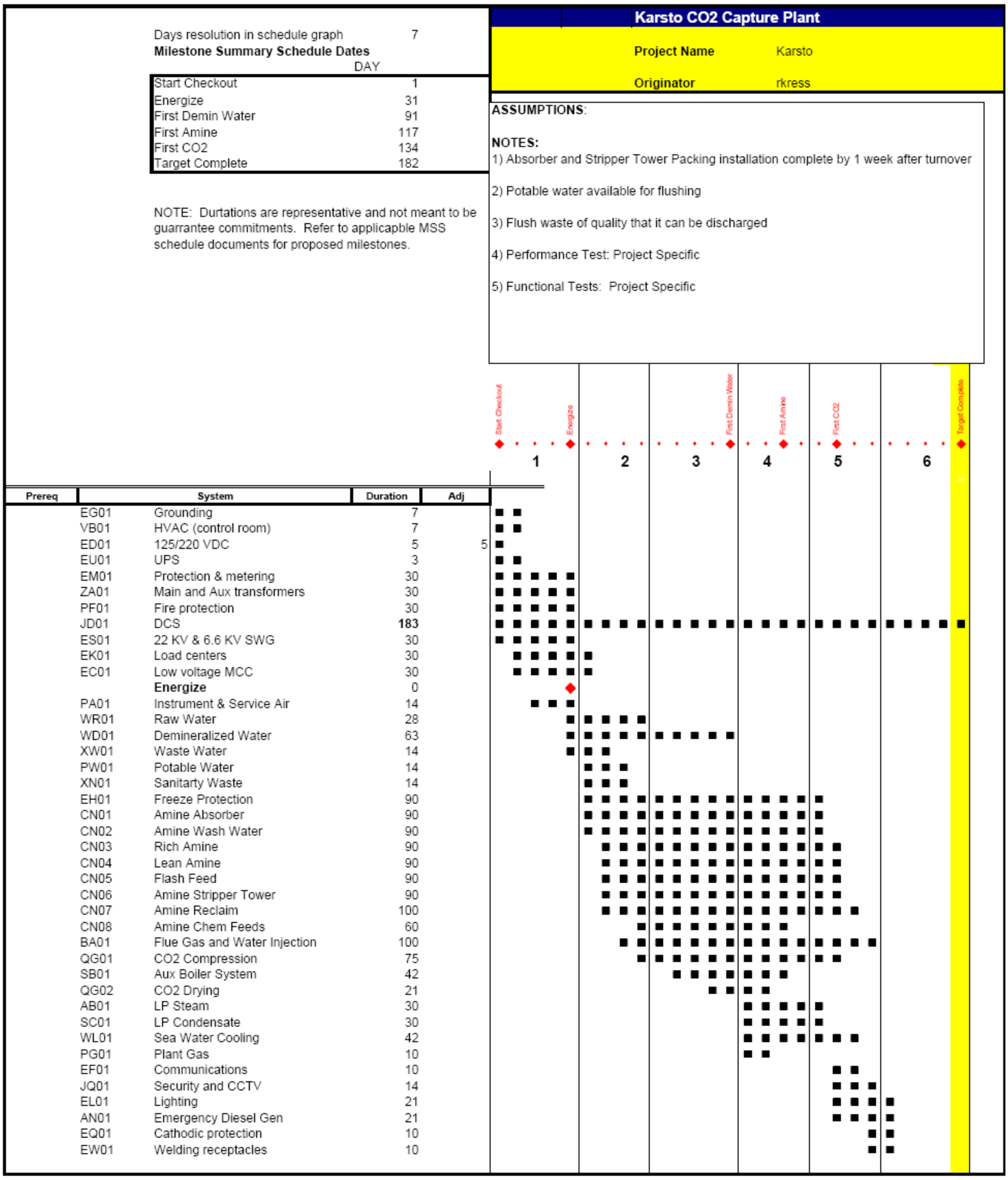
Permanent plant operations personnel assist with cold commissioning activities, which provides them their initial on-the-job training (OJT).

In addition to planning and scheduling, Startup performs the following tasks during this phase:

- Monitor precommissioning activities
- Inspect construction records
- Check equipment/systems and prepare preliminary punch lists
- Verify that mechanical completion checks have been performed
- Prepare all necessary inspection records and test certificates; ensure that all documentation is in place to allow systems to progress to the commissioning phase
- Generally expedite the transition from precommissioning to commissioning
- Monitor vendor representative activities so that personnel are used efficiently and contribute effectively to the vendor training program, both in the classroom and in the field
- Perform final inspection of vessels and other equipment internals on a selected basis and close and leak test such vessels and equipment where applicable (Final inspection of some vessels may take place in the initial stage of the commissioning phase.)
- Perform final cleanliness inspection prior to closing key piping

Plant equipment is accepted from Construction on a system-by-system basis for start of cold commissioning. Figure 16.3-1, Systems Turnover, depicts a representative series of turnovers from Construction to Startup for the Kårstø project. Durations shown are rough approximations of the duration of all aggregate commissioning activity for a given system.

Figure 16.3-2, Cold Commissioning Activities, lists typical activities undertaken during cold commissioning, along with the applicable STCPs.



Days resolution in schedule graph 7

Milestone Summary Schedule Dates

	DAY
Start Checkout	1
Energize	31
First Demin Water	91
First Amine	117
First CO2	134
Target Complete	182

NOTE: Durtations are representative and not meant to be guarrantee commitments. Refer to applicapble MSS schedule documents for proposed milestones.

Karsto CO2 Capture Plant

Project Name Karsto

Originator rkress

ASSUMPTIONS:

NOTES:

1) Absorber and Stripper Tower Packing installation complete by 1 week after turnover

2) Potable water available for flushing

3) Flush waste of quality that it can be discharged

4) Performance Test: Project Specific

5) Functional Tests: Project Specific

Prereq	System		Duration	Adj
	EG01	Grounding	7	
	VB01	HVAC (control room)	7	
	ED01	125/220 VDC	5	5
	EU01	UPS	3	
	EM01	Protection & metering	30	
	ZA01	Main and Aux transformers	30	
	PF01	Fire protection	30	
	JD01	DCS	**183**	
	ES01	22 KV & 6.6 KV SWG	30	
	EK01	Load centers	30	
	EC01	Low voltage MCC	30	
		Energize	0	
	PA01	Instrument & Service Air	14	
	WR01	Raw Water	28	
	WD01	Demineralized Water	63	
	XW01	Waste Water	14	
	PW01	Potable Water	14	
	XN01	Sanitarty Waste	14	
	EH01	Freeze Protection	90	
	CN01	Amine Absorber	90	
	CN02	Amine Wash Water	90	
	CN03	Rich Amine	90	
	CN04	Lean Amine	90	
	CN05	Flash Feed	90	
	CN06	Amine Stripper Tower	90	
	CN07	Amine Reclaim	100	
	CN08	Amine Chem Feeds	60	
	BA01	Flue Gas and Water Injection	100	
	QG01	CO2 Compression	75	
	SB01	Aux Boiler System	42	
	QG02	CO2 Drying	21	
	AB01	LP Steam	30	
	SC01	LP Condensate	30	
	WL01	Sea Water Cooling	42	
	PG01	Plant Gas	10	
	EF01	Communications	10	
	JQ01	Security and CCTV	14	
	EL01	Lighting	21	
	AN01	Emergency Diesel Gen	21	
	EQ01	Cathodic protection	10	
	EW01	Welding receptacles	10	

Figure 16.3-1. Systems Turnover

	5	6	7	8	9
A		Install temporary commissioning test equipment as required	Complete preparations for flushing, chemical cleaning, steam and blows	Perform flushing, chemical cleaning, steam and air blows	Install all orifice plates
B	Calibrate and test instruments	Initially energize and test control loops		Stroke control valves/dampers, etc.	
C	Install temporary pipe for flushing and cleaning	Perform API valve tightness test		Inspect temporary strainers and differential gauges	Perform equipment oil flushes
D	Schedule vendors for functional testing	Load catalyst and chemicals and close up	Provide chemistry consulting services	Load initial charge of resins, filter media, chemicals, etc.	Make all support utilities available
E	Calibrate/test meters, relays, CTs, PTs, and secondary circuits	Perform additional cable and equipment hi-pot/megger tests as required	Test power transformers and major electrical equipment	Initially energize major power supply systems, including phase checks	
F			Bump motors for rotation	Run-in and vibration test motors uncoupled	Couple rotating equipment
G	Check out and perform in-service test of control room HVAC	Power up DCS	Complete preparations for process system high pressure leak tests		
H	Set MOV torque switches and adjust limit switches	Electrically operate MOVs	Remove and set safety relief devices	Perform required maintenance on equipment and systems	Complete the data sheets and test records
J		Manage the clearance and safety tagging program	Complete insulation and painting	Identify design problems to engineering for resolution	Remove all scaffolding and combustible materials

The phase where component testing occurs. This phase is sometimes referred to as "precommissioning," "cold commissioning," "construction completion," or "pre-op." Typically, this phase of execution follows system/component turnover from Construction but may vary depending on contract requirements. Activities in this phase are typically executed by Startup personnel; however, some may be executed in the Construction Completion Phase by other experienced testing personnel trained and knowledgeable of Startup processes and procedures. Support labor for these activities may be subcontractors, Construction, or Startup direct, depending on project execution plan.

Pre-commissioning Phase (Cold Commissioning), from Figure 16.3-2, Project Completion Phases, Mechanical Testing and Completion Schedule, 10112936-PB-0-DOC-0005 (25474–000–583–U07G–00001)

Figure 16.3-2. Cold Commissioning Activities

16.3.2 Hot Commissioning

Once cold commissioning is finished, plant startup enters the hot commissioning phase. Carried out by the Startup group, hot commissioning is essentially a seamless phase transition in the plant's startup with respect to administration of the safety lock-out program and the care, custody, and control of the equipment and systems. Refer to Cold Commissioning Schedule 10112936-PB-O-DOC-0006 (25474-000-512-U07G-00001) for a description of activities leading to hot commissioning.

STCPs are used to perform cold commissioning, which is carried out in a manner compliant with NORSOK Z007 standard. Refer to Mechanical Testing and Completion Schedule 10112936-PB-O-DOC-0006 (28474-000-583-U07G-00001).

Permanent plant operations personnel assist with hot commissioning activities, which provides them the primary part of their OJT. During this time, these operators are expected to operate plant systems safely and efficiently as directed. Responsibility for hot commissioning rests with the Startup group, augmented by field engineering, safety, and maintenance personnel, as well as permanent plant operations personnel.

Plant equipment and systems are made ready to receive combined heat and power, CO_2 amine solvent, and other chemicals, to process flue gas during hot commissioning. Arranging for vendor service/startup representatives for major equipment at the appropriate times is a critical function during this phase. These activities also include:

- Performing initial charging of solvents and chemicals
- Performing system functional checkout
- Cleaning and checking temporary strainers during initial circulation or fluid flow operations
- Checking and testing hazard detection, firefighting, and other loss-prevention systems and equipment
- Ensuring that documentation is in place to allow a system to progress to the operation phase
- Supervising and directing permanent plant personnel in startup, testing, maintenance, and operation activities until turnover (These personnel are used only in ways consistent with staff position and responsibility.)
- Performing formal system walkdowns before startup, with appropriate prior notifications
- Preparing and submitting system turnover packages as scheduled. As a minimum, these packages consist of the following:
  - General
    - Turnover package and section indices

    - Copy of not-yet-incorporated Design Change Notices (DCNs)
    - Punchlist
    - Copy of system and specialty commissioning procedures that contain recorded data or sign-off
  - Mechanical
    - Current red-line, as-built, approved boundary piping and instrumentation diagrams (P&IDs)
    - Hydrostatic test records
    - Pipe cleaning records (flush, blow, chemical cleaning, etc.)
    - Safety/relief valve field setting record
    - Coupling alignment records (with and without pipe attachment)
    - Driven equipment data sheets
    - Vibration data sheets
    - Drive turbine data sheets
  - Electrical
    - Approved, highlighted schematic wiring diagrams or cable schedule indicating completion of proper cable checkout
    - Block diagram(s)
    - Bus bar torque data
    - Electrical scheme test data sheet
    - Termination/continuity record
    - Cable test record
    - Motor data sheets
    - Motor-operated valve (MOV) data sheets
    - Battery data sheets
    - Megger data sheets
    - High-potential test data sheets
    - Switchgear test records (EL)
    - Transformer test records
    - MCC test records (EL)
    - Earth loop impedance test records (EL)
  - Instrumentation and Control
    - Calibration sheets
    - Loop test records
    - Control logics/ diagrams
    - DCS interface drawing
    - DCS configuration diagram
    - As-built set points, alarms, and trips
    - level setting drawings
    - DCS input/output (I/O) list highlighted to reflect verified I/Os
    - Instrument Index

  - Operation and Maintenance
    - Lubrication records
    - Construction-storage-phase maintenance/lubrication/heating records
    - Startup-phase maintenance and lubrication records
    - Vendor service engineer's reports
- Administering and conducting system walkdowns in preparation for turnover

Before the scheduled turnover date, and allowing sufficient time for review, the Startup-to-Customer Turnover Package is submitted for acceptance. The turnover package typically includes those items listed above plus the Startup-to-Customer System/Facility Turnover Form, identifying the items being turned over. This form is completed and properly signed by the responsible personnel. Signatures indicate the following:

- The project startup manager's signature signifies that the system/facility testing is complete to the extent that it is ready for operation, and that exceptions are listed on the punchlist.
- The Customer’s, or Customer designee's, signature indicates turnover acceptance of the system/facility, including any exceptions noted.

Punchlists are updated to show the current status of turnover exceptions. Each exception item that has been completed before turnover is signed as complete by the responsible personnel. Each exception that is not completed before turnover has an estimated completion date and responsible party entered on the form. The form is included in the turnover package.

The Customer reviews the turnover package for completeness, accuracy, and exception status. If the turnover is acceptable, the Facility Manager indicates acceptance by signing the Startup-to-Customer System/Facility Turnover Form transmitted with the package and distributes a signed copy to the project startup manager. If a turnover is not acceptable, the turnover package is returned to the project startup manager with a detailed written explanation of why the turnover was rejected.

Upon receiving the signed copy of the Startup-to-Customer Turnover Form, Startup proceeds to remove green turnover tags and replace them with blue tags if the blue tag process is being used by the project. If the blue tag process is not being used, the green tags remain in place until the Customer takes care, custody, and control of the facility.

Figure 16.3-3, Hot Commissioning Activities, lists typical activities undertaken during hot commissioning, along with the applicable SCTPs. Figure 16.3-4, High Level Schedule of Commissioning Activities, provides a basic schedule of aggregate commissioning and startup activities.

	10	11	12
A	Set all process blinds as per blind list		Operate & monitor permanent plant equipment & systems
B		Verify digital & analog control circuits & interlocks	Functionally test/operate instruments & controls as systems
C	Perform final HVAC testing	Check & set boiler safety valves	N_2 purge of the flare & fuel gas systems
D	Conduct steam boiler functional tests	Perform vacuum leak tests as required	(C) Remove temporary piping & equipment as required
E	♦ Schedule Vendors for initial equip. operation		Perform steam line blows (boiler operation)
F	Run-in & vibration test rotating equipment	Perform in-service leak tests	Process system N_2 purge
G	Perform process System high pressure leak tests	Adjust pipe hangers to operational settings	Perform hot alignment checks on rotating equipment
H	Supply chemicals, fluids & spare parts as required	Complete data sheets & test records	
J	Identify design problems to engineering for resolution		Turnover to owner walkdown

→ Systems testing complete and facility ready for integrated startup & process operation.

13	14
Lineup systems for operation	Unit line out
Gas in & pressure up to the facility working pressure	Fine tune process variables
	Introduce feedstock
Cold circulation operation	Lab tests of all samples
Hot circulation operation	Route product to storage
Re-torque bolting as required	Perform transient tests
Setup for performance testing	Establish normal operation
	Complete data sheets & test records
Touchup insulation, painting, etc. as required	Feed rate to design conditions

→ Facility ready for Acceptance/ Performance Test and Turnover to Owner.

HOT COMMISSIONING

Commissioning Phase

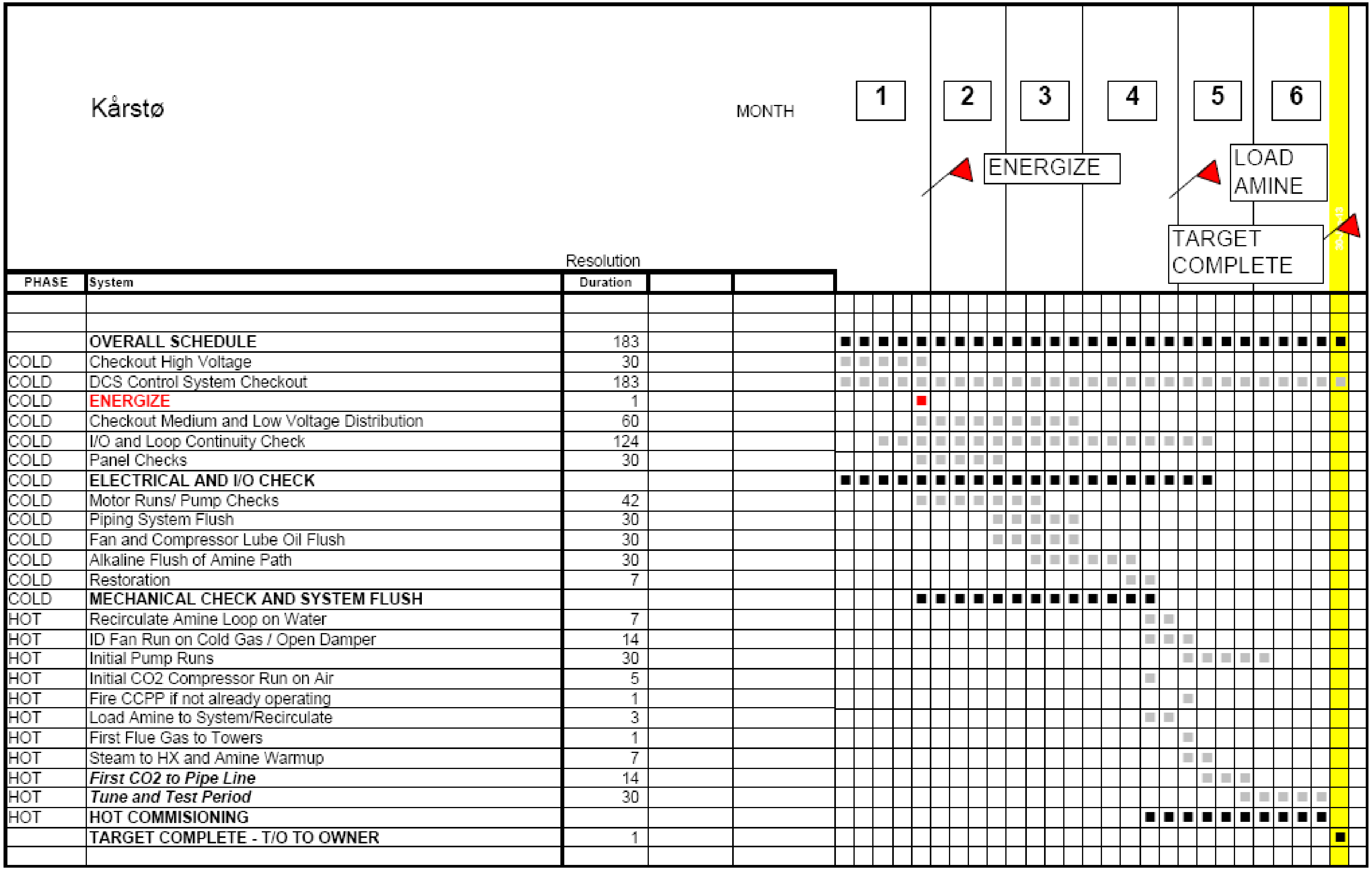
Occurs after completion of component testing and system turnover to Startup or others as defined by contract. System testing and integrated system testing on safe fluids are performed in this phase and systems are placed in service to support overall plant startup. Performance of activities in this phase are typically executed by Startup personnel.

Startup/Operations Phase

The phase where final system tests are performed, feedstocks are introduced, and the facility is made ready for performance/ acceptance testing. Activities in this phase are typically executed by Startup or Facility Operations personnel.

Commissioning and Startup/Operations Phase, from Figure 1, Project Completion Phases, Mechanical Testing and Completion Schedule, 10112936-PB-O-DOC-0005 (25474 - 000 – 583 – U07G – 00001)

Figure 16.3-3. Hot Commissioning Activities



PHASE	System	Duration
	OVERALL SCHEDULE	183
COLD	Checkout High Voltage	30
COLD	DCS Control System Checkout	183
COLD	ENERGIZE	1
COLD	Checkout Medium and Low Voltage Distribution	60
COLD	I/O and Loop Continuity Check	124
COLD	Panel Checks	30
COLD	**ELECTRICAL AND I/O CHECK**	
COLD	Motor Runs/ Pump Checks	42
COLD	Piping System Flush	30
COLD	Fan and Compressor Lube Oil Flush	30
COLD	Alkaline Flush of Amine Path	30
COLD	Restoration	7
COLD	**MECHANICAL CHECK AND SYSTEM FLUSH**	
HOT	Recirculate Amine Loop on Water	7
HOT	ID Fan Run on Cold Gas / Open Damper	14
HOT	Initial Pump Runs	30
HOT	Initial CO2 Compressor Run on Air	5
HOT	Fire CCPP if not already operating	1
HOT	Load Amine to System/Recirculate	3
HOT	First Flue Gas to Towers	1
HOT	Steam to HX and Amine Warmup	7
HOT	***First CO2 to Pipe Line***	14
HOT	***Tune and Test Period***	30
HOT	**HOT COMMISIONING**	
	TARGET COMPLETE - T/O TO OWNER	1

Figure 16.3-4. High Level Schedule of Commissioning Activities

16.4 Schedule Overview (Level II with Storyboard)

16.4.1 Critical Path Activities

The critical path begins with initial system engineering. This leads to preparing the specification for the columns of the flue gas absorber and amine stripper and continues with bidding, evaluating, and awarding the columns. These columns are the long lead time items in today's market. The path continues with fabricating, delivering, and setting the columns and installing the column internals. The path then follows through precommissioning and concludes with project completion at the end of hot commissioning.

16.4.2 Key Schedule Durations

Key schedule durations are as follows:

Milestone Description	Months from NTP
NTP	0
Site mobilization	9
First concrete	12
Absorber column delivery	18
Energization	23
Project completion	28

16.5 Schedule Assumptions and Risks

16.5.1 Schedule Basis and Assumptions

Schedule is based on modular approach to installing the pipe rack and associated pipes and cable trays. Equipment lead times are based on budgetary quotes. Construction schedule development was based on detailed storyboard analysis.

16.5.2 Schedule Risks

Schedule risks include the following:

- Early design support is required to support procurement of major commodities.
- The compressor lead time is 18 months.

- Early design support is required for release of bulk pipe in support of offsite pipe rack modularization.
- Crane access and installation sequencing must take pipe rack layout into consideration.
- Winter weather is a factor.
- Owner support is required for the power plant outage.
- Overseas shipment is scheduled for all major equipment.

16.6 Owner Milestones (Required by Schedule)

The following Owner milestones are required by schedule:

Milestone Description	Months from NTP
Geotechnical investigation complete	(-) 2
EPC Contract Award	(-) 2
Notice to Proceed	0
All required permits received	8
Site free and clear	9
Tie-in outage starts	17
Tie-in outage completes	18
Seawater intake completed	22
22 kV power available	22
Seawater available	24
Naturkraft CCPP in operation	25
Natural gas available	25
HP and LP steam available	25.5
CCC Plant in operation	30

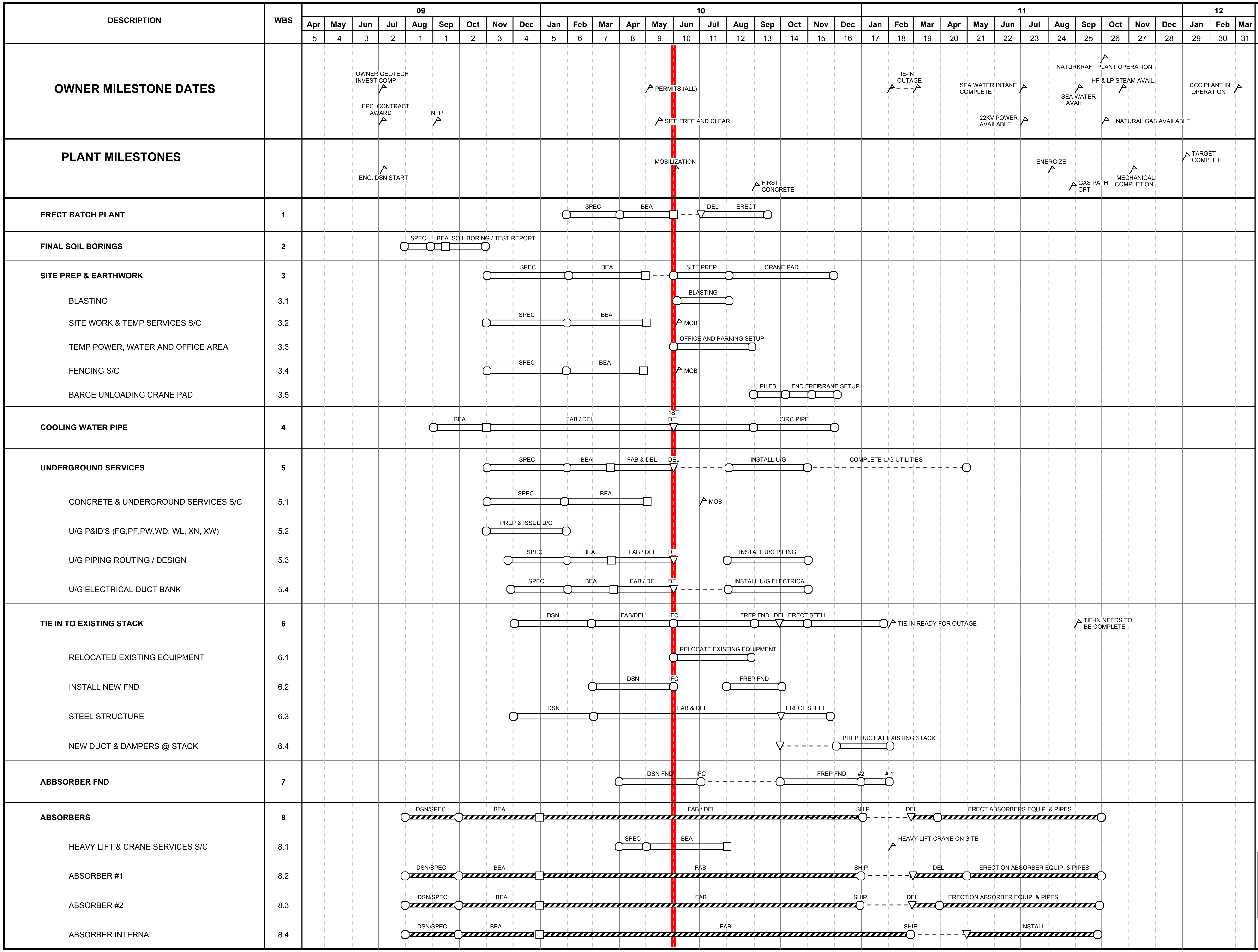
Attachments

16.1 Project Level II Schedule

16.2 Project Construction Story Boards

- Months 10 to 22, starting at Notice to Proceed (NTP) as shown on the Schedule
- Pipe Rack Sequence

CO2 KARSTO PROJECT



- ⚑ SCHEDULE MILESTONE EVENT
- ○ ACTIVITY NODE
- ☐ P.O. OR SUBCONTRACT AWARD
- ⬡ RELEASE FOR FABRICATION
- ▽ SITE DELIVERY
- ○━━━○ SCHEDULED ACTIVITY
- ○- - -○ INTERMITTENT ACTIVITY
- ○▨▨▨○ CRITICAL ACTIVITY
- ○═══○ SECOND SHIFT

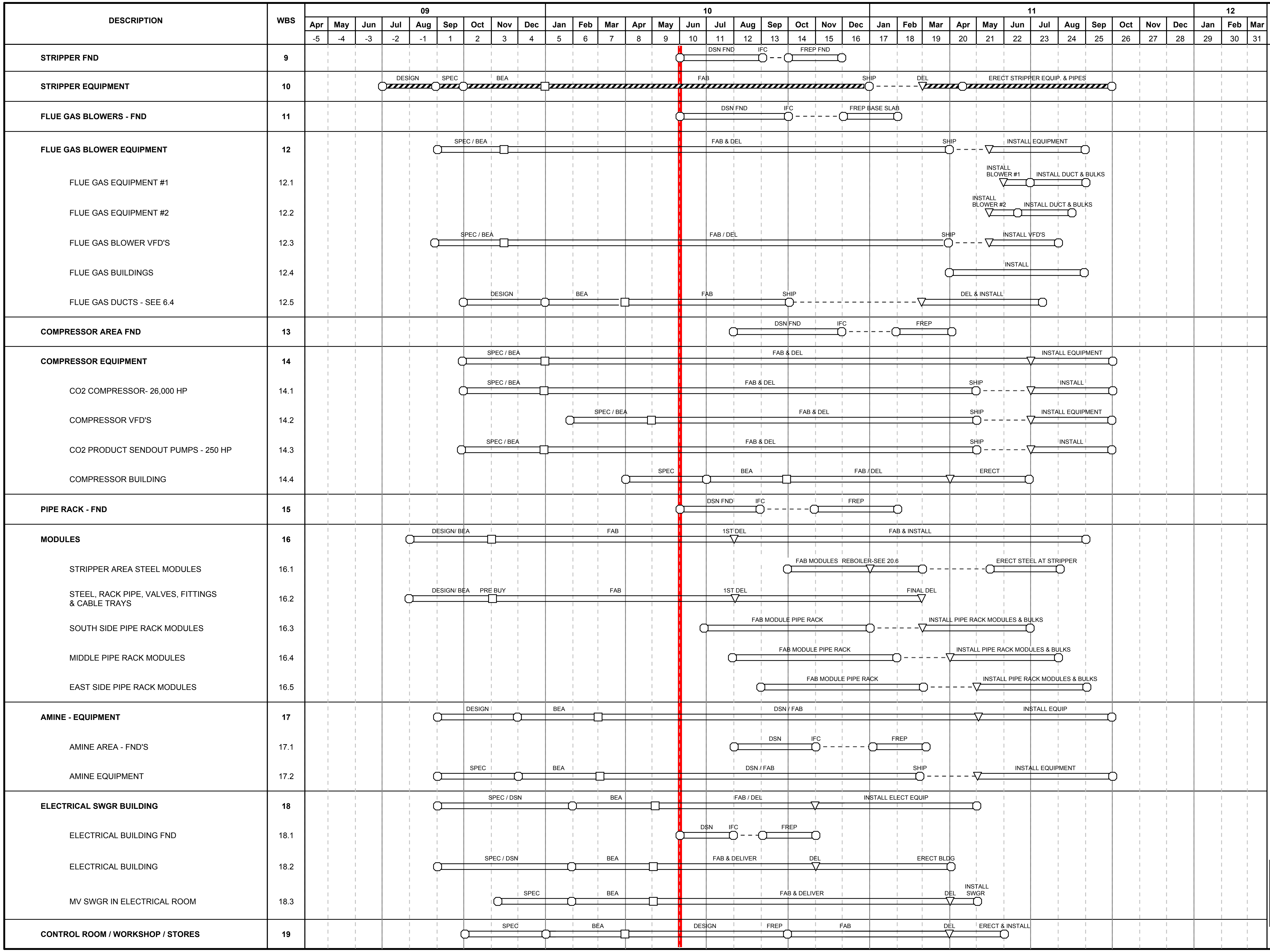
ABBREVIATIONS:

BEA	BID, EVALUATE, AWARD
BLDG	BUILDING
CONS	CONSTRUCTION
COMP.	COMPLETE
DEL	DELIVER
DSN	DESIGN
EPC	ENGINEERING, PROCUREMENT, CONSTRUCTION
EQUIP	EQUIPMENT
FAB	FABRICATE
FDN	FOUNDATION
FREP	FORM, REBAR, EMBEDS, PLACE
GPC	GAS PATH COMPLETE
HP	HIGH PRESSURE
IFC	ISSUE FOR CONSTRUCTION
INST	INSTALL
LNTP	LIMITED NOTICE TO PROCEED
LP	LOW PRESSURE
MOB	MOBILIZATION
NTP	NOTICE TO PROCEED
SPEC	SPECIFICATION
U/G	UNDERGROUND
UTIL	UTILITIES

BECHTEL
FREDERICK, MD

KARSTO
2 UNIT CO2 PROJECT

CO2 KARSTO PROJECT



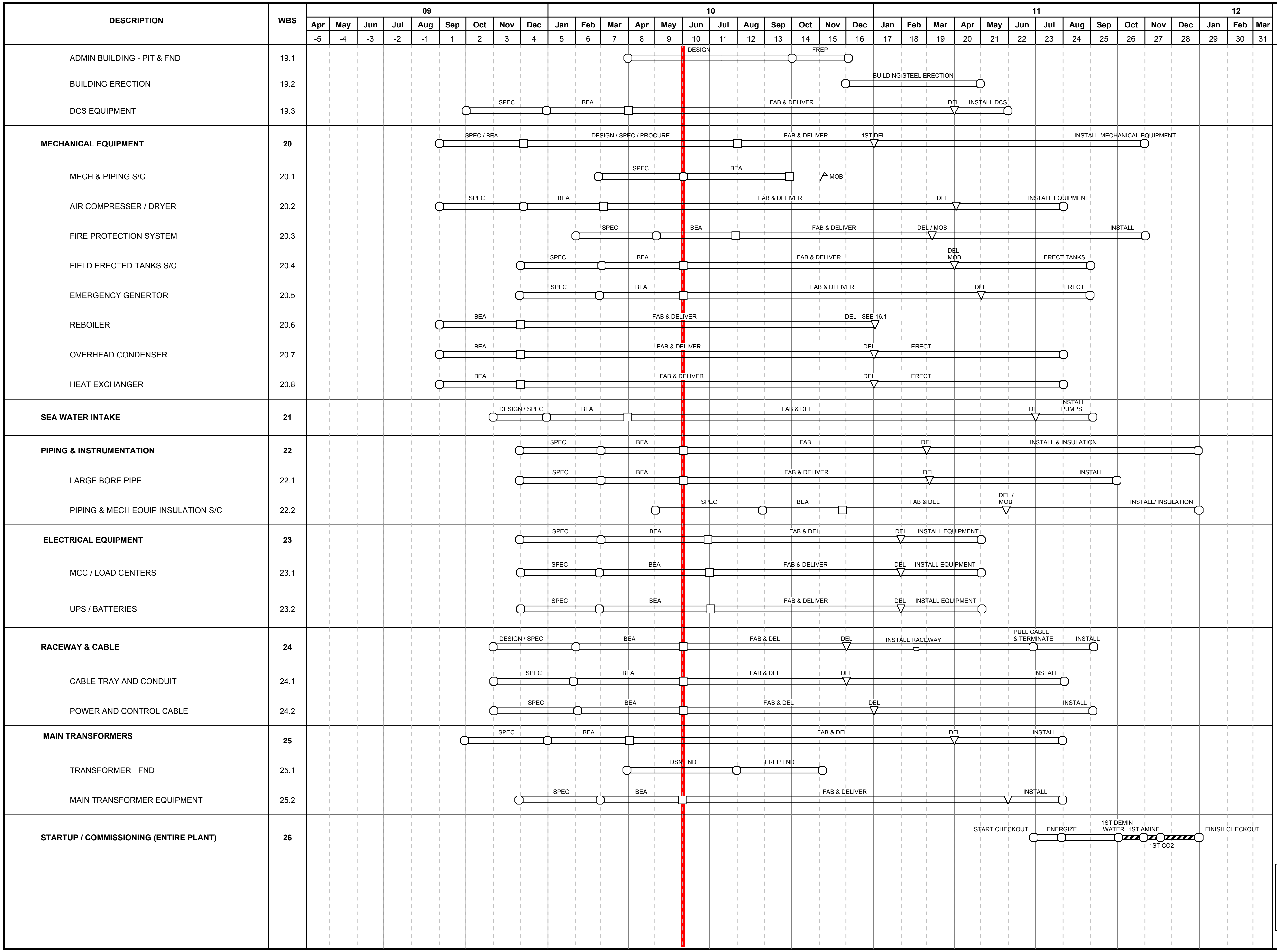
SCHEDULE MILESTONE EVENT
○ ACTIVITY NODE
☐ P.O. OR SUBCONTRACT AWARD
⬡ RELEASE FOR FABRICATION
▽ SITE DELIVERY
○━━○ SCHEDULED ACTIVITY
○- - -○ INTERMITTENT ACTIVITY
○▨▨○ CRITICAL ACTIVITY
○══○ SECOND SHIFT

ABBREVIATIONS:

BEA	BID, EVALUATE, AWARD
BLDG	BUILDING
CONS	CONSTRUCTION
COMP.	COMPLETE
DEL	DELIVER
DSN	DESIGN
EPC	ENGINEERING, PROCUREMENT, CONSTRUCTION
EQUIP	EQUIPMENT
FAB	FABRICATE
FDN	FOUNDATION
FREP	FORM, REBAR, EMBEDS, PLACE
GPC	GAS PATH COMPLETE
HP	HIGH PRESSURE
IFC	ISSUE FOR CONSTRUCTION
INST	INSTALL
LNTP	LIMITED NOTICE TO PROCEED
LP	LOW PRESSURE
MOB	MOBILIZATION
NTP	NOTICE TO PROCEED
SPEC	SPECIFICATION
U/G	UNDERGROUND
UTIL	UTILITIES

BECHTEL
FREDERICK, MD

KARSTO
2 UNIT CO2 PROJECT



CO2 KARSTO PROJECT

- SCHEDULE MILESTONE EVENT
- ○ ACTIVITY NODE
- ☐ P.O. OR SUBCONTRACT AWARD
- ⬡ RELEASE FOR FABRICATION
- ▽ SITE DELIVERY
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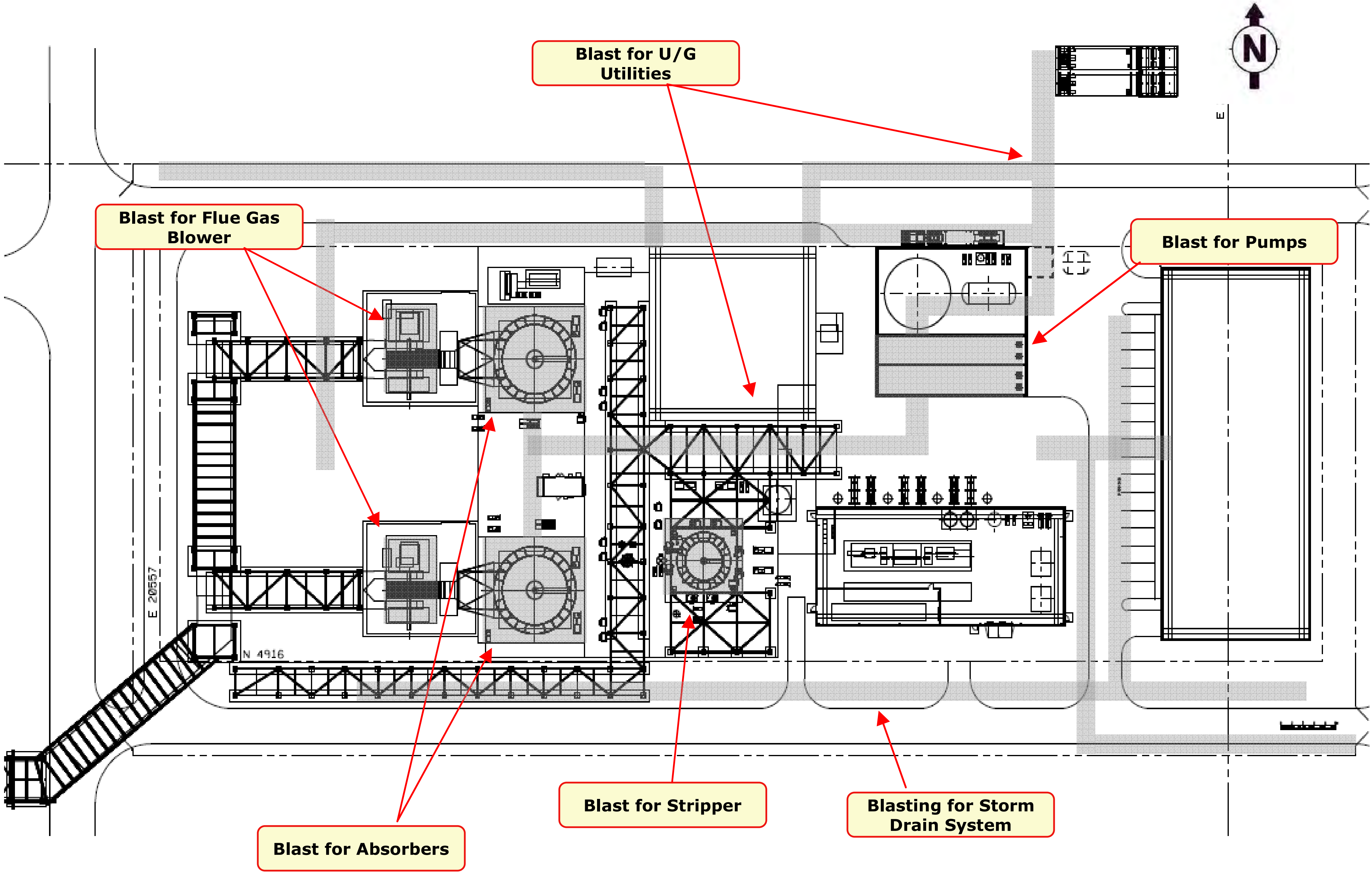
BECHTEL
FREDERICK, MD

KARSTO
2 UNIT CO2 PROJECT



Karsto Facility

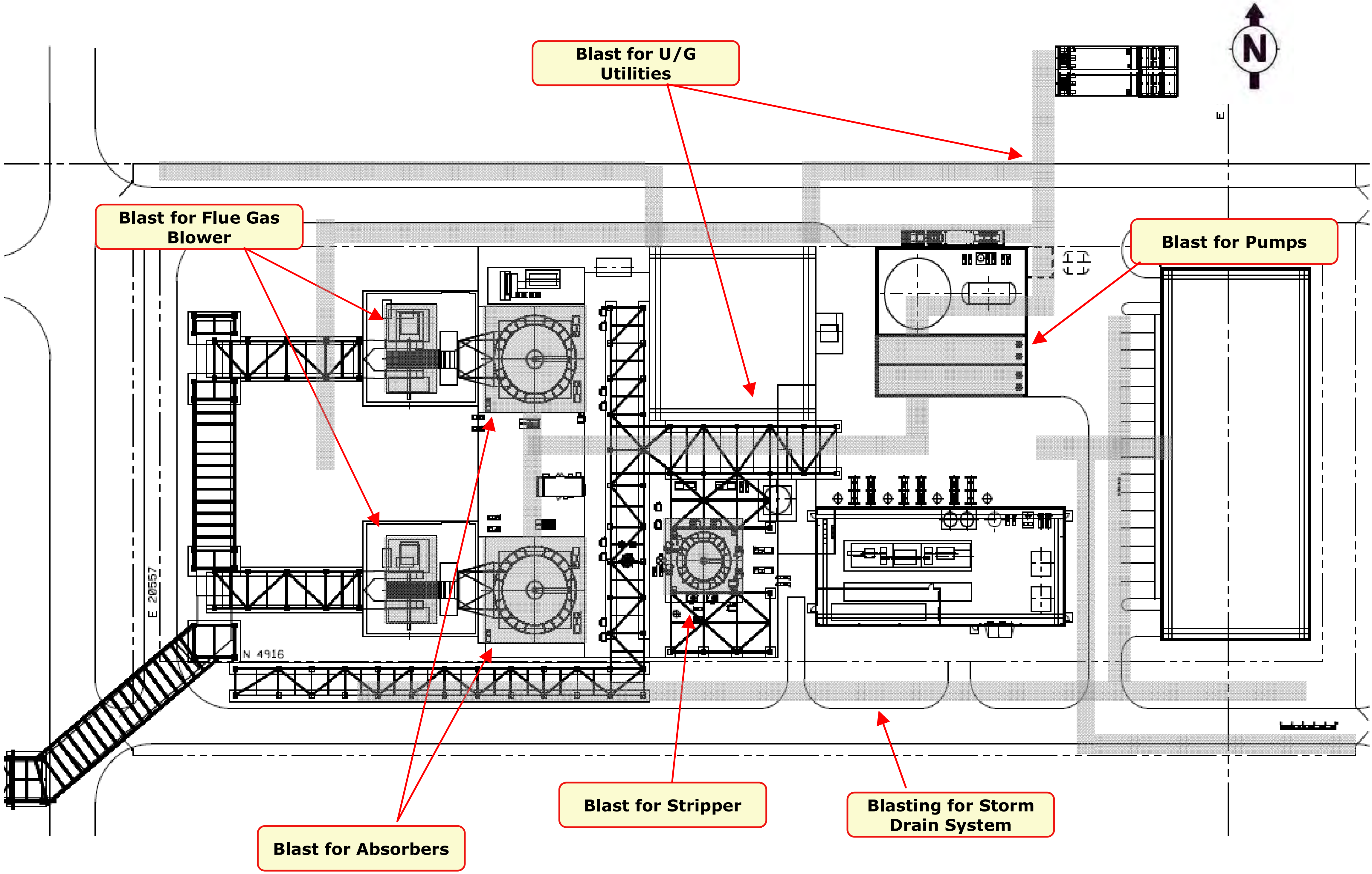
Month 10

Construction Activities

- ➔ Site Mobilization
- ➔ Blasting Plan
- ➔ Setup Site Offices
- ➔ Establish Laydown
- ➔ Establish Parking Lots
- ➔ Start Site Grading

Color Legend:

- Concrete
- Underground Utilities
- Mechanical Equipment
- Steel
- Electrical Equipment
- Blasting
- Crane



Karsto Facility

Month 11

Construction Activities

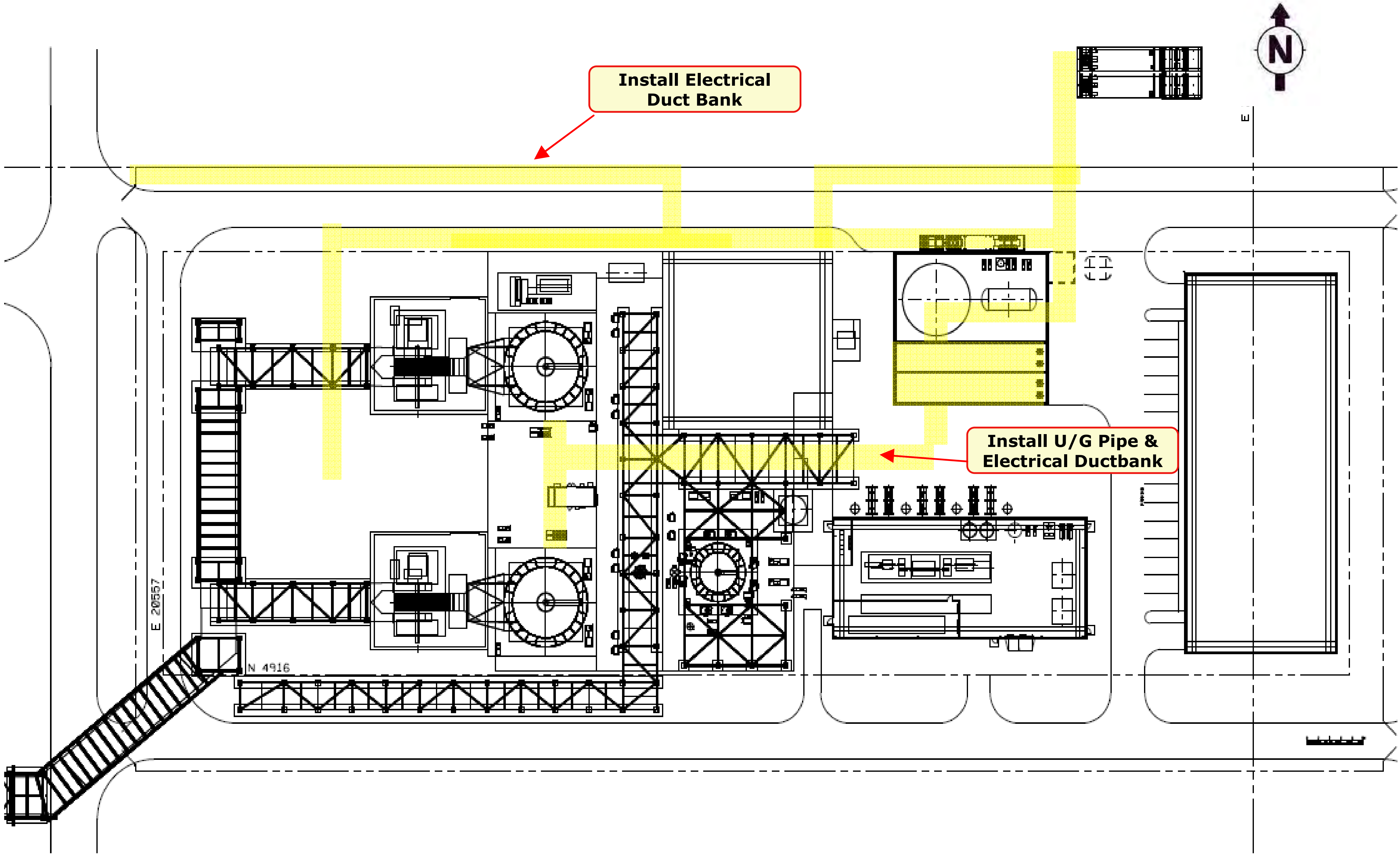
- Site Mobilization
- Blasting Plan
- Setup Site Offices
- Establish Laydown
- Establish Parking Lots
- Start Site Grading

Color Legend:

🟩 Concrete
🟪 Electrical Equipment
🟨 Underground Utilities
▨ Blasting
🟧 Mechanical Equipment
🟥 Crane
🟦 Steel

Karsto Facility

Month 12



Install Electrical Duct Bank

Install U/G Pipe & Electrical Ductbank

Construction Activities

- → Start Installation at Processor Area for Circulating Water Pipe
- → Install Underground Utilities.

Color Legend:

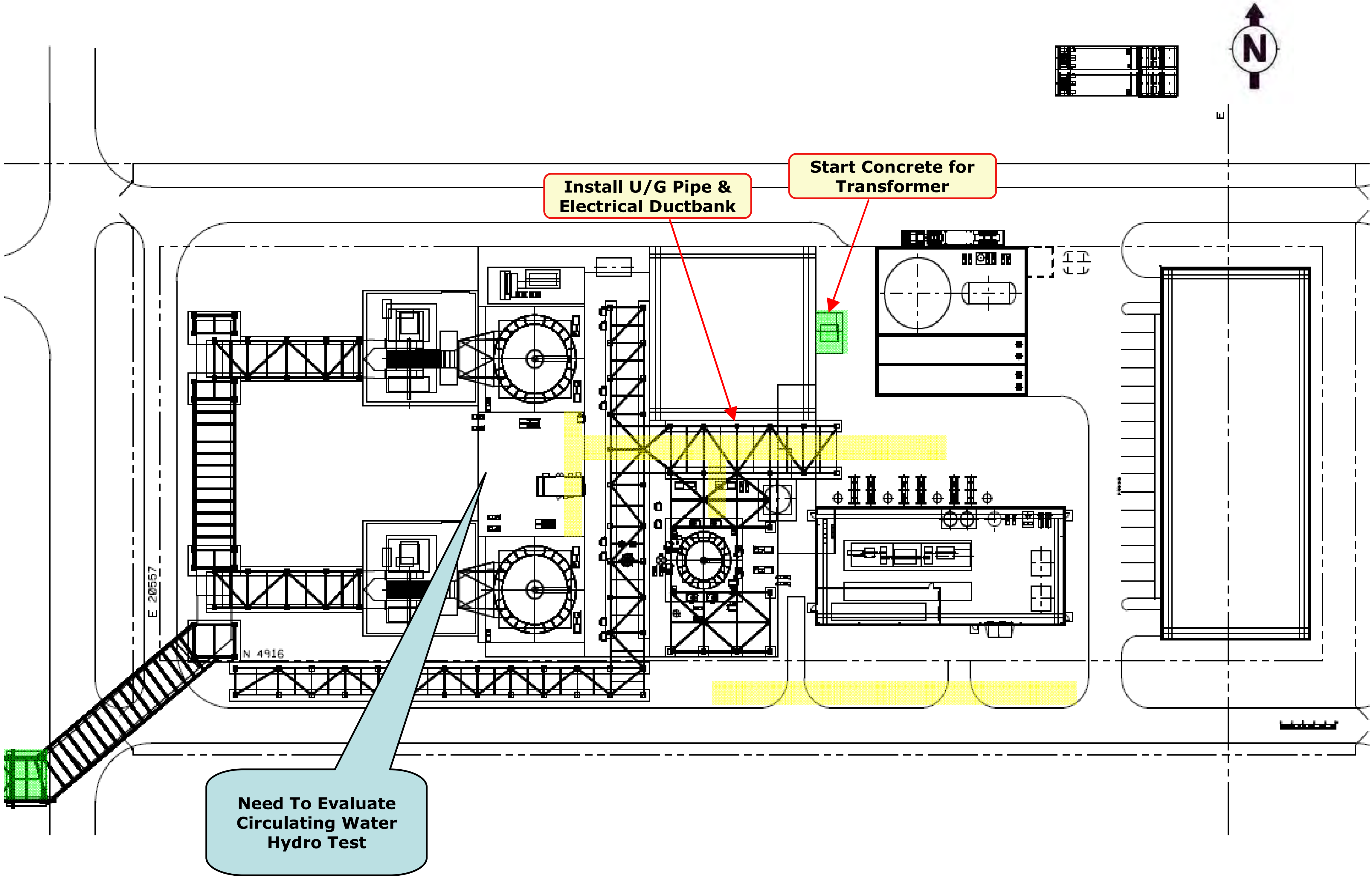
Concrete	Electrical Equipment
Underground Utilities	Blasting
Mechanical Equipment	Crane
Steel	

Karsto Facility

Month 13

Construction Activities

- Continue Installation of Circulating Water Pipe
- Continue Installation of Underground Utilities
- Start Concrete for Transformer



Install U/G Pipe & Electrical Ductbank

Start Concrete for Transformer

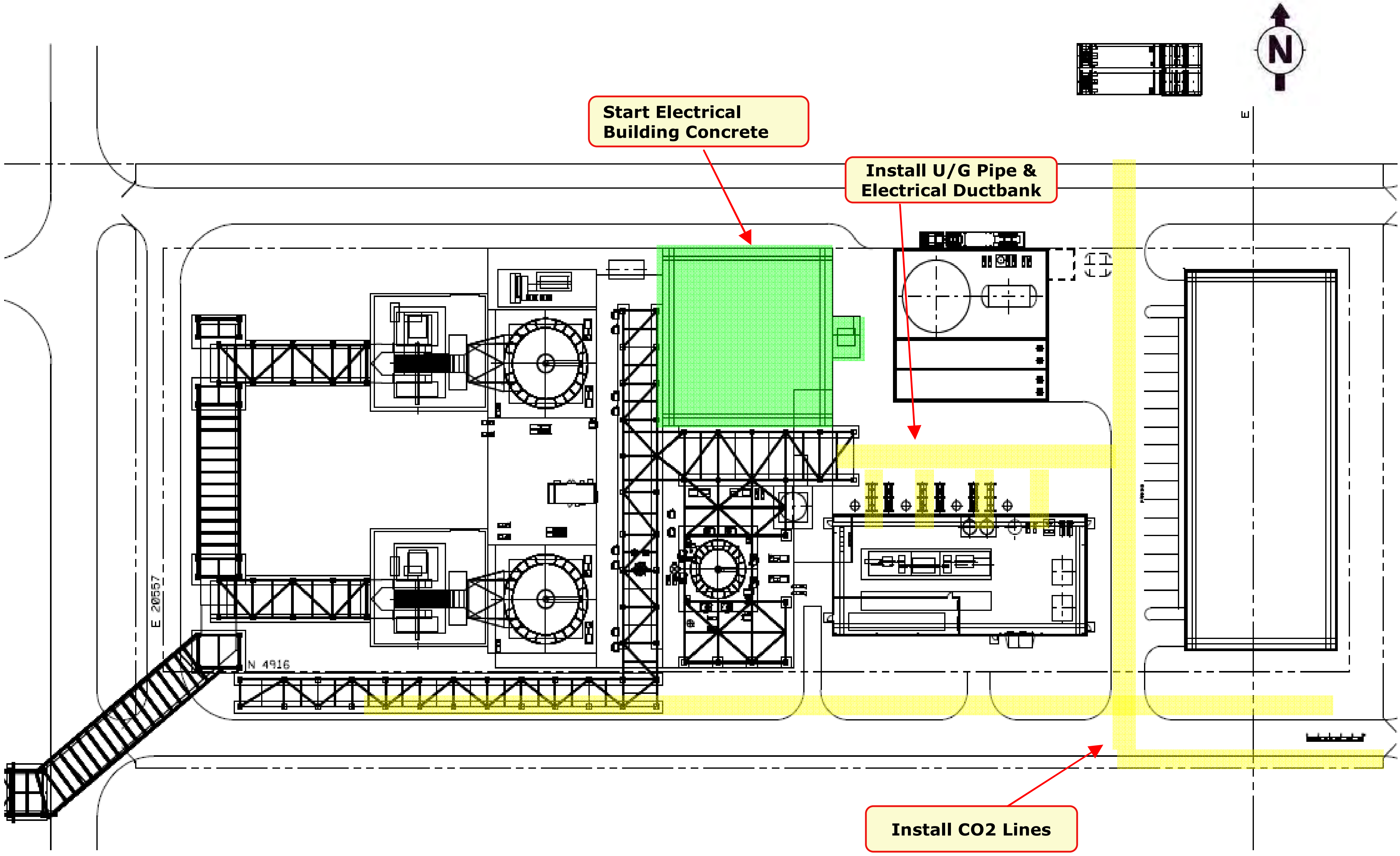
Need To Evaluate Circulating Water Hydro Test

Color Legend:

- 🟩 Concrete
- 🟨 Underground Utilities
- 🟧 Mechanical Equipment
- 🟦 Steel
- 🟪 Electrical Equipment
- ▨ Blasting
- 🟥 Crane

Karsto Facility

Month 14



Start Electrical Building Concrete

Install U/G Pipe & Electrical Ductbank

Install CO2 Lines

Construction Activities

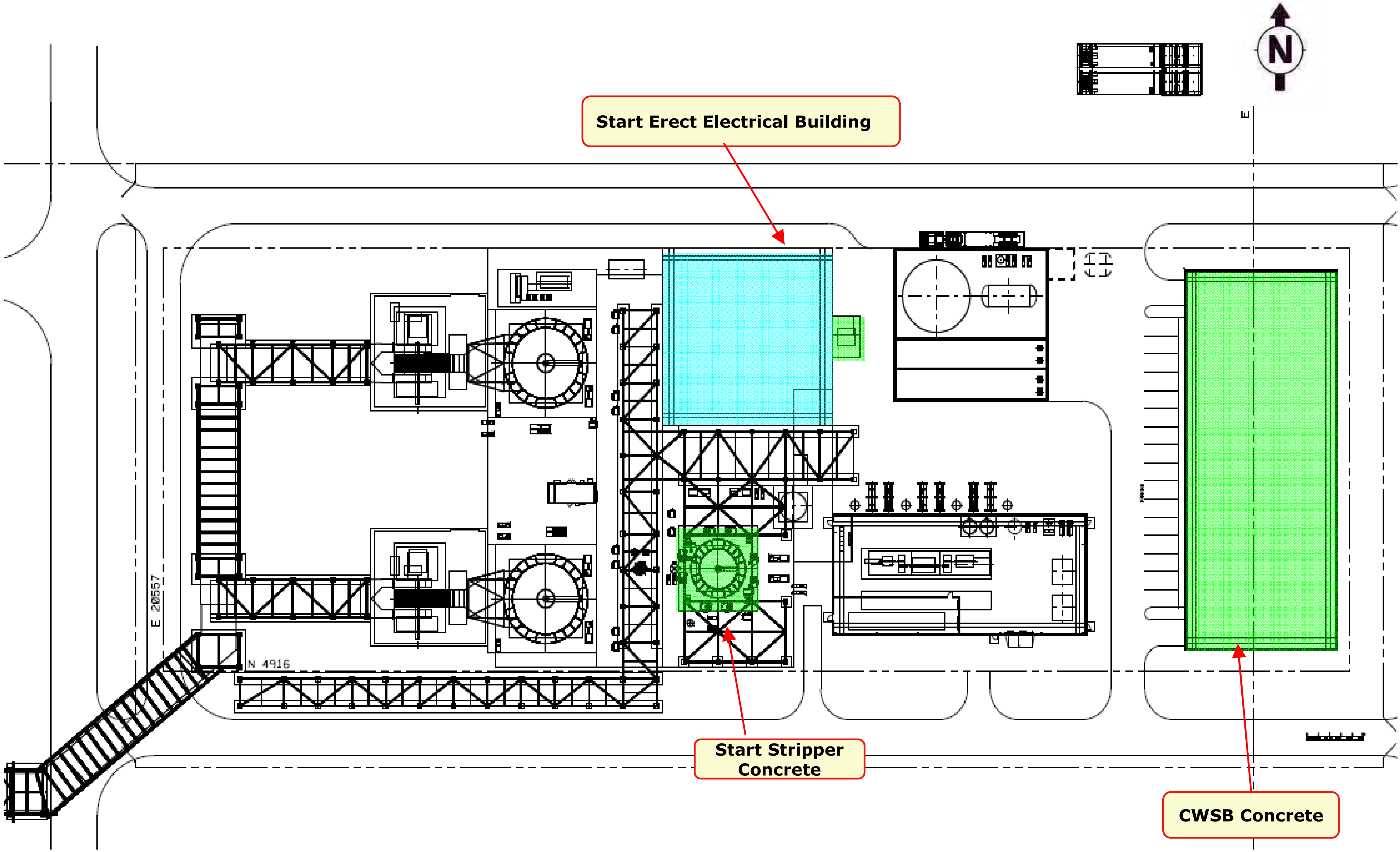
- Install Circulating Water Pipe
- Install Underground Utilities
- Install CO2 Lines
- Start Electrical Building Concrete
- Continue Transformer Foundation

Color Legend:

- 🟩 Concrete
- 🟨 Underground Utilities
- 🟧 Mechanical Equipment
- 🟦 Steel
- 🟪 Electrical Equipment
- ⬛ Blasting
- 🟥 Crane

Karsto Facility

Month 15



Start Erect Electrical Building

Start Stripper Concrete

CWSB Concrete

Construction Activities

- Start Stripper Concrete
- Start Electrical Building Steel Work
- Concrete work for the Control, Workshop, Store building
- Finish Concrete Work for the Transformer

Color Legend:

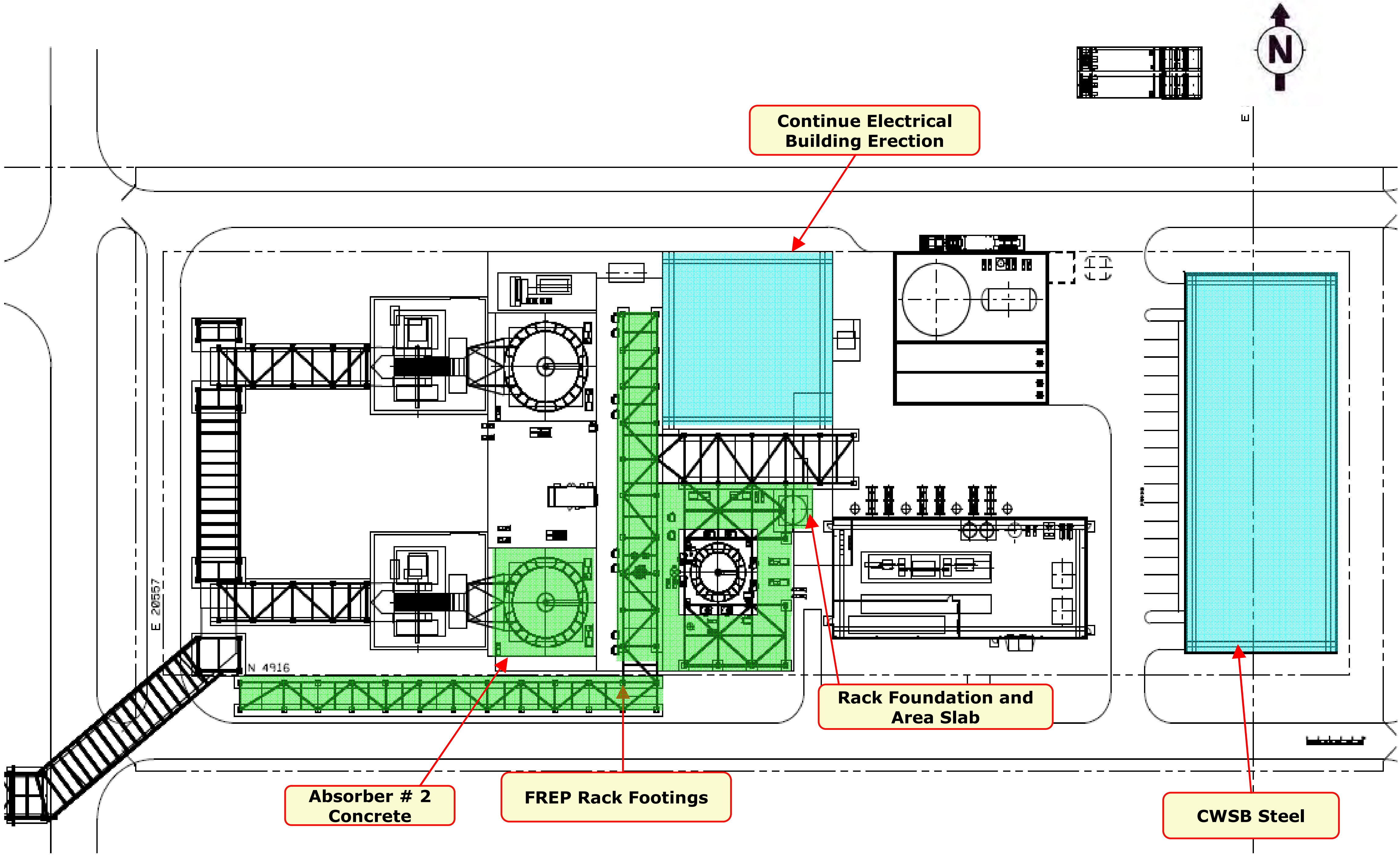
- 🟩 Concrete
- 🟪 Electrical Equipment
- 🟨 Underground Utilities
- ⬜ Blasting
- 🟧 Mechanical Equipment
- 🟥 Crane
- 🟦 Steel

Karsto Facility

Month 16

Construction Activities

- Absorber #2 Concrete
- FREP Rack Footings
- Start Steel work for the Control/ Workshop Building
- Place Area Slab (Area around the stripper
- Continue Electrical Building Steel work



Continue Electrical Building Erection

Rack Foundation and Area Slab

Absorber # 2 Concrete

FREP Rack Footings

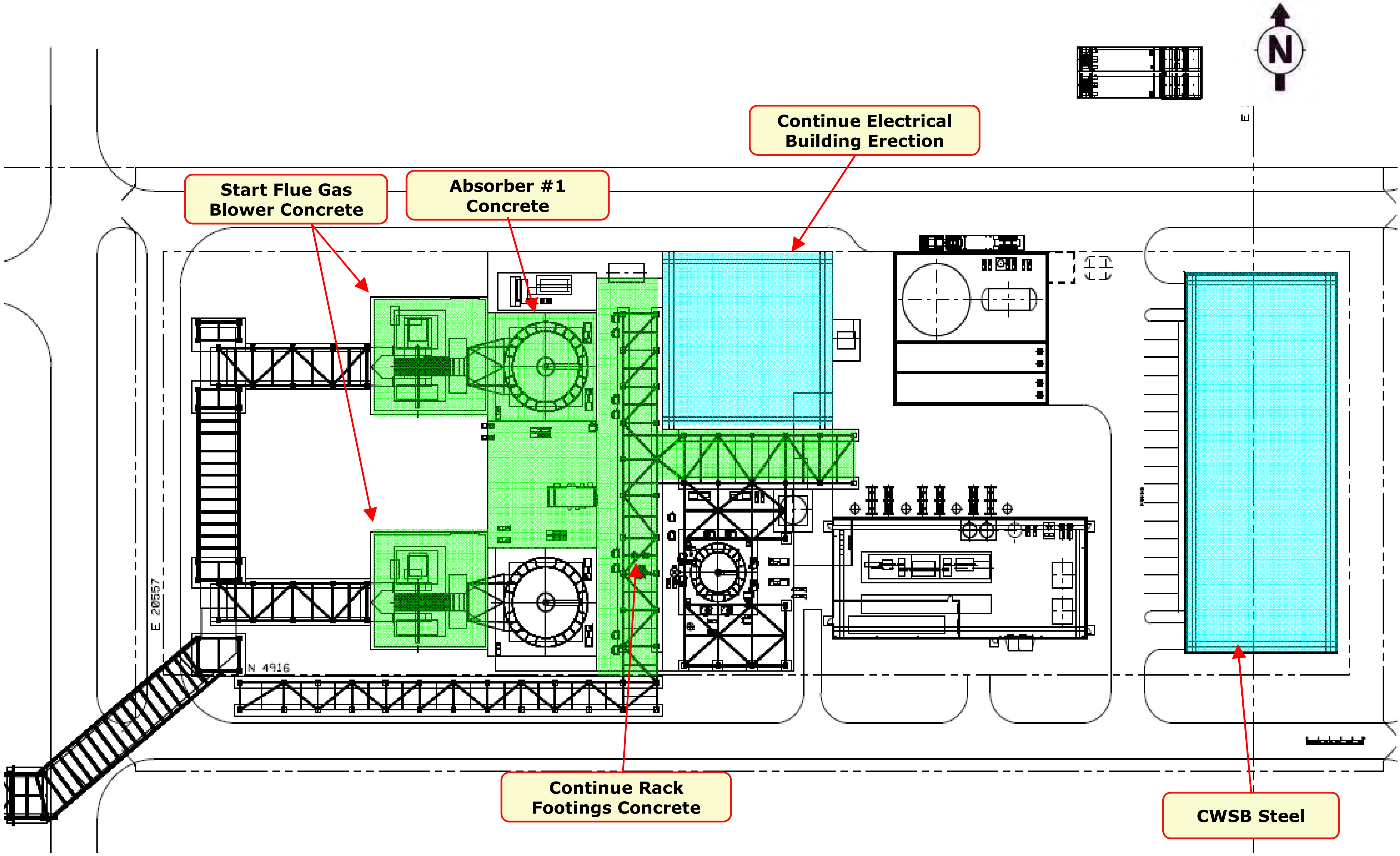
CWSB Steel

Color Legend:

- 🟩 Concrete
- 🟨 Underground Utilities
- 🟧 Mechanical Equipment
- 🟦 Steel
- 🟪 Electrical Equipment
- ▨ Blasting
- 🟥 Crane

Karsto Facility

Month 17



Start Flue Gas Blower Concrete

Absorber #1 Concrete

Continue Electrical Building Erection

Continue Rack Footings Concrete

CWSB Steel

Construction Activities

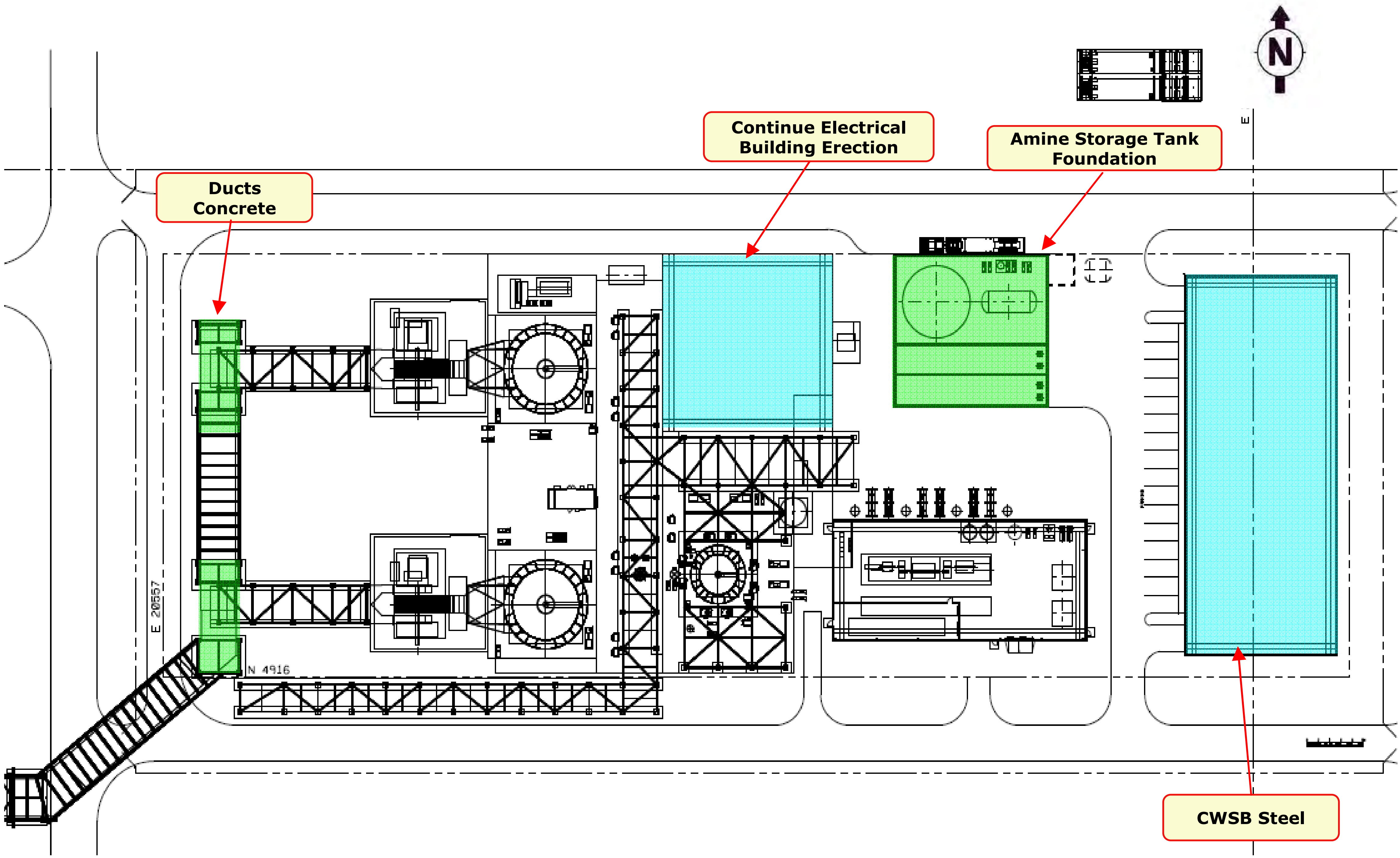
- Continue Electrical Building Steel work
- Concrete for Flue Gas Blower #1 & 2
- Continue Control Building / Workshop steel erection
- Continue Area Concrete to Allow Rack Setting
- Concrete for the Absorber #1

Color Legend:

- Concrete
- Underground Utilities
- Mechanical Equipment
- Steel
- Electrical Equipment
- Blasting
- Crane

Karsto Facility

Month 18



Construction Activities

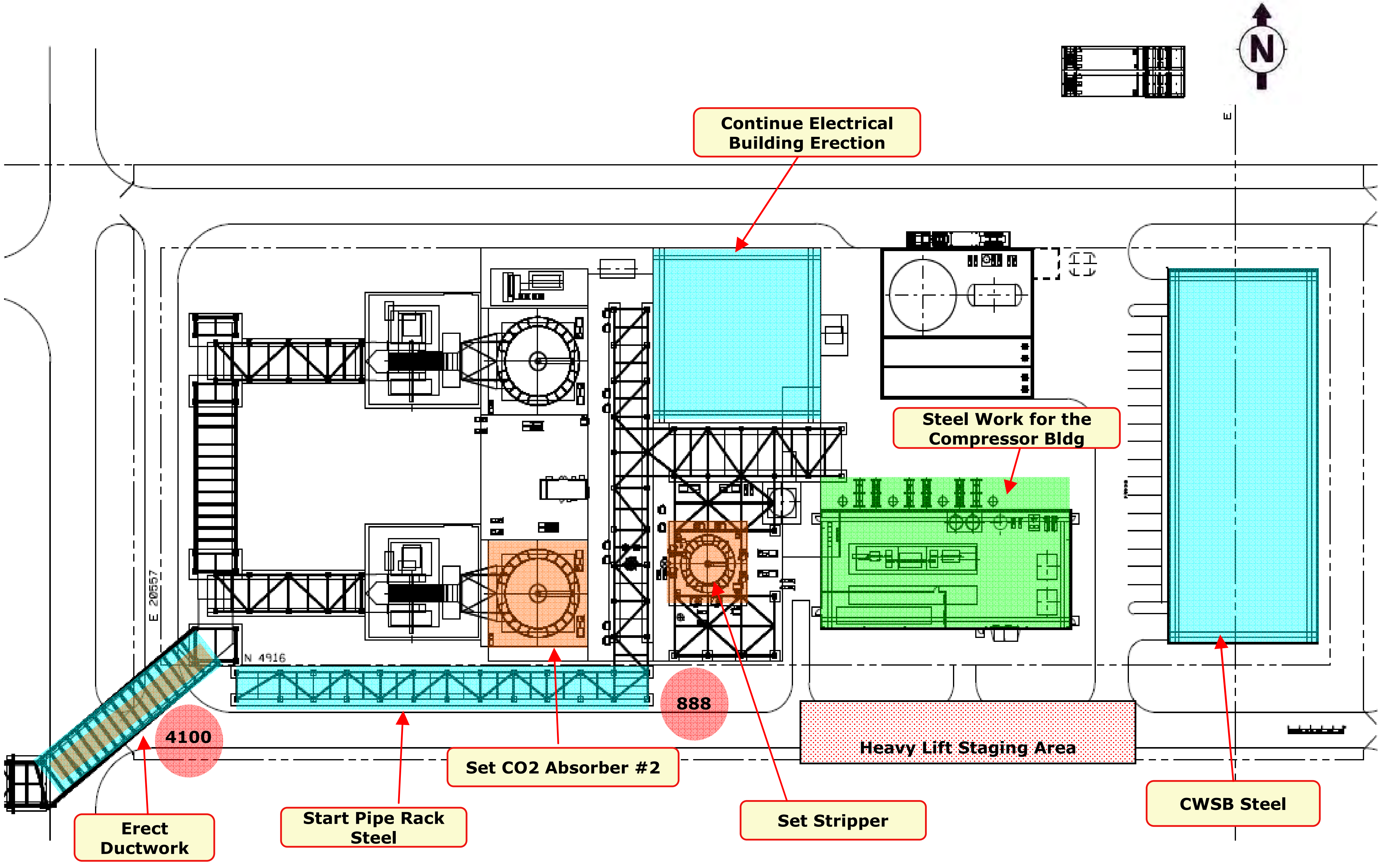
- Continue steel work for the CWSB & Electrical Building
- Concrete foundation for the Duct Towers
- Concrete for the Amine Building

Color Legend:

- Concrete
- Underground Utilities
- Mechanical Equipment
- Steel
- Electrical Equipment
- Blasting
- Crane

Karsto Facility

Month 19



Continue Electrical Building Erection

Steel Work for the Compressor Bldg

Heavy Lift Staging Area

4100

888

Erect Ductwork

Start Pipe Rack Steel

Set CO2 Absorber #2

Set Stripper

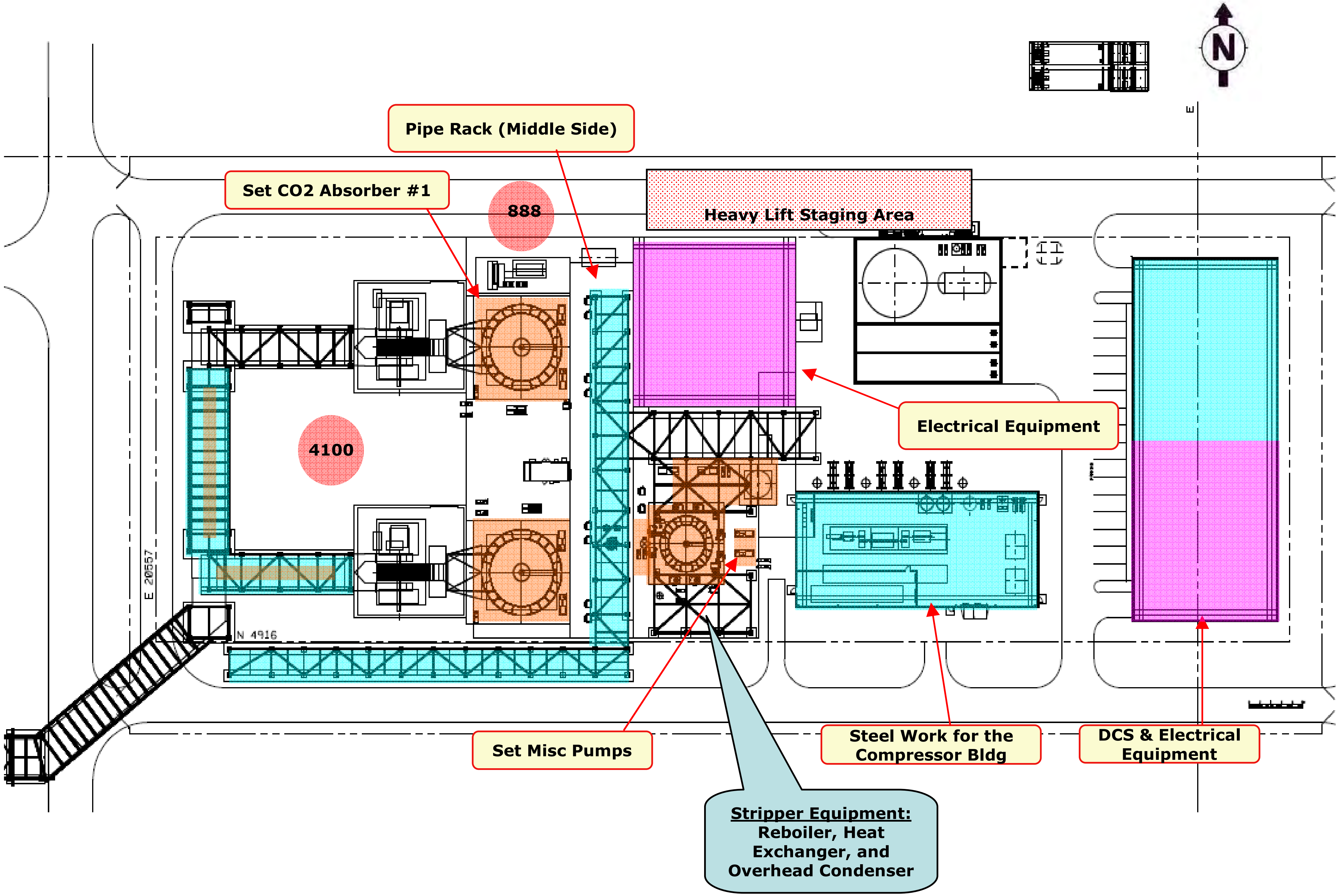
CWSB Steel

Construction Activities

- → Start Pipe Rack Steel (South Side)
- → Set south side Ductwork
- → Finish Electrical Building Steel Work
- → Continue Control Room / Workshop Building Steel
- → Set the Absorber #2
- → Set The Stripper
- → Concrete for the Compressor Building

Color Legend:

Concrete	Electrical Equipment
Underground Utilities	Blasting
Mechanical Equipment	Crane
Steel	



Karsto Facility

Month 20

Construction Activities

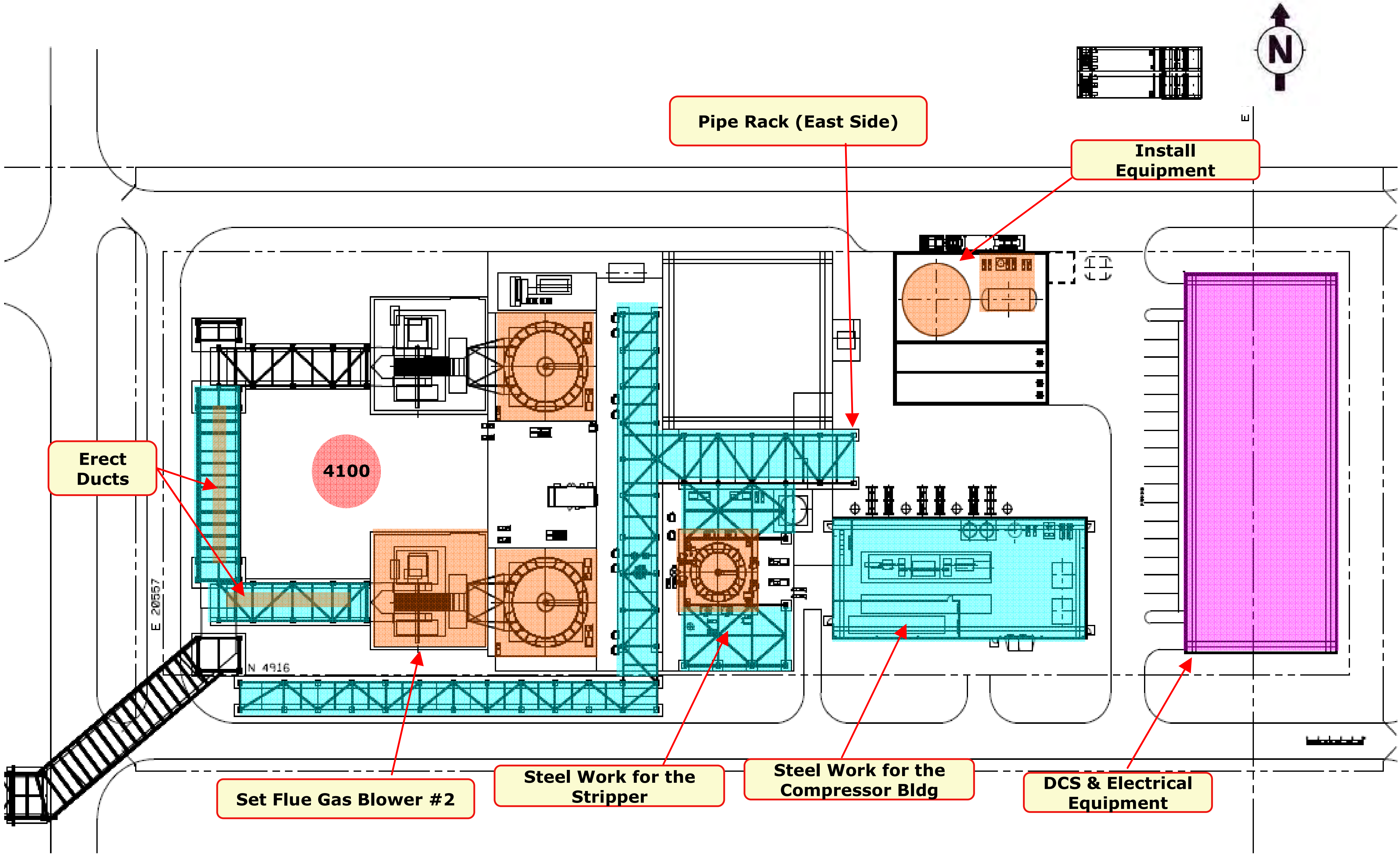
- ➔ Set Miscellaneous Pumps
- ➔ Relocate the 888 Crane from the East side
- ➔ Start Erect Compressor Building
- ➔ DCS & Electrical Equipment for Control Room / Workshop Building
- ➔ Finish Steel Work for the CWSB
- ➔ Start Pipe Rack Steel (Middle Side)
- ➔ Set Ductworks
- ➔ Set The Absorber #1
- ➔ Setting Absorbers Equipments & Pipes

Color Legend:

Concrete
Electrical Equipment
Underground Utilities
Blasting
Mechanical Equipment
Crane
Steel

Karsto Facility

Month 21



Pipe Rack (East Side)

Install Equipment

Erect Ducts

Set Flue Gas Blower #2

Steel Work for the Stripper

Steel Work for the Compressor Bldg

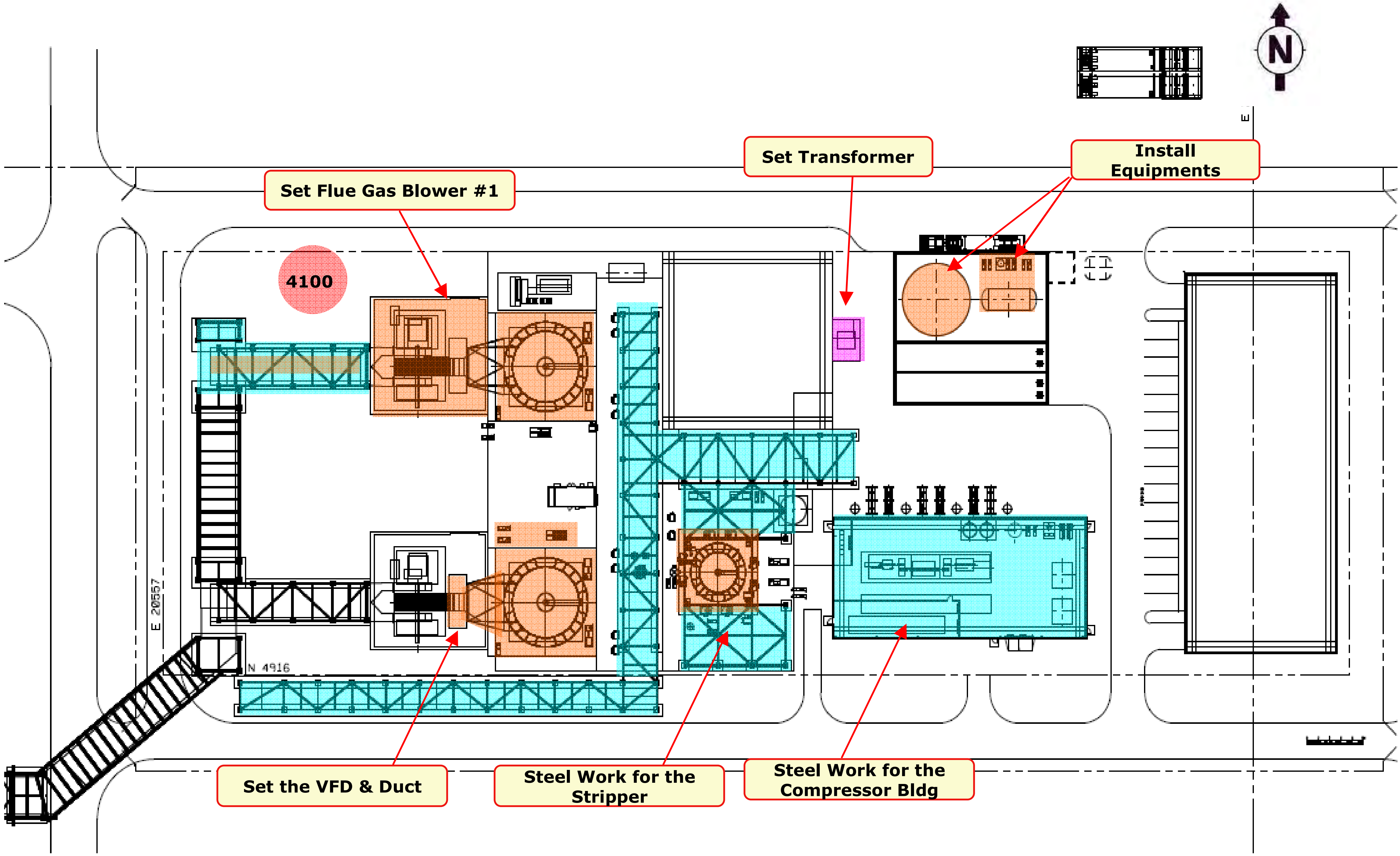
DCS & Electrical Equipment

Construction Activities

- → Start Cable Pulling
- → Finish Setting Electrical Equipment for Control Room / Workshop Building
- → Set Equipment for the Amine Building
- → Start Pipe Rack Steel (East Side)
- → Set The Blower #2
- → Continue Setting the Ducts
- → Continue Setting Absorbers Equipments & Pipes
- → Start Stripper Steel work

Color Legend:

Concrete	Electrical Equipment
Underground Utilities	Blasting
Mechanical Equipment	Crane
Steel	



Karsto Facility

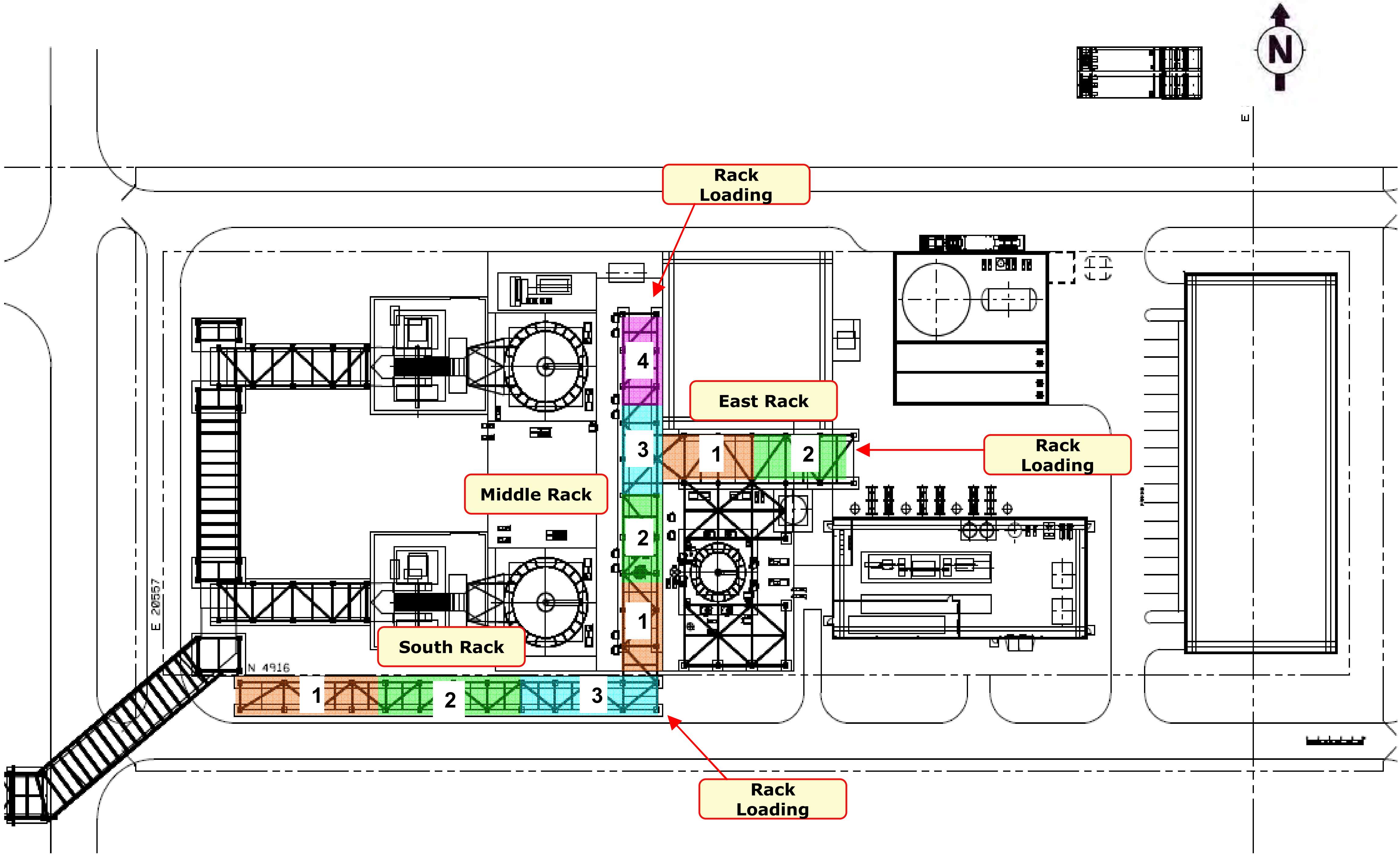
Month 22

Construction Activities

- Start Set the Transformer
- Relocate the 4100 Crane
- Continue Pipe Rack Steel.
- Continue Setting Absorbers Equipments & Pipes
- Setting the Ducts
- Continue Setting the Equipments for the Amine Building
- Setting The Duct Between The Blower And Absorber #2
- Setting The VFD for the Blower #2
- Continue Stripper Steel work

Color Legend:

Concrete	Electrical Equipment
Underground Utilities	Blasting
Mechanical Equipment	Crane
Steel	



Karsto Facility

Pipe Rack Sequence

Notes:

- → Go to Month 19 for Rack Sequencing

Rack Module Sequence:

1) SR1
2) SR2
3) SR3
4) MR1
5) MR2
6) MR3
7) MR4
8) ER1
9) ER2

17.0-Optional Functionalities

17.0 Optional Functionalities

The following items represent possible options and opportunities that could be implemented in the engineering, procurement, construction, and installation (EPCI) phase of the Kårstø CO_2 Carbon Capture and Compression (CCC) Plant project:

1. Add a spray header under the absorber demister to increase its efficiency by keeping it wet, and delete the upper absorber packing bed.

2. Delete the individual pump minimum flow recirculation lines and use only a single recirculation system for the redundant pumps.

3. Move pump P-105A/B downstream of heat exchanger E-107 to reduce pump exposure to the hot amine from the stripper; pump NPSH will not be an issue.

4. Move all of the stream flows 102/202/333 (pumps P-102/ P-104/P-109) to Tank TK-102 to blend the streams before returning to the absorber as stream 104/204.

5. Move out-feed from carbon filter F-107 to tank TK-102 to blend this stream in the tank prior to returning to the process. This makes F-107 an atmospheric vessel and facilitates changing the filter beds. Make the filter dual in-line to permit on-line filter media change out.

6. Add a CO_2 compressor 1st stage inlet cooler in the recycle line to save motive power demand, which would reduce total compression HP and handle any 1st stage spillback flow without combining the spillback with the stripper overhead condenser. This scheme would simplify compressor startup since it isolates the compressor from stripper operation.

7. Provide each stripper reboiler with its own column connection for better symmetry and subsequent flow.

8. Move dual filters to the pump skids, with one filter per pump, since the pumps and their filters are redundant.

9. Change to caustic soda (NaOH) for the reclaimer as this is easier and safer to handle than soda ash.

10. Provide for a bunkered shelter under the flue gas duct or around the west end of the CCC Plant to reduce the travel distance for the operator in case of a site alarm.

11. Design the stack tie-in as a reinforced rib/plate steel template attached to the east side of the heat recovery steam generator (HRSG) stack with hole penetrations the same as the present HRSG breeching penetration, to eliminate the need for the external structural steel frame.

12. Steam generators (E-112, E-114, and E-116) are all single-pass tubular exchangers. Provide them as double-ended kettle type for steam collection and disengagement, plus a steam dome with demister to further reduce water carryover.

13. Remove the steam generators from the interstage compressor cooling arrangement to reduce capital cost.

14. Produce all low-pressure (LP) steam onsite using natural gas to avoid derating the Naturkraft plant steam turbine. This will avoid the cost of steam and condensate piping and preclude any possibility of condensate contamination.

15. Produce steam on site at a higher pressure (4 barg) to improve the overall amine plant efficiency.

16. Incorporate amine degradation byproducts into the simulation model when these products are determined by theoretical study.

17. Develop a blinding and isolation philosophy to possibly remove some of the piping blinds.

18. Assess the efficiency of a three-stage compressor versus a compressor with more stages.

19. Optimize the flow rate through the carbon filter package to reduce waste generation.

20. Investigate minimum flue gas vent temperature to recover more water. Dispersion modeling will need to be done to ascertain minimum flue gas temperature.

21. Investigate the opportunity to recover heat from the condensate before returning to the offsite battery limit (OSB/L).

22. Reassess the bypass requirements for the heat exchangers given their built in over-capacity.

23. Investigate recovering of the water generated during dryer regeneration operations.

24. If required based on emissions dispersion modeling being completed by the Owner, provide an absorber tower discharge stack that is larger in diameter.

25. Remove the split flow amine equipment (E-103/E-107/E-109, V-101, and P-106A/B) to reduce capital cost.

26. Consider higher MEA concentrations.

[redacted]

18.0-References

18.0 References

18.1 Attached Documents

The following documents are attached to this FEED Study:

- 10112936-PB-P-DGM-0001 (25474-000-M6-BA-00001) – Ducting and Instrument Diagram, Flue Gas System
- 10112936-PB-P-DGM-0002 (25474-000-M6-BA-00002) – Ducting and Instrument Diagram, Flue Gas System
- 10112936-PB-R-PAL-0001 (25474-000-M0X-0000-00001) – Mechanical Equipment List
- 10112936-PB-G-DRW-0001 (25474-000-P1-0010-00001) – General Arrangement Plan
- 10112936-PB-G-DRW-0002 (25474-000-P1-0310-00001) – Main Plant Layout, Flue Gas Blower/Absorber Area
- 10112936-PB-G-DRW-0003 (25474-000-P1-0310-00002) – Main Plant Layout, Stripper Area/CO_2 Compressor Building
- 10112936-PB-G-DRW-0004 (25474-000-P1-0310-00003) – Main Plant Layout, Control/Workshop/Stores Building, Switchgear Building & Tank Farm
- 10112936-PB-G-DRW-0007 (25474-000-P1-0010-00002) – Plant Interface Tie-Point Plan
- 10112936-PB-C-TED-0005 (25474-000-CS-0000-00001) – Access Roads and Finish Grading Plan
- 10112936-PB-C-PLN-0005 (25474-000-A1-3110-00001) – Conceptual Plan, Control/Workshop/Stores Building
- 10112936-PB-E-DGM-0001 (25474-000-E1-0000-00001) – [Electrical] Main Single line Diagram
- 10112936-PB-E- DGM-0002 (25474-000-E1-0000-00002) – [Electrical] DC and UPS Single line Diagram
- 10112936-PB-C-DRW-0003 (25474-000-C0-0000-00001) – Construction Facilities Plan

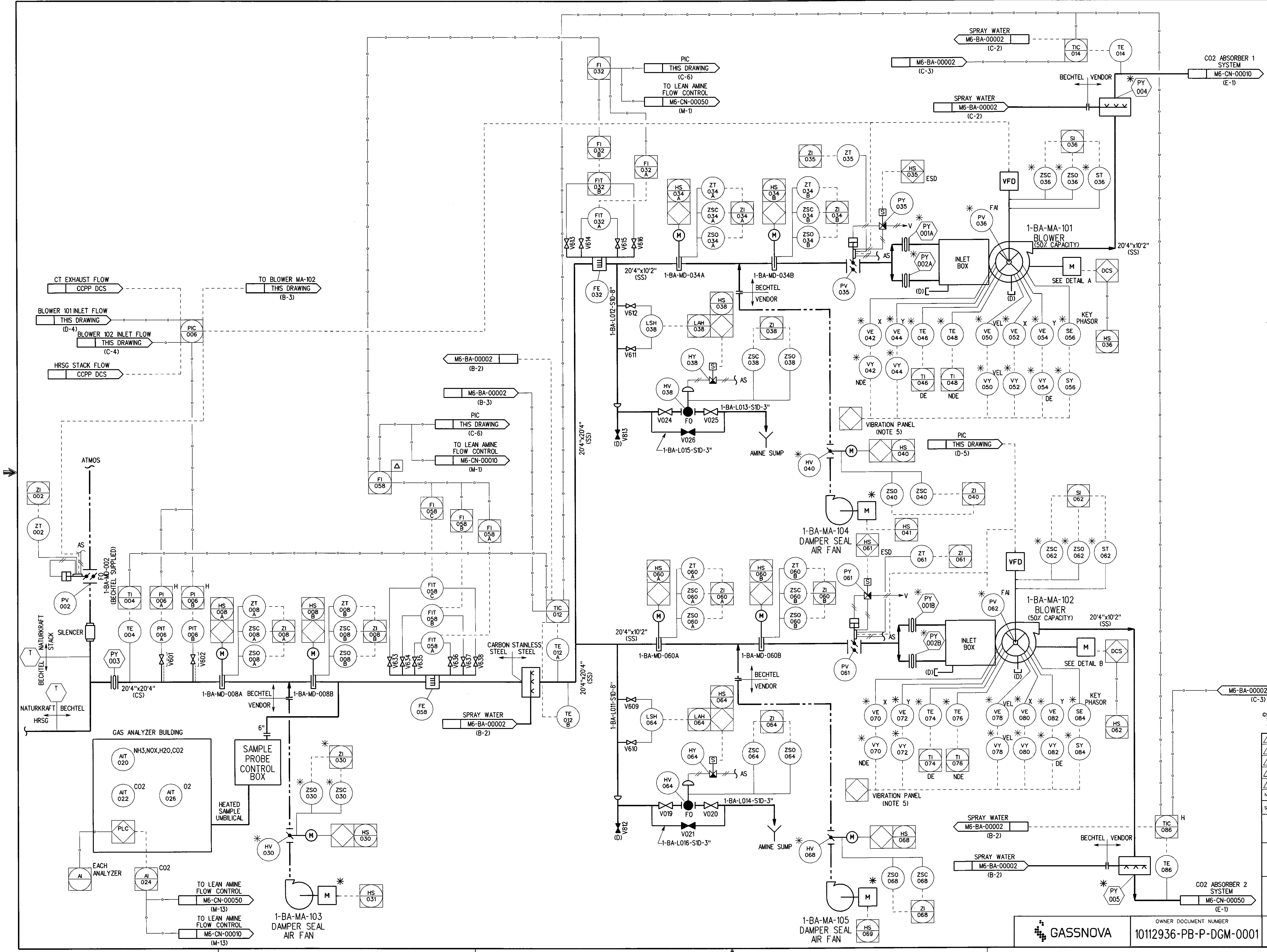
18.2 Supplementary Lists

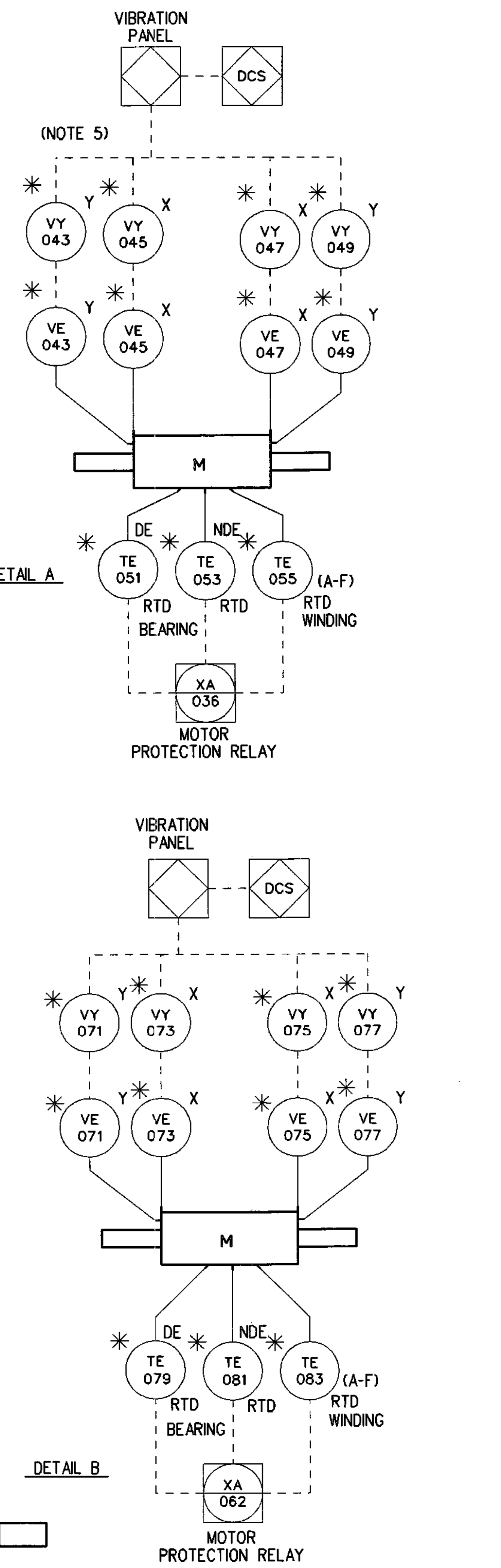
The following provide a comprehensive list of documents submitted as part of the FEED Study and that are available from PKM:

- FEED Study Document List - From Bechtel's ***Info****Works* document control system
- Fichtner Review Sheets List –A list of the Review Sheets and the completion status of contractor responses

NOTES:

1. FOR SYMBOLS AND LEGENDS SEE DRAWINGS M6J-YA-00001 THROUGH M6J-YA-00005.
2. ALL LINES, VALVES, EQUIPMENT, AND INSTRUMENT NUMBERS ARE PREFIXED WITH "BA", UNLESS NOTED OTHERWISE.
3. ALL VENTS, DRAINS AND INSTRUMENTATION ROOT VALVES ARE 1", UNLESS NOTED OTHERWISE.
4. ✳ SYMBOL INDICATES EQUIPMENT SUPPLIED BY VENDOR.
5. SINGLE VIBRATION MONITORING PANEL.





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NO.	DATE	REVISIONS	BY	CHK	MECH SUPV	CS SUPV	PD SUPV	PROJ ENGR
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0	13 NOV 08	ISSUED FOR APPROVAL					-	

SCALE	DESIGNED	DRAWN	PM

BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

PIPING & INSTRUMENT DIAGRAM
FLUE GAS SYSTEM

GASSNOVA	OWNER DOCUMENT NUMBER	BECHTEL	JOB NO.	DRAWING NO.	REV
	10112936-PB-P-DGM-0001		25474-000	M6-BA-00001	0

22 x 34 "D" SIZE

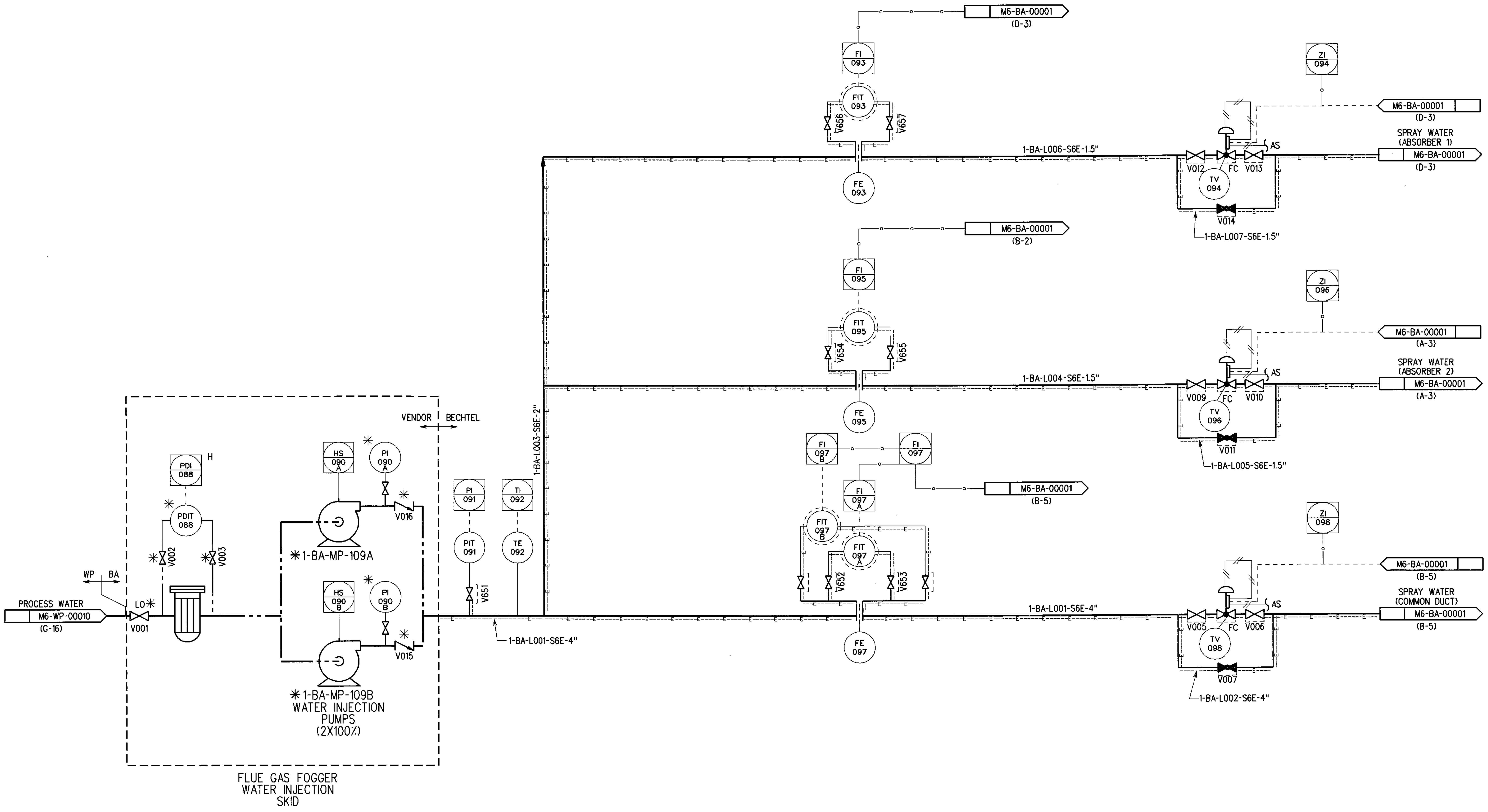
A R I

6 5 4 3 2

D C B A

LEVELS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63

FOR NOTES SEE DRAWING M6-BA-00001



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NO.	DATE	REVISIONS	BY	CHK	MECH SUPV	CS SUPV	PD SUPV	PROJ ENGR

SCALE | DESIGNED | DRAWN | PM

BECHTEL POWER CORPORATION

FREDERICK, MARYLAND

CO2 KARSTO PROJECT

PIPING & INSTRUMENT DIAGRAM
FLUE GAS SYSTEM

GASSNOVA

OWNER DOCUMENT NUMBER	JOB NO.	DRAWING NO.	REV
10112936-PB-P-DGM-0002	25474-000	M6-BA-00002	0

22 x 34 "D" SIZE

A R I

LEVELS 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63

Kårstø CO_2 Capture and Compression Plant

Kårstø, Norway

Mechanical Equipment List

(25474-000-M0X-0000-00001)

for Front-End Engineering and Design (FEED) Study Report

Mechanical Equipment List

CO2 Karsto Project

Job No: 25474

Document No.: 25474-000-M0X-0000-00001

Rev. No.: 1

Project Qty	System Code	Tag No.	Item Description	Capacity Per Component	Type	P&ID	Nominal or Rated	Units (Each)	Diff.	Motor (Rated)	LD./W	H/T-T	Surf Area	Metallurgy / Remarks
									bar	kW	m	m	m^2	
1	BA	MA-101	Flue gas blower (Absorber 1)	1x100% per Train (50% per Unit)	Horizontal Centrifugal	M6-BA-00001	1,252,885	m^3/h	0.1	6340	N/A	N/A	N/A	Stainless Steel Housing and Internals; Includes 2x100% lube oil pumps
1	BA	MA-102	Flue gas blower (Absorber 2)	1x100% per Train (50% per Unit)	Horizontal Centrifugal	M6-BA-00001	1,252,885	m^3/h	0.1	6340	N/A	N/A	N/A	Stainless Steel Housing and Internals; Includes 2x100% lube oil pumps
1	SB	MB-101	Auxiliary Boiler	1x100%	Saturated steam boiler with 2x100% feedwater pumps, deaerator w/storage tank, blowdown tank, chemical feed skid, etc.	M6-SB-00001	20	Tonnes/hr	N/A	7.5	N/A	N/A	N/A	
2	PA	MC-101A/B	Instrument/Service Air Compressor	2x100%	Horizontal Rotary Screw, Air-Cooled, Acoustical Enclosure	M6-PA-00001	500	m^3/h	N/A	55	1.0 (W) x 2.6 (L)	1.8	N/A	1600 kg
1	QG	MC-103	CO2 Compressor	1x100%	Centrifugal; 3 Stage	M6-QG-00020, -00050 & -00090	74684	m^3/h	92.7	20,000	4.0 (W) x 21.4 (L)	4.1	N/A	Including 2x100% lube oil pumps.
2	CN	ME-101	Wash Water Cooler (Absorber 1)	2x50% per Train	Plate and Frame	M6-CN-00030	30.7	MW	N/A	N/A	1.95 (W) x 3.8 (L)	3.8	743	Titanium.
1	CN	ME-102	Lean Amine Cooler	1x100%	Welded Plate and Frame	M6-CN-00080	10.7	MW	N/A	N/A	TBD	TBD	TBD	Titanium. Alfa Laval Compabloc type
2	CN	ME-103A/B	Semi-Lean / Rich Heat Exchanger	2x50%	Welded Plate and Frame	M6-CN-00085	15.4	MW	N/A	N/A	TBD	TBD	TBD	Stainless steel. Alfa Laval Compabloc type
2	CN	ME-104	Wash Water Cooler (Absorber 2)	2x50% per Train	Plate and Frame	M6-CN-00070	30.7	MW	N/A	N/A	1.95 (W) x 3.8 (L)	3.8	743	Titanium.
1	CN	ME-107	Flash Feed Heat Exchanger	1x100%	Welded Plate and Frame	M6-CN-00100	2.9	MW	N/A	N/A	TBD	TBD	TBD	Stainless steel. Alfa Laval Compabloc type
8	CN	ME-108A/H	Lean/Rich Amine Heat Exchanger	8x12.5%	Welded Plate and Frame	M6-CN-00080 through -00084	18.1	MW	N/A	N/A	1.2 (W) x 4.6 (L)	3.2	8392.0	Stainless steel. Alfa Laval Compabloc type
1	CN	ME-109	Flash Feed Heater	1x100%	Welded Plate and Frame	M6-CN-00100	5.4	MW	N/A	N/A	TBD	TBD	TBD	Stainless steel. Alfa Laval Compabloc type
8	CN	ME-110A/H	Stripper Reboiler	8x12.5%	Welded Plate and Frame	M6-CN-00150 & -00160	15.3	MW	N/A	N/A	1.75 (W) x 1.75 (L)	3.5	534.0	Stainless steel. Alfa Laval Compabloc type

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Project Qty	System Code	Tag No.	Item Description	Capacity Per Component	Type	P&ID	Nominal or Rated	Units (Each)	Diff. bar	Motor (Rated) kW	LD./W m	H/T-T m	Surf Area m^2	Metallurgy / Remarks
4	CN	ME-111A/D	Overhead Stripper Condenser	4x25%	Plate and Frame	M6-CN-00130	61.3	MW	N/A	N/A	TBD	TBD	TBD	Titanium.
1	QG	ME-112	CO2 Compressor 1st Stage Steam Generator	1x100%	Shell & Tube	M6-QG-00030	1.8	MW	N/A	N/A	1.3 (W) x 2.9 (L)	TBD	426	CO2 Side - SS Tubes. Steam/Cond Side - CS Shell
1	QG	ME-113	CO2 Compressor 1st Stage Intercooler	1x100%	Shell & Tube	M6-QG-00030	6.5	MW	N/A	N/A	1.3 (W) x 6.6 (L)	TBD	510	CO2 Side - 304LSS Shell. Sea Water Side - Titanium or SeaCure Tubes.
1	QG	ME-114	CO2 Compressor 2nd Stage Steam Generator	1x100%	Shell & Tube	M6-QG-00060	1.8	MW	N/A	N/A	1.2 (W) x 3.8 (L)	TBD	262	CO2 Side - SS Tubes. Steam/Cond Side - CS Shell
1	QG	ME-115	CO2 Compressor 2nd Stage Intercooler	1x100%	Shell & Tube	M6-QG-00060	4.3	MW	N/A	N/A	1.0 (W) x 7.2 (L)	TBD	392	CO2 Side - 304LSS Shell. Sea Water Side - Titanium or SeaCure Tubes.
1	QG	ME-116	CO2 Compressor 3rd Stage Steam Generator	1x100%	Shell & Tube	M6-QG-00100	2.1	MW	N/A	N/A	1.0 (W) x 4.5 (L)	TBD	279	CO2 Side - SS Tubes. Steam/Cond Side - CS Shell
1	QG	ME-117	CO2 Cooler	1x100%	Shell & Tube	M6-QG-00100	10.6	MW	N/A	N/A	1.1 (W) x 7.2 (L)	TBD	463	CO2 Side - 304LSS Shell. Sea Water Side - Titanium or SeaCure Tubes.
1	CY	ME-118	Amine Storage Tank Heater	1x100%	Electric Bayonet	M6-CY-00010	11	KW	N/A	N/A	N/A	N/A	N/A	
1	CY	ME-119	Lean Amine Solvent Storage Tank Heater	1x100%	Electric Bayonet	M6-CY-00010	150	KW	N/A	N/A	N/A	N/A	N/A	
1	WP	ME-123	Process Water Surge Storage Tank Heater	1x100%	Electric Bayonet	M6-WP-00010	11	KW	N/A	N/A	N/A	N/A	N/A	
1	CN	MF-101	Lean Amine Side Stream Carbon Filter	1x100%	Carbon	M6-CN-00090	420	m^3/h	1	N/A	N/A	N/A	N/A	Stainless steel housing. Packaged skid w/pre-filter and after-filter
2	CN	MF-102A/B	Rich Amine Mechanical Filter	2x100%	Cartridge	M6-CN-00040	2500	m^3/h	0.5	N/A	N/A	N/A	N/A	10 micron absolute filter. Stainless steel housing & Polypropylene cartridge.
2	CN	MF-105A/B	Lean Amine Mechanical Filter	2x100%	Cartridge	M6-CN-00170	2000	m^3/h	0.5	N/A	N/A	N/A	N/A	10 micron absolute filter. Stainless steel housing & Polypropylene cartridge.
1	CN	MF-106	Lean Amine Side Stream Pre-Filter	1x100%	Cartridge	M6-CN-00090	420	m^3/h	0.5	N/A	N/A	N/A	N/A	5 micron absolute filter. Stainless steel housing & Polypropylene cartridge. Packaged skid with carbon filter.
1	CN	MF-107	Lean Amine Side Stream After-Filter	1x100%	Cartridge	M6-CN-00090	420	m^3/h	0.5	N/A	N/A	N/A	N/A	10 micron absolute filter. Stainless steel housing & Polypropylene cartridge. Packaged skid with carbon filter.
2	XW	MF-108A/B	Amine Return Filter	2x100%	Cartridge	M6-XW-00001	125	m^3/h	1	N/A	N/A	N/A	N/A	10 micron absolute filter. Stainless steel housing & Polypropylene cartridge.

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									bar	kW	m	m	m^2	
1	AN	MG-101	Standby diesel generator	1x100%	Diesel driven	N/A	600	KW	N/A	N/A	N/A	N/A	N/A	Fuel oil storage tank integral with generator.
2	CN	MP-101A/B	Rich Amine Pump (Absorber 1)	2x100% per Absorber	Horizontal Centrifugal	M6-CN-00040	1361	m^3/h	16.1	900	N/A	N/A	N/A	API 610 design. Stainless Steel.
2	CN	MP-102A/B	Wash Water Recirculation Pump (Absorber 1)	2x100%	Horizontal Centrifugal	M6-CN-00030	1811	m^3/h	4.9	370	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design
2	CN	MP-104A/B	Wash Water Recirculation Pump (Absorber 2)	2x100%	Horizontal Centrifugal	M6-CN-00070	1811	m^3/h	4.9	373	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design
2	CN	MP-105A/B	Lean Amine Pump	2x100%	Horizontal Centrifugal	M6-CN-00170	2175	m^3/h	10.4	900	N/A	N/A	N/A	API 610 design. Stainless Steel.
2	CN	MP-106A/B	Flash Drum Pump	2x100%	Horizontal Centrifugal	M6-CN-00110	548	m^3/h	5	107	N/A	N/A	N/A	API 610 design. Stainless Steel.
2	CN	MP-107A/B	Reflux Pump	2x100%	Horizontal Centrifugal	M6-CN-00140	95	m^3/h	5.4	45	N/A	N/A	N/A	Capacity includes an assumed constant recirc flow. Constant speed motor. Stainless steel. ANSI design
2	QG	MP-108A/B	CO2 Product Sendout Pump	2x100%	Horizontal Centrifugal	M6-QG-00100	194	m^3/h	118	960	N/A	N/A	N/A	API 610 design. Stainless Steel.
2	BA	MP-109A/B	Flue Gas Fogger Water Supply Pump	2x100%	Horizontal Centrifugal	M6-BA-00002	65	m^3/h	30	93	N/A	N/A	N/A	Supplied with fogger skid package. Constant speed motor. Stainless steel. ANSI design
2	CY	MP-110A/B	Fresh Amine Metering Pump	2x100%	Positive Displacement	M6-CY-00010	0.2	m^3/h	8	1	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design
2	CY	MP-111A/B	Lean Amine Solvent Fill Pump	2x100%	Horizontal Centrifugal	M6-CY-00010	91	m^3/h	7.6	45	N/A	N/A	N/A	Stainless steel. ANSI design.
2	XW	MP-112A/B	Amine Waste Sump Pump	2x100%	Vertical Centrifugal	M6-XW-00001	55	m^3/h	3.5	11	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design. Located in concrete sump.
2	XW	MP-113A/B	Wastewater Forwarding Pump	2x100%	Vertical Centrifugal	M6-XW-00002	35	m^3/h	1	7.5	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design. Located in concrete sump.
2	SC	MP-114A/B	LP Condensate Return Pump	2x100%	Vertical Centrifugal	M6-SC-00001	225	m^3/h	8	75	N/A	N/A	N/A	Constant speed motor. SS impeller. ANSI design
2	WL	MP115A/B	Sea Water Cooling Pump	2x100%	Vertical Centrifugal	M6-WL-00001	17340	m^3/h	2.1	1500	N/A	N/A	N/A	Single speed motor. Duplex stainless steel. ANSI design. Located in Owner's intake dry pit.
2	CY	MP-116A/B	Chemical Additive Metering Pump	2x100%	Positive Displacement	N/A	1	m^3/h	7	0.37	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design
2	CY	MP-117A/B	Caustic Metering Pump	2x100%	Positive Displacement	N/A	0.2	m^3/h	3.1	1	N/A	N/A	N/A	Constant speed motor. Stainless steel. ANSI design

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							or Rated		bar	kW	m	m	m^2	
2	WP	MP-119A/B	Absorber makeup water pumps	2x100%	Horizontal Centrifugal	M6-WP-00010	15	m^3/h	2	1.5	N/A	N/A	N/A	Common pumps feed both absorbers. Constant speed motor. SS impeller. ANSI design
2	WL	MP-121A/B	Sea Water Cooling Booster Pump	2x100%	Horizontal Centrifugal	M6-WL-00001	5124	m^3/h	0.84	224	N/A	N/A	N/A	Constant speed motor. Duplex SS. ANSI design
2	WR	MP-122A/B	Raw (Softened) Water Supply Pumps	2x100%	Horizontal Centrifugal	M6-WR-00001	9	m^3/h	1.17	1	N/A	N/A	N/A	Constant speed motor. SS impeller. ANSI design
2	CN	MP-124A/B	Rich Amine Pump (Absorber 2)	2x100% per Absorber	Horizontal Centrifugal	M6-CN-00040	1361	m^3/h	16.1	900	N/A	N/A	N/A	API 610 design. Stainless Steel.
2	WD	MP-125A/B	Demineralized Water Pumps	2x100%	Horizontal Centrifugal	M6-WD-00001	1	m^3/h	7	1	N/A	N/A	N/A	Constant speed motor. SS. ANSI design
2	CN	T-101, 102	CO2 Absorber	2x50%	Vertical Column	00020, - 00050, & - 00060	N/A	N/A	N/A	N/A	11.8	44.3	N/A	Stainless steel
1	CN	T-103	Stripper	1x100%	Vertical Column	M6-CN-00120 & - 00130	N/A	N/A	N/A	N/A	6.7	43.6	N/A	Stainless steel
1	CY	MT-101	Amine Storage Tank (Concentrated)	1x100%	Horizontal	M6-CY-00010	85	m^3	N/A	N/A	TBD	TBD	N/A	Fiberglass w/Electric Heater
1	CY	MT-102	Lean Amine Solvent (35% MEA) Storage Tank	1x100%	Vertical	M6-CY-00010	1638	m^3	N/A	N/A	TBD	TBD	N/A	Stainless steel w/Electric Heater
1	WP	MT-104	Process Water Surge Tank	1x100%	Vertical	M6-WP-00010	104	m^3	N/A	N/A	TBD	TBD	N/A	Fiberglass w/Electric Heater
1	WR	MT-107	Raw (Softened) Water Storage Tank	1x100%	Vertical	M6-WR-00001	6	m^3	N/A	N/A	TBD	TBD	N/A	Fiberglass
1	CN	MT-108	Reclaimer Waste Storage Tank	1x100%		N/A		m^3	N/A	N/A	TBD	TBD	N/A	Carbon steel
1	PA	MT-109	Instrument Air Receiver	1x100%	Vertical, ASME VIII	M6-PA-00001	40	m^3	N/A	N/A	TBD	TBD	N/A	Carbon steel
1	WD	MT-110	Demineralized Water Storage Tank	1x100%	Vertical	M6-PA-00001	2	m^3	N/A	N/A	TBD	TBD	N/A	Fiberglass
1	CN	MV-201	Semi-Lean Flash Drum	1x100%	Vertical, ASME VIII	M6-CN-00110	70	m^3	N/A	N/A	3.1	9.1	N/A	Stainless steel
1	CN	MV-202	Stripper Reflux Drum	1x100%	Vertical, ASME VIII	M6-CN-00140	60	m^3	N/A	N/A	3.7	5.5	N/A	Stainless steel
1	QG	MV-203	CO2 Compressor Suction Drum	1x100%	Vertical, ASME VIII	M6-QG-00010	75	m^3	N/A	N/A	4.0	6.0	N/A	Stainless steel
1	QG	MV-104	CO2 Compressor 1st Interstage Knockout Drum	1x100%	Vertical, ASME VIII	M6-QG-00040	23	m^3	N/A	N/A	2.7	4.1	N/A	Stainless steel
1	QG	MV-105	CO2 Compressor 2nd Interstage Knockout Drum	1x100%	Vertical, ASME VIII	M6-QG-00070	7	m^3	N/A	N/A	1.8	2.7	N/A	Stainless steel
1	QG	MV-106	CO2 Surge Drum	1x100%	Vertical, ASME VIII	M6-QG-00080	7	m^3	N/A	N/A	1.8	2.7	N/A	Stainless steel
1	SC	MV-107	LP Condensate Blowdown Tank	1x100%	Vertical, ASME VIII	M6-SC-00001	25	m^3	N/A	N/A	2.4	6.0	N/A	Carbon steel
1	BA	MS-101A/C	Flue Gas Water Fogger System	1x100%		M6-BA-00001 & - 00002	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Package includes pumps, 3 foggers (1 common duct and 1 in each blower disch to absorber) and 2x100% water supply pumps.
1	CN	MS-102	Amine Reclaimer	1x100%	Shell & Tube Evaporator Type	M6-CN-00180	TBD	TBD	N/A	N/A	TBD	TBD	N/A	Including associated instrumentation.
1	CY	MS-103	Reclaimer Chemical Feed Package	1x100%		M6-CN-00190	TBD	TBD	N/A	N/A	N/A	N/A	N/A	

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1	QG	MS-104	CO2 Drying Package	1x100%	Regenerative, Closed Loop blower type	M6-QG-00080	71078	m3/hr	N/A	N/A	5.5 (W) x 5.5 (L)	5.2	N/A	304 SS piping, valves and vesssel.
2	PA	MS-105A/B	Instrument Air Dryer	2x100%	Desiccant; Dual Columns Nonrefrigerent with Prefilters After Filters	M6-PA-00001	500	m3/hr	N/A	N/A	TBD	TBD	N/A	
8	PW		Emergency Shower	1x100%	Heated	M6-PW-00001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Uses potable water
2	BA	MD-008A/B	Common Flue Gas Duct Isolation Damper	2x100%	Motor Actuated Guillotine Type. Each 6.2m x 6.2m	M6-BA-00001	N/A	N/A	N/A	TBD	N/A	N/A	N/A	Damper package includes seal air fan skid containing 1x100% fan. Damper and damper housing material is carbon steel.
2	BA	MD-034A/B	Flue Gas Duct Isolation Damper (Absorber 1)	2x100%	Motor Actuated Guillotine Type. Each 6.2m x 3.1m	M6-BA-00001	N/A	N/A	N/A	TBD	N/A	N/A	N/A	The two-damper package for each blower includes a seal air fan skid containing 1x100% fan. Damper and housing material is stainless steel.
2	BA	MD-060A/B	Flue Gas Duct Isolation Damper (Absorber 2)	2x100%	Motor Actuated Guillotine Type. Each 6.2m x 3.1m	M6-BA-00001	N/A	N/A	N/A	TBD	N/A	N/A	N/A	The two-damper package for each blower includes a seal air fan skid containing 1x100% fan. Damper and housing material is stainless steel.
4	BA		Flue Gas Expansion Joint (Common Duct)		Each 6.2m x 6.2m	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Damper and housing material is Carbon Steel.
4	BA		Flue Gas Expansion Joint (Common Duct)		Each 6.2m x 6.2m	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Damper and housing material is Stainless Steel.
6	BA		Flue Gas Expansion Joint (Blower Duct)		Each 6.2m x 3.1m	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Damper and housing material is Stainless Steel.
1	BA	PV-002	Stack Damper Actuator	1x100%	Add pneumatic actuator to existing damper located in the CCPP 7m dia stack. Also add local volume air tank for two full strokes and quick opening solenoid (<1sec opening).	M6-BA-00001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Stainless steel air tank.
2	BA	PV-035 & -061	Control Damper at Inlet of Each Blower		Pneumatic. Each 6.2m x 3.1m	M6-BA-00001	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Stainless Steel.
8	PF		Fire Hydrants and Hose Houses			M6-PF-00001	TBD	TBD	N/A	N/A	N/A	N/A	N/A	
10	PF		Fire Extinguishers	1x100%	Handheld (ABC Dry Powder)	N/A	TBD	TBD	N/A	N/A	N/A	N/A	N/A	Quantity as required.
1	PF		Fire Extinguishers	1x100%	Wheeled (ABC Dry Powder)	N/A	TBD	TBD	N/A	N/A	N/A	N/A	N/A	Quantity as required.

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10	PF		Fire Extinguishers	1x100%	Handheld (CO2)	N/A	TBD	TBD	N/A	N/A	N/A	N/A	N/A	Quantity as required.
9	PW		Emergency Eyewash	1x100%	Heated	M6-PW-00001	TBD	TBD	N/A	N/A	N/A	N/A	N/A	Uses bottled water
1	PF		Wet Pipe Sprinkler System - CO2 Compressor Area	1x100%	Automatic	M6-PF-00001	TBD	TBD	N/A	N/A	N/A	N/A	N/A	
1	PF		Fire and Gas Detection System	1x100%		N/A	TBD	TBD	N/A	N/A	N/A	N/A	N/A	
2	VB		Control/Workshop/Stores Bldg HVAC Units (Control & Admin Areas Only)	2x100%	32 Tons	N/A	110	kW	N/A	N/A	N/A	N/A	N/A	
4	VB		Control/Workshop/Stores Bldg Vent Fans (Workshop & Stores Areas Only)	4x25%	21,000 m3/hr	N/A	3.7	kW	N/A	N/A	N/A	N/A	N/A	
6	VB		Control/Workshop/Stores Bldg Electric Unit Heaters (Workshop & Stores Areas Only)	6x17%		N/A	15	kW	N/A	N/A	N/A	N/A	N/A	
5	VB		CO2 Compressor Bldg Ventilation Fans (Compressor area)	5X25%	26,000 m3/hr	N/A	3.5	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		CO2 Compressor Bldg Ventilation Fans (VFD Area)	2x100%	24,500 m3/hr	N/A	2.2	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		CO2 Compressor Bldg Ventilation Fans (Water Treatment Area)	2x100%	10,000 m3/hr	N/A	1.1	kW	N/A	N/A	N/A	N/A	N/A	
8	VB		CO2 Compressor Bldg Electric Unit Heaters (Compressor Area)	8x14.5%		N/A	15	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		CO2 Compressor Bldg Electric Unit Heaters (VFD Area)	2X50%		N/A	15	kW	N/A	N/A	N/A	N/A	N/A	
1	VB		CO2 Compressor Bldg Electric Unit Heaters (Water Treatment Area)	1x100%		N/A	15	kW	N/A	N/A	N/A	N/A	N/A	
3	VB		Blower Bldg Ventilation Fans (Absorber 1)	3x33%	22,000 m3/hr	N/A	2.2	kW	N/A	N/A	N/A	N/A	N/A	
4	VB		Blower Bldg Electric Unit Heaters (Absorber 1)	4x25%		N/A	15	kW	N/A	N/A	N/A	N/A	N/A	
3	VB		Blower Bldg Ventilation Fans (Absorber 2)	3x33%	22,000 m3/hr	N/A	2.2	kW	N/A	N/A	N/A	N/A	N/A	
4	VB		Blower Bldg Electric Unit Heaters (Absorber 2)	4x25%		N/A	15	kW	N/A	N/A	N/A	N/A	N/A	
1	VB		Lube Oil Storage Bldg Ventilation Fan	1x100%	1,500 m3/hr	N/A	0.2	kW	N/A	N/A	N/A	N/A	N/A	
1	VB		Lube Oil Storage Bldg Unit Heater	1x100%		N/A	1	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		CO2 Compressor Bldg HVAC Units (Analyzer Room)	2x100%	1.5 Tons	N/A	5	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		Electrical Bldg HVAC Units	2x100%	25 Tons	N/A	80	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		Battery Room Exhaust Fans	2x100%	Explosion proof	N/A	0.2	kW	N/A	N/A	N/A	N/A	N/A	
2	VB		CGMS Shelter HVAC Units	2x100%	1 Ton	N/A	3	kW	N/A	N/A	N/A	N/A	N/A	

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Project Qty	System Code	Tag No.	Item Description	Capacity Per Component	Type	P&ID	Nominal	Units (Each)	Diff.	Motor (Rated)	I.D./W	H/T-T	Surf Area	Metallurgy / Remarks
							or Rated		bar	kW	m	m	m^2	
2	WD		Desalination Equipment	2x100%	2-Pass Reverse Osmosis	M6-WD-00001	8	m^3/h	N/A	N/A	TBD	TBD	N/A	FRP Housing; Packaged unit complete with filters, pumps, chemical feed skids, clean in place skid, etc.

Note: This mechanical equipment list provides preliminary data, scope, and quantities that may be subject to change during final engineering design.

0	19 Nov 08	ISSUED FOR APPROVAL	KLJ						
NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR	

Owner
GASSNOVA

CO2 KARSTO PROJECT

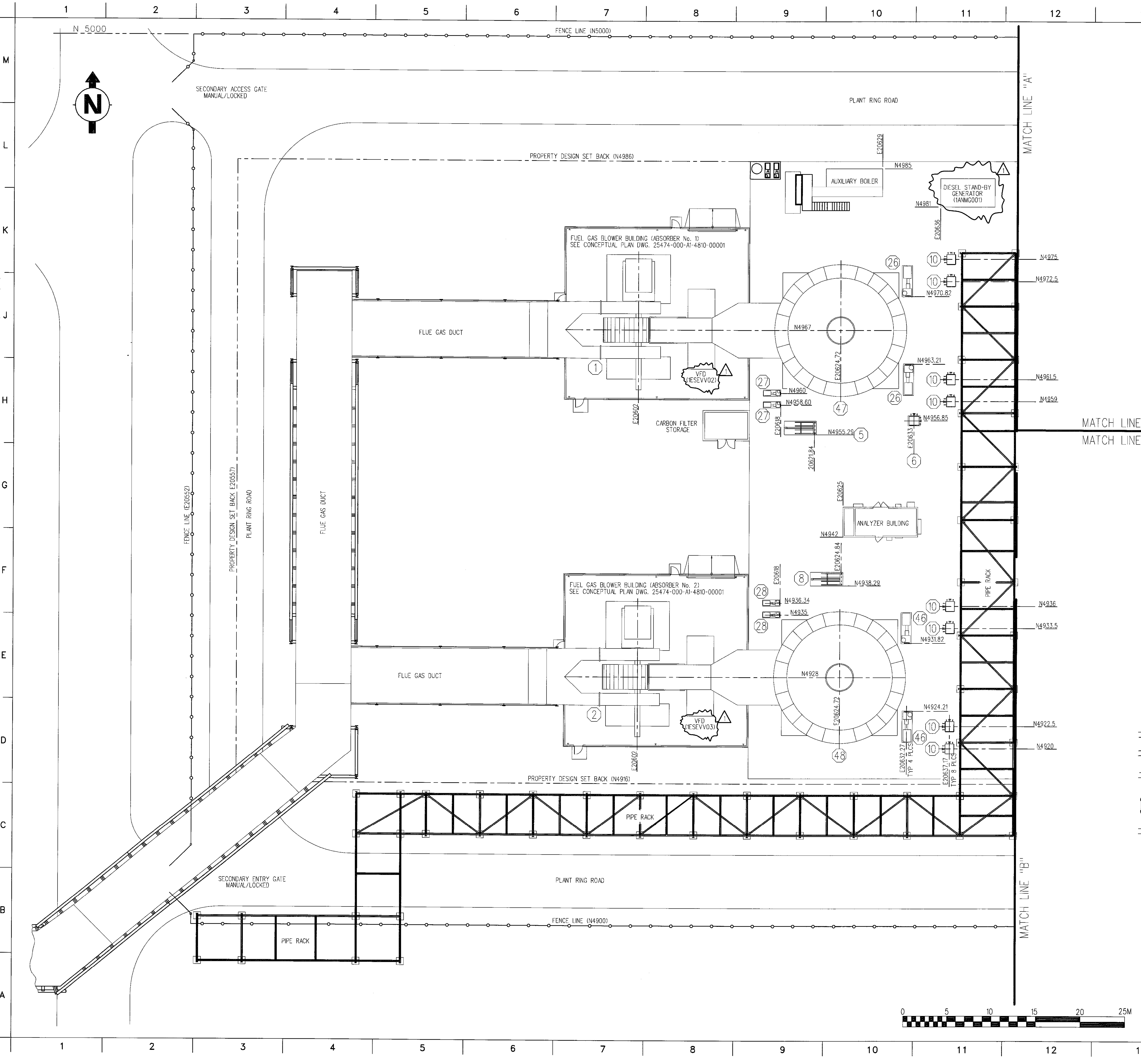
Owner Drawing No.
10112936-PB-G-DRW-0001

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

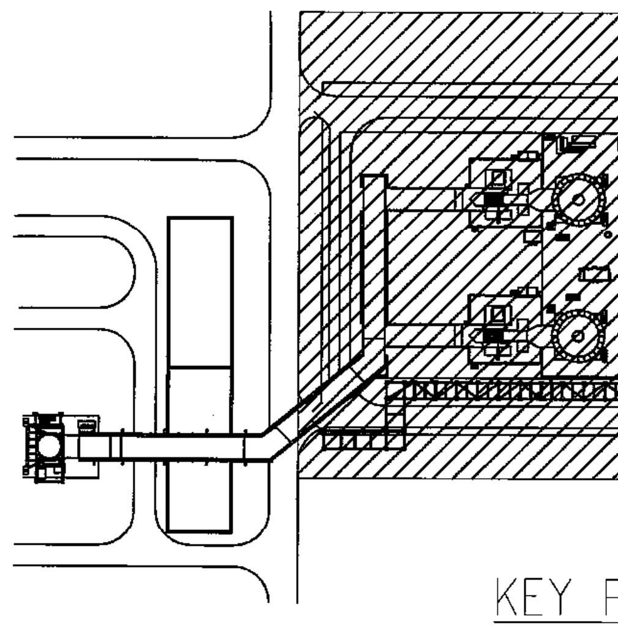
GENERAL ARRANGEMENT PLAN

Sheet Size 594x841 "A1"
Scale: 1:400

JOB NO.	DRAWING NO.	REV.
25474	P1-0010-00001	0



LEGEND			
ID NO.	EQUIPMENT TAG NO.	ALTERNATE TAG NO.	DESCRIPTION
1	MA-101	K-101	FUEL GAS BLOWER (ABSORBER 1)
2	MA-102	K-102	FUEL GAS BLOWER (ABSORBER 2)
3	MC-101A/B	N/A	INSTRUMENT/SERVICE AIR COMPRESSOR
4	MC-103A/C	K-103A/C	CO2 COMPRESSOR
5	ME-101	E-101	WASH WATER COOLER (ABSORBER 1)
6	ME-102	E-102	LEAN AMINE COOLER
7	ME-103A/B	E-103A/B	SEMI-LEAN/RICH HEAT EXCHANGER
8	ME-104	E-104	WASH WATER COOLER (ABSORBER 2)
9	ME-107	E-107	FLASH FEED HEAT EXCHANGER
10	ME-108A/H	E-108A/H	LEAN/RICH AMINE HEAT EXCHANGER
11	ME-109	E-109	FLASH FEED HEATER
12	ME-110A/H	E-110A/H	STRIPPER REBOILER
13	ME-111A/D	E-111A/D	OVERHEAD STRIPPER CONDENSER
14	ME-112	E-112	CO2 COMPRESSOR 1ST STAGE STEAM GENERATOR
15	ME-113	E-113	CO2 COMPRESSOR 1ST STAGE INTERCOOLER
16	ME-114	E-114	CO2 COMPRESSOR 2ND STAGE STEAM GENERATOR
17	ME-115	E-115	CO2 COMPRESSOR 2ND STAGE INTERCOOLER
18	ME-116	E-116	CO2 COMPRESSOR 3RD STAGE STEAM GENERATOR
19	ME-117	E-117	CO2 COOLER
20	ME-118	N/A	AMINE STORAGE TANK HEATER
21	ME-119	N/A	LEAN AMINE SOLVENT STORAGE TANK HEATER
22	ME-122	N/A	SOFTENED WATER STORAGE TANK HEATER
23	ME-123	N/A	PROCESS WATER SURGE STORAGE TANK HEATER
24	MF-101	F-101	LEAN AMINE SIDE STREAM CARBON FILTER
25	MF-102A/B	F-102A/B	RICH AMINE MECHANICAL FILTER
26	MP-101A/B	P-101A/B	RICH AMINE PUMPS (ABSORBER 1)
27	MP-102A/B	P-102A/B	WASH WATER RECIRCULATION PUMPS (ABSORBER 1)
28	MP-104A/B	P-104A/B	WASH WATER RECIRCULATION PUMPS (ABSORBER 2)
29	MP-105A/B	P-105A/B	LEAN AMINE PUMPS
30	MP-106A/B	P-106A/B	FLASH DRUM PUMPS
31	MP-107A/B	P-107A/B	REFLUX PUMPS
32	MP-108A/B	P-108A/B	CO2 PRODUCT SENDOUT PUMPS
33	MP-109A/B	P-109A/B	FLUE GAS FOGGER WATER SUPPLY PUMPS
34	MP-110A/B	P-110A/B	FRESH AMINE METERING PUMPS
35	MP-111A/B	P-111A/B	LEAN AMINE SOLVENT FILL PUMPS
36	MP-112A/B	P-112A/B	AMINE WASTE SUMP PUMPS
37	MP-113A/B	P-113	WASTEWATER FORWARDING PUMPS
38	MP-114A/B	P-114	LP CONDENSATE RETURN PUMPS
39	MP-115A/B	P-115A/B	SEA WATER COOLING PUMPS
40	MP-116A/B	P-116A/B	CHEMICAL ADDITIVE METERING PUMPS
41	MP-117A/B	P-117A/B	CAUSTIC METERING PUMPS
42	MP-119A/B	N/A	ABSORBER MAKEUP WATER PUMPS
43	MP-121A/B	N/A	SEA WATER COOLING BOOSTER PUMPS
44	MP-122A/B	N/A	SOFTENED WATER SUPPLY PUMPS
45	MP-123A/B	N/A	COMPRESSOR 1ST STAGE CONDENSATE BOOSTER PUMPS
46	MP-124A/B	P-124A/B	RICH AMINE PUMPS (ABSORBER 2)
47	MV-101	T-101	CO2 ABSORBER NO.1
48	MV-102	T-102	CO2 ABSORBER NO.2
49	MV-103	T-103	STRIPPER
50	MV-104	V-104	CO2 COMPRESSOR 1ST INTERSTAGE KNOCKOUT DRUM
51	MV-105	V-105	CO2 COMPRESSOR 2ND INTERSTAGE KNOCKOUT DRUM
52	MV-106	V-106	CO2 SURGE DRUM
53	MV-107	N/A	LP CONDENSATE BLOWDOWN TANK
54	MV-201	V-101	SEMI-LEAN FLASH DRUM
55	MV-202	V-102	STRIPPER REFLUX DRUM
56	MV-203	V-103	CO2 COMPRESSOR SUCTION DRUM
57	MT-101	TK-101	AMINE STORAGE TANK (CONCENTRATED)
58	MT-102	TK-102	LEAN AMINE SOLVENT (35% MEA) STORAGE TANK
59	MT-104	TK-104	PROCESS WATER SURGE TANK
60	MT-107	N/A	SOFTENED WATER STORAGE TANK
61	MT-109	N/A	INSTRUMENT AIR RECEIVER
62	MS-101A/C	X-101A/C	FLUE GAS WATER FOGGER SYSTEM
63	MS-102	X-102	AMINE RECLAIMER
64	MS-103	X-103	RECLAIMER CHEMICAL FEED PACKAGE
65	MS-104	X-104	CO2 DRYING PACKAGE
66	MS-105A/B	N/A	INSTRUMENT AIR DRYER



KEY PLAN

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	10/12/08	REVISED PER 10112936-S-FIPB-G-0188 TO INCORPORATE MAIN ELECTRICAL EQUIPMENT DESIGNATIONS	RPT	DB				
0	19/11/08	ISSUED FOR APPROVAL	KLJ	RPT	RPT		BTR	AJG

Owner
GASSNOVA

CO2 KARSTO PROJECT

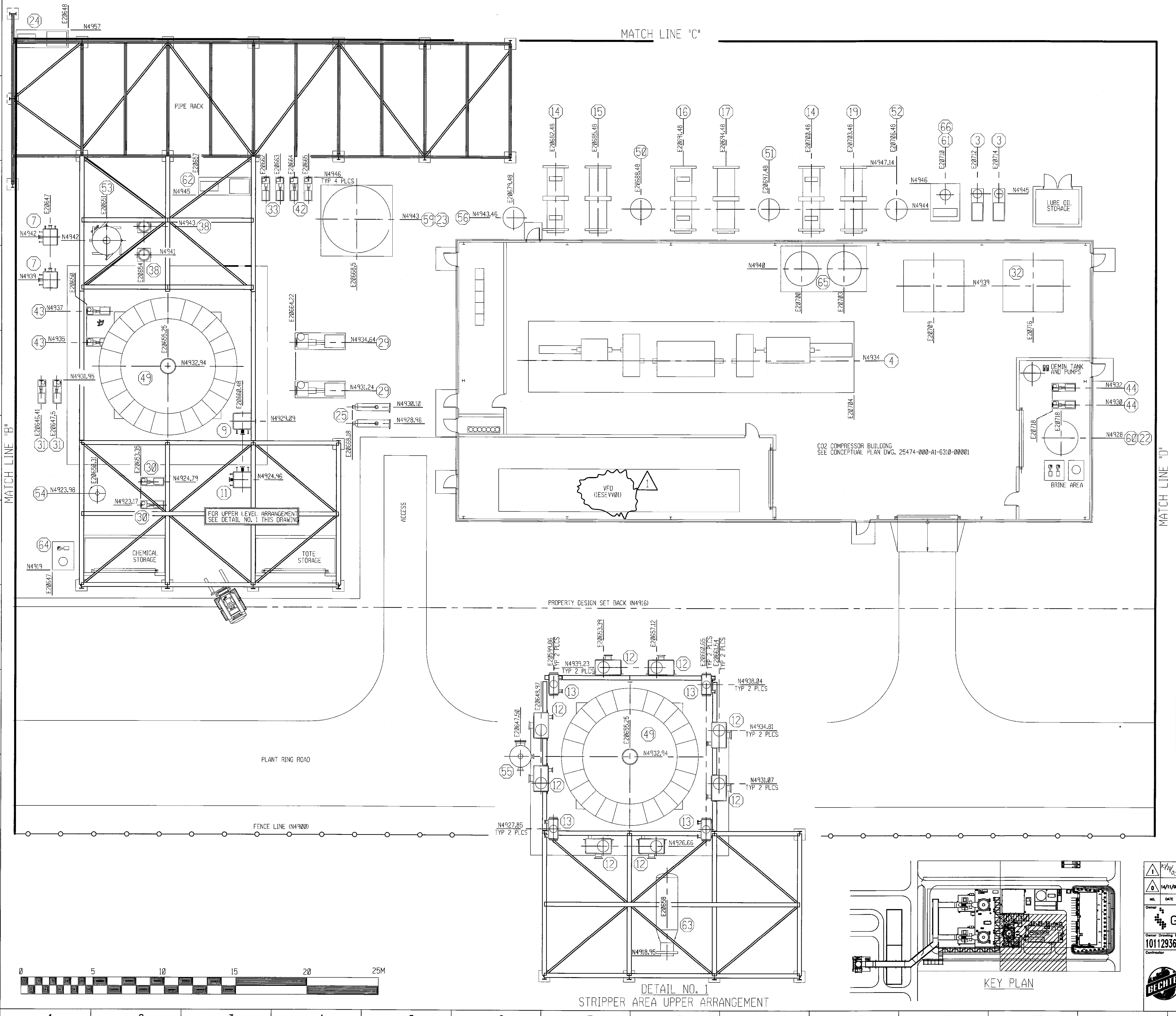
Owner Drawing No.
10112936-PB-G-DRW-0002

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

MAIN EQUIPMENT LAYOUT
FLUE GAS BLOWER/ABSORBER AREA

Sheet Size 594x841 "A1"
Scale: 1:200

JOB NO.	DRAWING NO.	REV.
25474	P1-0310-00001	1



ID NO.	EQUIPMENT TAG NO.	ALTERNATE TAG NO.	DESCRIPTION
1	MA-101	K-101	FUEL GAS BLOWER (ABSORBER 1)
2	MA-102	K-102	FUEL GAS BLOWER (ABSORBER 2)
3	MC-101A/B	N/A	INSTRUMENT/SERVICE AIR COMPRESSOR
4	MC-103A/C	K-103A/C	CO2 COMPRESSOR
5	ME-101	E-101	WASH WATER COOLER (ABSORBER 1)
6	ME-102	E-102	LEAN AMINE COOLER
7	ME-103A/B	E-103A/B	SEMI-LEAN/RICH HEAT EXCHANGER
8	ME-104	E-104	WASH WATER COOLER (ABSORBER 2)
9	ME-107	E-107	FLASH FEED HEAT EXCHANGER
10	ME-108A/H	E-108A/H	LEAN/RICH AMINE HEAT EXCHANGER
11	ME-109	E-109	FLASH FEED HEATER
12	ME-110A/H	E-110A/H	STRIPPER REBOILER
13	ME-111A/D	E-111A/D	OVERHEAD STRIPPER CONDENSER
14	ME-112	E-112	CO2 COMPRESSOR 1ST STAGE STEAM GENERATOR
15	ME-113	E-113	CO2 COMPRESSOR 1ST STAGE INTERCOOLER
16	ME-114	E-114	CO2 COMPRESSOR 2ND STAGE STEAM GENERATOR
17	ME-115	E-115	CO2 COMPRESSOR 2ND STAGE INTERCOOLER
18	ME-116	E-116	CO2 COMPRESSOR 3RD STAGE STEAM GENERATOR
19	ME-117	E-117	CO2 COOLER
20	ME-118	N/A	AMINE STORAGE TANK HEATER
21	ME-119	N/A	LEAN AMINE SOLVENT STORAGE TANK HEATER
22	ME-122	N/A	SOFTENED WATER STORAGE TANK HEATER
23	ME-123	N/A	PROCESS WATER SURGE STORAGE TANK HEATER
24	MF-101	F-101	LEAN AMINE SIDE STREAM CARBON FILTER
25	MF-102A/B	F-102A/B	RICH AMINE MECHANICAL FILTER
26	MP-101A/B	P-101A/B	RICH AMINE PUMPS (ABSORBER 1)
27	MP-102A/B	P-102A/B	WASH WATER RECIRCULATION PUMPS (ABSORBER 1)
28	MP-104A/B	P-104A/B	WASH WATER RECIRCULATION PUMPS (ABSORBER 2)
29	MP-105A/B	P-105A/B	LEAN AMINE PUMPS
30	MP-106A/B	P-106A/B	FLASH DRUM PUMPS
31	MP-107A/B	P-107A/B	REFLUX PUMPS
32	MP-108A/B	P-108A/B	CO2 PRODUCT SENDOUT PUMPS
33	MP-109A/B	P-109A/B	FLUE GAS FOGGER WATER SUPPLY PUMPS
34	MP-110A/B	P-110A/B	FRESH AMINE METERING PUMPS
35	MP-111A/B	P-111A/B	LEAN AMINE SOLVENT FILL PUMPS
36	MP-112A/B	P-112A/B	AMINE WASTE SUMP PUMPS
37	MP-113A/B	P-113	WASTEWATER FORWARDING PUMPS
38	MP-114A/B	P-114	LP CONDENSATE RETURN PUMPS
39	MP-115A/B	P-115A/B	SEA WATER COOLING PUMPS
40	MP-116A/B	P-116A/B	CHEMICAL ADDITIVE METERING PUMPS
41	MP-117A/B	P-117A/B	CAUSTIC METERING PUMPS
42	MP-119A/B	N/A	ABSORBER MAKEUP WATER PUMPS
43	MP-121A/B	N/A	SEA WATER COOLING BOOSTER PUMPS
44	MP-122A/B	N/A	SOFTENED WATER SUPPLY PUMPS
45	MP-123A/B	N/A	COMPRESSOR 1ST STAGE CONDENSATE BOOSTER PUMPS
46	MP-124A/B	P-124A/B	RICH AMINE PUMPS (ABSORBER 2)
47	MV-101	T-101	CO2 ABSORBER NO.1
48	MV-102	T-102	CO2 ABSORBER NO.2
49	MV-103	T-103	STRIPPER
50	MV-104	V-104	CO2 COMPRESSOR 1ST INTERSTAGE KNOCKOUT DRUM
51	MV-105	V-105	CO2 COMPRESSOR 2ND INTERSTAGE KNOCKOUT DRUM
52	MV-106	V-106	CO2 SURGE DRUM
53	MV-107	N/A	LP CONDENSATE BLOWDOWN TANK
54	MV-201	V-101	SEMI-LEAN FLASH DRUM
55	MV-202	V-102	STRIPPER REFLUX DRUM
56	MV-203	V-103	CO2 COMPRESSOR SUCTION DRUM
57	MT-101	TK-101	AMINE STORAGE TANK (CONCENTRATED)
58	MT-102	TK-102	LEAN AMINE SOLVENT (35% MEA) STORAGE TANK
59	MT-104	TK-104	PROCESS WATER SURGE TANK
60	MT-107	N/A	SOFTENED WATER STORAGE TANK
61	MT-109	N/A	INSTRUMENT AIR RECEIVER
62	MS-101A/C	X-101A/C	FLUE GAS WATER FOGGER SYSTEM
63	MS-102	X-102	AMINE RECLAIMER
64	MS-103	X-103	RECLAIMER CHEMICAL FEED PACKAGE
65	MS-104	X-104	CO2 DRYING PACKAGE
66	MS-105A/B	N/A	INSTRUMENT AIR DRYER

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	10/11/05	REVISED PER 10112936-S-FIPB-G-0208 TO INCORPORATE MAIN ELECTRICAL EQUIPMENT DESIGNATION	RPT					
0	14/11/08	ISSUED FOR APPROVAL	KLJ	RPT	RPT		BTR	AJG

Owner
GASSNOVA

Owner Drawing No.
10112936-PB-G-DRW-0003

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

MAIN EQUIPMENT LAYOUT
STRIPPER AREA &
CO2 COMPRESSOR BUILDING

Sheet Size 594x841 "A1"
Scale: 1:125

JOB NO.	DRAWING NO.	REV.
25474	P1-0310-00002	1

LEGEND

ID NO.	EQUIPMENT TAG NO.	ALTERNATE TAG NO.	DESCRIPTION
1	MA-101	K-101	FUEL GAS BLOWER (ABSORBER 1)
2	MA-102	K-102	FUEL GAS BLOWER (ABSORBER 2)
3	MC-101A/B	N/A	INSTRUMENT/SERVICE AIR COMPRESSOR
4	MC-103A/C	K-103A/C	CO2 COMPRESSOR
5	ME-101	E-101	WASH WATER COOLER (ABSORBER 1)
6	ME-102	E-102	LEAN AMINE COOLER
7	ME-103A/B	E-103A/B	SEMI-LEAN/RICH HEAT EXCHANGER
8	ME-104	E-104	WASH WATER COOLER (ABSORBER 2)
9	ME-107	E-107	FLASH FEED HEAT EXCHANGER
10	ME-108A/H	E-108A/H	LEAN/RICH AMINE HEAT EXCHANGER
11	ME-109	E-109	FLASH FEED HEATER
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19	ME-117	E-117	CO2 COOLER
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28	MP-104A/B	P-104A/B	WASH WATER RECIRCULATION PUMPS (ABSORBER 2)
29	MP-105A/B	P-105A/B	LEAN AMINE PUMPS
30	MP-106A/B	P-106A/B	FLASH DRUM PUMPS
31	MP-107A/B	P-107A/B	REFLUX PUMPS
32	MP-108A/B	P-108A/B	CO2 PRODUCT SENDOUT PUMPS
33	MP-109A/B	P-109A/B	FLUE GAS FOGGER WATER SUPPLY PUMPS
34	MP-110A/B	P-110A/B	FRESH AMINE METERING PUMPS
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45	MP-123A/B	N/A	COMPRESSOR 1ST STAGE CONDENSATE BOOSTER PUMPS
46	MP-124A/B	P-124A/B	RICH AMINE PUMPS (ABSORBER 2)
47	MV-101	T-101	CO2 ABSORBER NO.1
48	MV-102	T-102	CO2 ABSORBER NO.2
49	MV-103	T-103	STRIPPER
50	MV-104	V-104	CO2 COMPRESSOR 1ST INTERSTAGE KNOCKOUT DRUM
51	MV-105	V-105	CO2 COMPRESSOR 2ND INTERSTAGE KNOCKOUT DRUM
52	MV-106	V-106	CO2 SURGE DRUM
53	MV-107	N/A	LP CONDENSATE BLOWDOWN TANK
54	MV-201	V-101	SEMI-LEAN FLASH DRUM
55	MV-202	V-102	STRIPPER REFLUX DRUM
56	MV-203	V-103	CO2 COMPRESSOR SUCTION DRUM
57	MT-101	TK-101	AMINE STORAGE TANK (CONCENTRATED)
58	MT-102	TK-102	LEAN AMINE SOLVENT (35% MEA) STORAGE TANK
59	MT-104	TK-104	PROCESS WATER SURGE TANK
60	MT-107	N/A	SOFTENED WATER STORAGE TANK
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62	MS-101A/C	X-101A/C	FLUE GAS WATER FOGGER SYSTEM
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64	MS-103	X-103	RECLAIMER CHEMICAL FEED PACKAGE
65	MS-104	X-104	CO2 DRYING PACKAGE
66	MS-105A/B	N/A	INSTRUMENT AIR DRYER

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
1	10/11/05	REVISED PER 10112936-S-FIPB-G-0183 TO INCORPORATE MAIN ELECTRICAL EQUIPMENT DESIGNATIONS	RPT	DB	JB		DD	
0	20/11/08	ISSUED FOR APPROVAL	KLJ	RPT	RPT		BTR	AJG

Owner
GASSNOVA

CO2 KARSTO PROJECT

Owner Drawing No.
10112936-PB-G-DRW-0004

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

MAIN EQUIPMENT LAYOUT CONTROL/WORKSHOP/STORE BUILDING, SWITCHGEAR BUILDING & TANK FARM

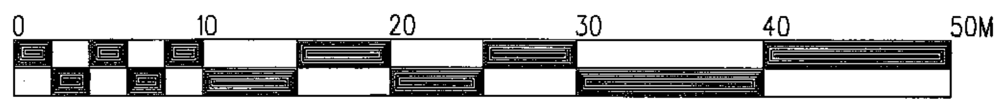
Sheet Size 594x841 "A1"
Scale: 1:200

JOB NO.	DRAWING NO.	REV.
25474	P1-0310-00003	1

INTERFACE POINTS LEGEND

TIE-IN Nr.	N COORD.	N COORD.	ELEVATION	DESCRIPTION
I-001	4993.8	20773	+4.7m	NE ROAD
I-002	4905	20773	+4.5m	SE ROAD
I-003	4993.8	20552	+9.4m	NW ROAD
I-004	4905	20552	+8.6m	SW ROAD
I-010	4900	20555		PIPE RACK FOR STEAM AND CONDENSATE FROM CCPP
I-020	4900	20554	+15.442m	LP STEAM FROM CCPP
I-030	4900	20555	+14.8m	LP CONDENSATE TO CCPP
I-040	4902.8	20479.063	+11.030m	HP STEAM FROM CCPP
I-050	N/A	N/A	N/A	HP CONDENSATE TO CCPP
I-060	4900	20556.5	+14.8m	FUEL GAS TO CCC PLANT
I-070	N/A	N/A	N/A	FLARE FROM CCC PLANT
I-080	4896	20488.83	+14.8m	FLUE GAS (INCLUDING STACK MODS AND FLUE GAS TO CCC PLANT)
I-110	-	-	-	22 kV ELECTRICAL POWER CABLES, ALTERNATIVE 2
I-120	-	-	-	6 kV ELECTRICAL POWER CABLES
I-130	4999	20550	+7m	UNDERGROUND FIREWATER (WEST)
I-140	N/A	N/A	N/A	UNDERGROUND COOLING WATER SUPPLY 1
I-150	5017.88	20719.5	+2m	UNDERGROUND COOLING WATER SUPPLY 2
I-160	5013.56	20719.5	+2m	UNDERGROUND COOLING WATER SUPPLY 3
I-170	5000	20716	-	ELECTRICAL POWER CABLES TO COOLING WATER PUMPS
I-180	5000	20716	-	PROTECTION, MEASURING AND CONTROL PURPOSES CABELING TO/FROM COOLING WATER PUMPS
I-210	5010	20735	-4m	UNDERGROUND COOLING WATER RETURN
I-220	4999	20773	+2m	UNDERGROUND FIREWATER (EAST)
I-230	4975	20773	+3m	POTABLE WATER
I-240	4976	20773	+3m	SEWAGE WATER
I-250	N/A	N/A	N/A	PIPE RACK TO CO2 TRANSPORT AREA
I-260	4900	20770	+14.8m	PIPLINE CO2 EXPORT
I-270	4950	20769.5	+14.8m	VENT LINE FROM CO2 TRANSPORT AREA
I-280	-	-	-	FRESH WATER TO CO2 TRANSPORT AREA (UTILITY STATION)
I-281	-	-	-	COMPRESSED AIR TO CO2 TRANSPORT AREA (UTILITY STATION)
I-282	-	-	-	NITROGEN TO CO2 TRANSPORT AREA (UTILITY STATION)
I-283	-	-	-	LP STEAM TO CO2 TRANSPORT AREA (UTILITY STATION)
I-290	4900	20725	-	INSTRUMENT CABLES TO/FROM CO2 TRANSPORT AREA
I-300	4900	20745	-	ELECTRICAL POWER CABLES TO CO2 TRANSPORT AREA
I-310	4950	20375	-	INSTRUMENT CABLES TO/FROM NATURKRAFT CCPP
I-311	4950	20375	-	INSTRUMENT CABLES TO/FROM KARSTO GAS TERMINAL
I-320	4950	20375	-	CABELING FOR PROTECTION, MEASURING AND CONTROL PURPOSES
I-330	4950	20375	-	400V POWER CABELING INTERFACE FOR NEW F.G. DAMPER IN PLENUM
I-340	-	-	-	EARTHING SYSTEM CONNECTION POINT 1
I-341	-	-	-	EARTHING SYSTEM CONNECTION POINT 2
I-342	-	-	-	EARTHING SYSTEM CONNECTION POINT 3
I-343	-	-	-	EARTHING SYSTEM CONNECTION POINT 4

FOR CONNECTION INFORMATION, ETC. REFER TO E-17 INTERFACE REGISTER 10112936-FI-Z-LST-0004.



NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
0	19 DEC 08	ISSUED FOR INFORMATION	RPT					

Owner
GASSNOVA

CO2 KARSTO PROJECT

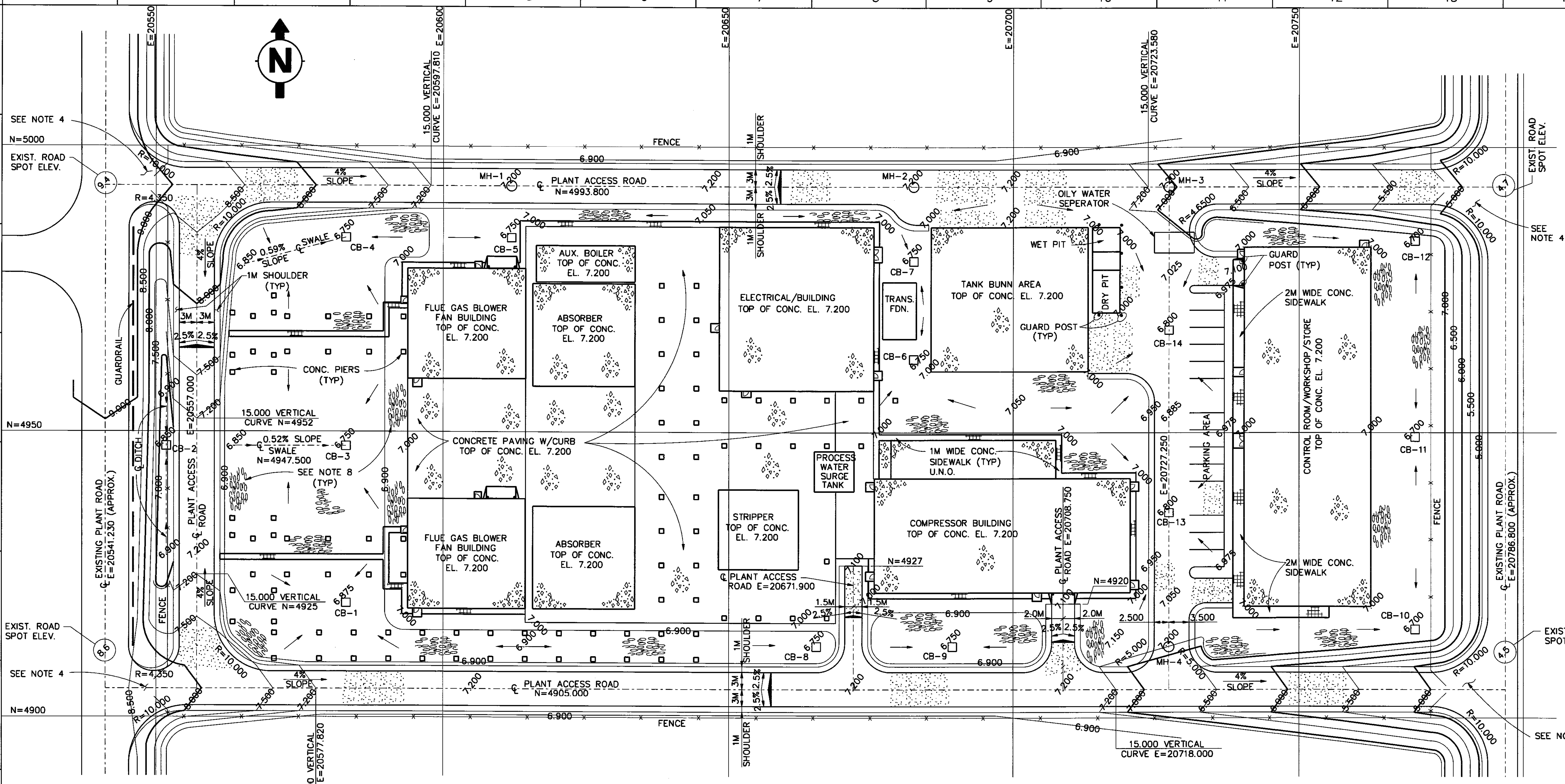
Owner Drawing No.
10112936-PB-G-DRW-0007

CCCP BATTERY LIMITS
INTERFACE TIE-POINT PLAN

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

Sheet Size 594x841 "A1"
Scale: 1:400

JOB NO.	DRAWING NO.	REV.
25474	P1-0010-00002	0



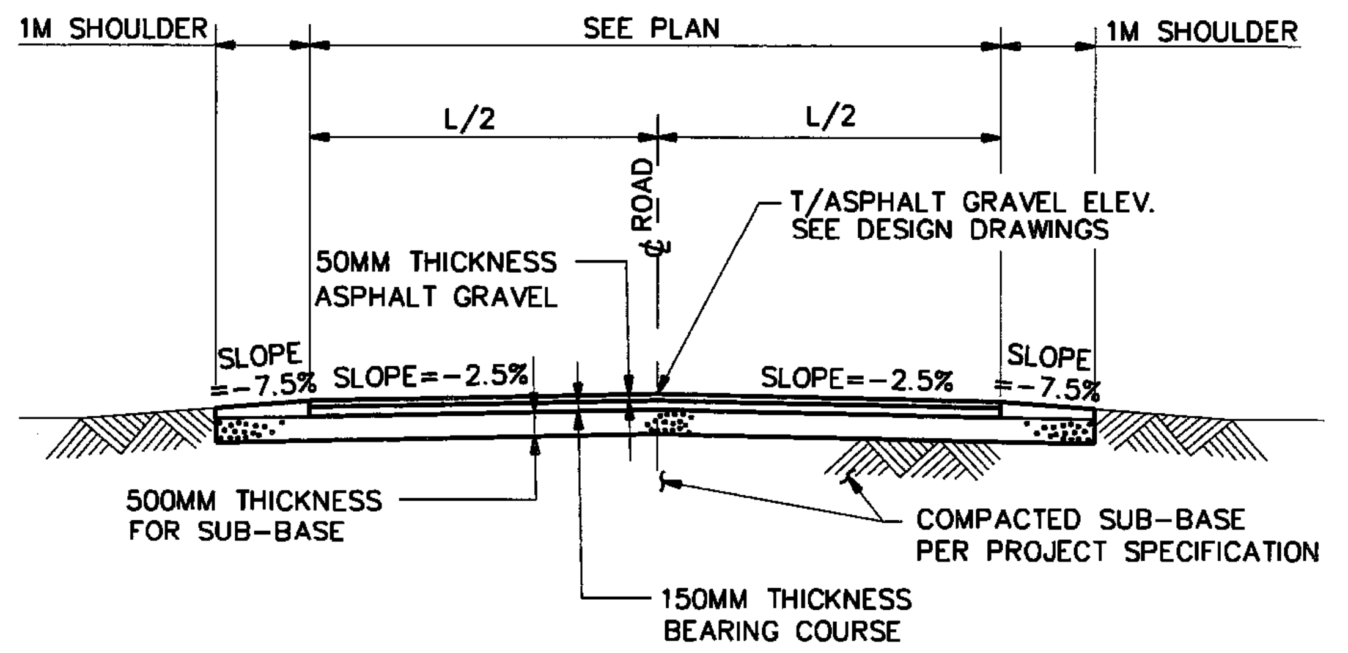
NOTES

1. ALL DIMENSIONS AND ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
2. THE REFERENCE LEVEL AT KARSTO IS 2.29 METERS OVER THE MSL (MEAN SEA LEVEL).
3. THE EXISTING SPOT ELEVATIONS WERE OBTAINED FROM GASSNOVA DRAWING 10112936-0078-GAD.
4. THE PAVING CONTRACTOR SHALL ENSURE THAT THE NEW ROAD SURFACE HAS A SMOOTH TRANSITION WITH THE EXISTING ROAD WHERE THE TWO SURFACES MEET.
5. ALL PAVED ROADS SHALL HAVE 1 METER WIDE SHOULDERS.
6. MANHOLES MH-1, MH-2 AND MH-3 SHALL HAVE THEIR HEAVY DUTY MANHOLE FRAME AND SOLID LID INSTALLED PRIOR TO THE ROAD PAVING CONTRACTOR STARTING THE PAVING OF THE ROADWAY.
7. FOR CONTOUR ELEVATIONS AND VERTICAL SLOPES ON EMBANKMENTS NOT SHOWN ON THIS DRAWING SEE ROUGH GRADING PLAN DRAWING CG-0000-00001.
8. ALL AREAS WITHIN THE LIMITS OF THE CCC PLANT ROADS BOUNDING THE PROCESS AREA THAT ARE NOT COVERED BY ASPHALT, CONCRETE, GRASS OR STRUCTURES SHALL BE COVERED BY 150 MM OF AGGREGATE SURFACING (16-32 MM IN GRANULAR SIZE)
9. FOR DITCH AND SWALE DETAILS SEE ROUGH GRADING DRAWING CG-0000-00001.
10. THIS DRAWING IS INTENDED TO BE READ IN CONJUNCTIONWITH THE DESIGN PHILOSOPHY AND ACCEPTANCE CRITERIA 25474-000-30Y-C01G-00001.

LEGEND

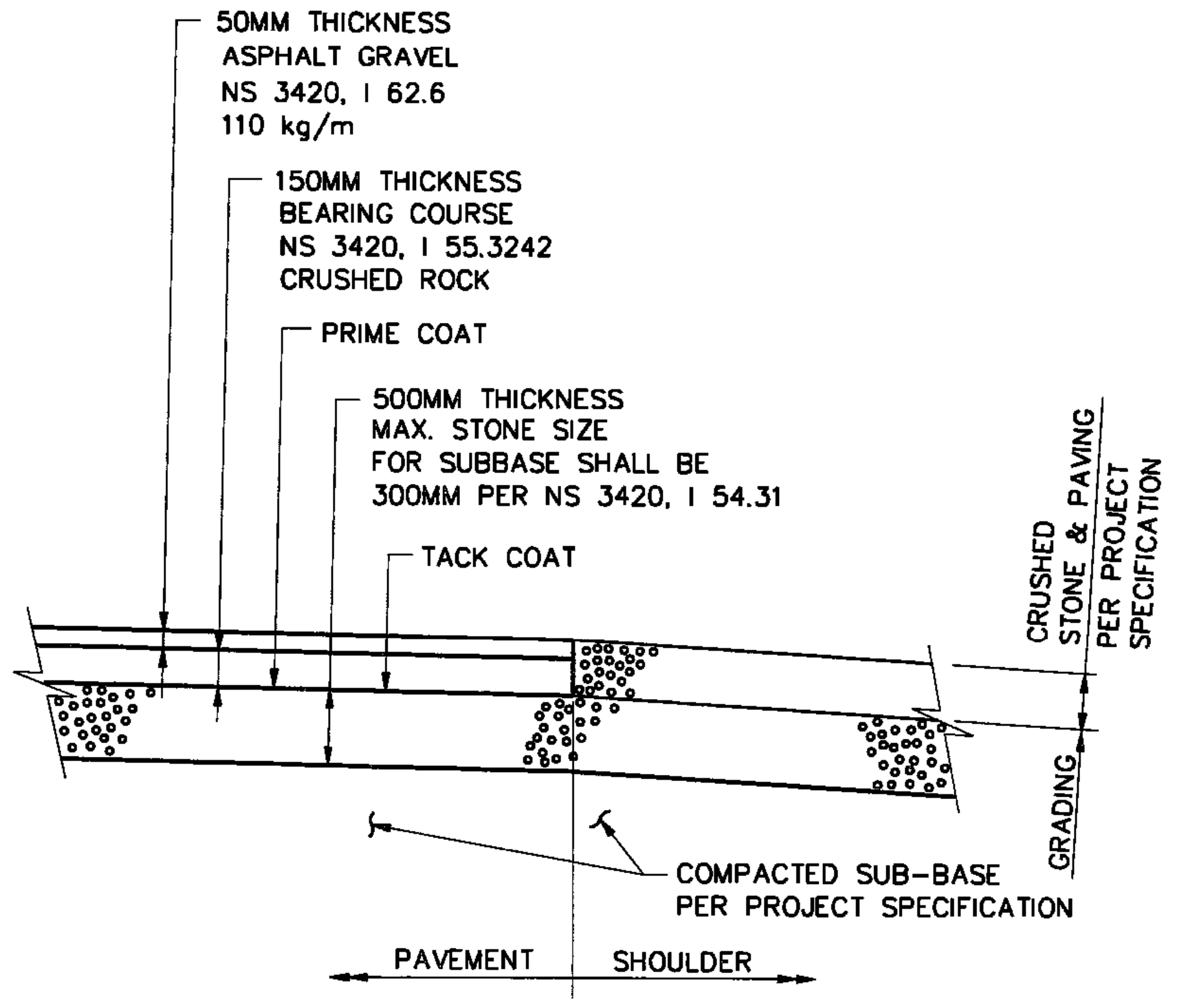
———	1.000 METER CONTOUR
———	0.500 METER CONTOUR
— - —	℄ SWALE OR DITCH
→	SURFACE FLOW DRAINAGE DIRECTION
CB-1 □	CATCH BASIN
MH-1 ○	MANHOLE
6.700	PROPOSED SPOT ELEVATION
2.5% 2.5%	DIRECTION & PERCENT OF ROAD CROSSFALL
R=10.000	EDGE OF PAVED ROAD RADIUS
—×—	FENCE
— — —	GUARDRAIL
▦	CONCRETE WALKWAY
▨	AGGREGATE SURFACING ROADWAY & PARKING AREA
▨	TOP/CONCRETE FOUNDATIONS & CONCRETE PAVING AREAS
▨	TOP/CRUSHED ROCK
▫	DOOR ENTRANCE PAD
⏢	VEHICLE ENTRANCE PAD

0 10 20 30 40 50M



PLANT ACCESS ROAD

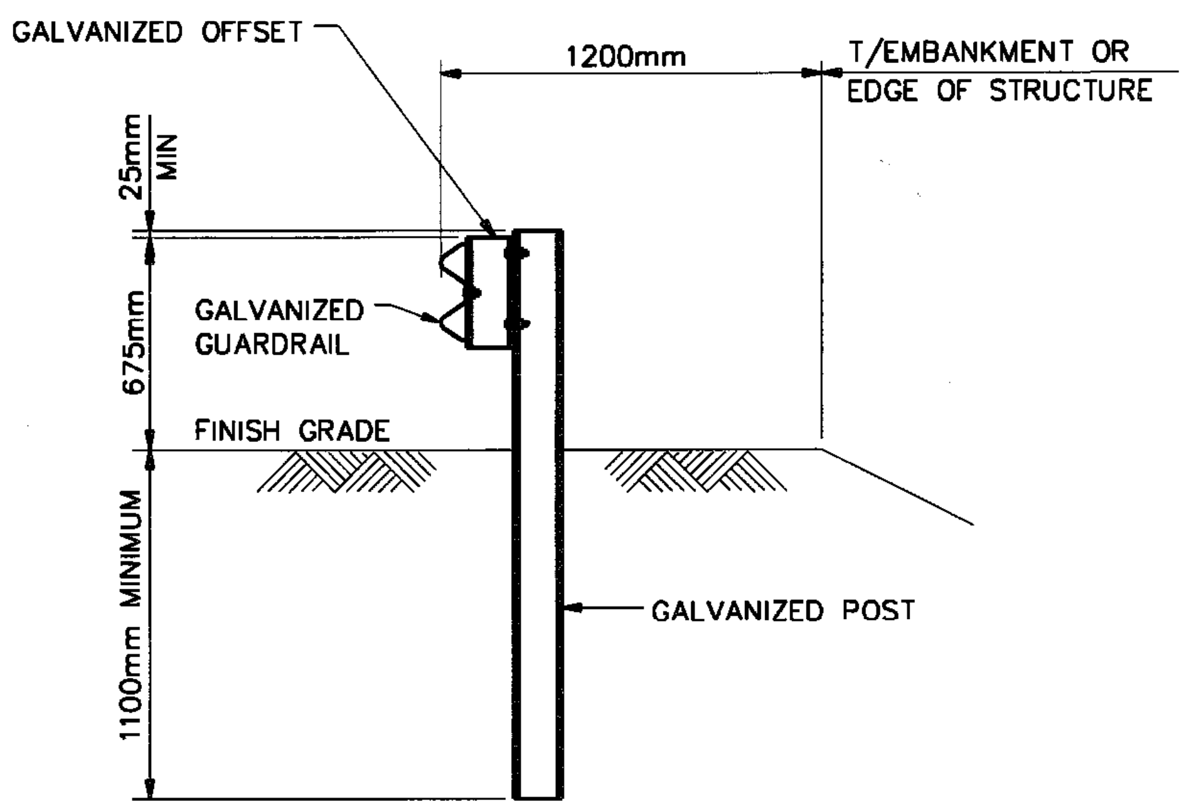
DETAIL ①



PLANT ACCESS ROAD PAVING DETAIL

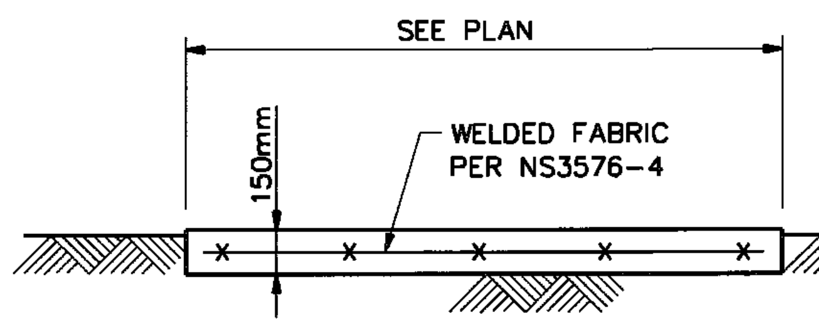
DETAIL ②

ROAD DETAILS



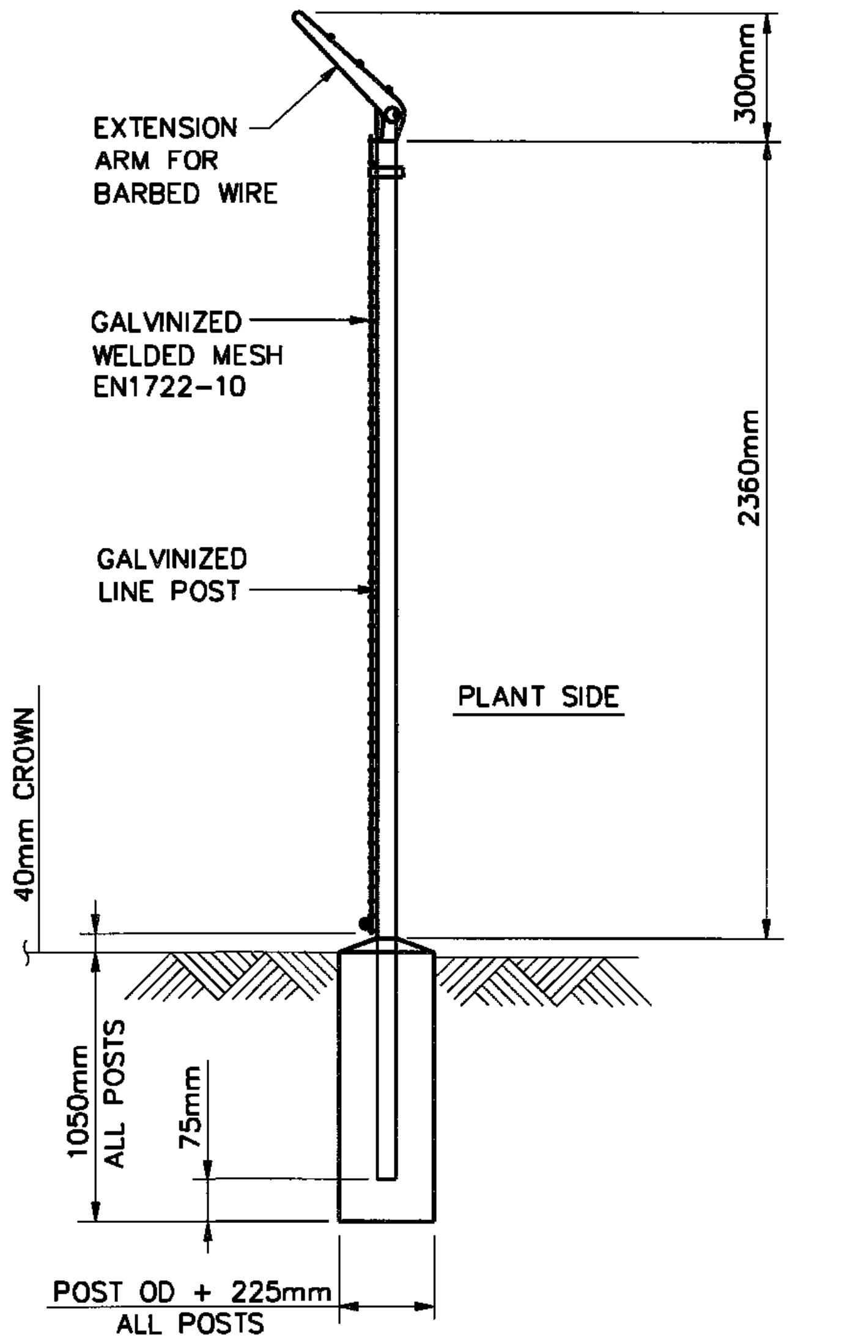
GUARDRAIL

DETAIL ③



CONCRETE SIDEWALK

DETAIL ④



SECTION THRU FENCE

DETAIL ⑤

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
△								
△								
△								
△								
0	4 Dec 08	ISSUED FOR COMMENT	RS	Rws	–	Rws		

Owner
GASSNOVA

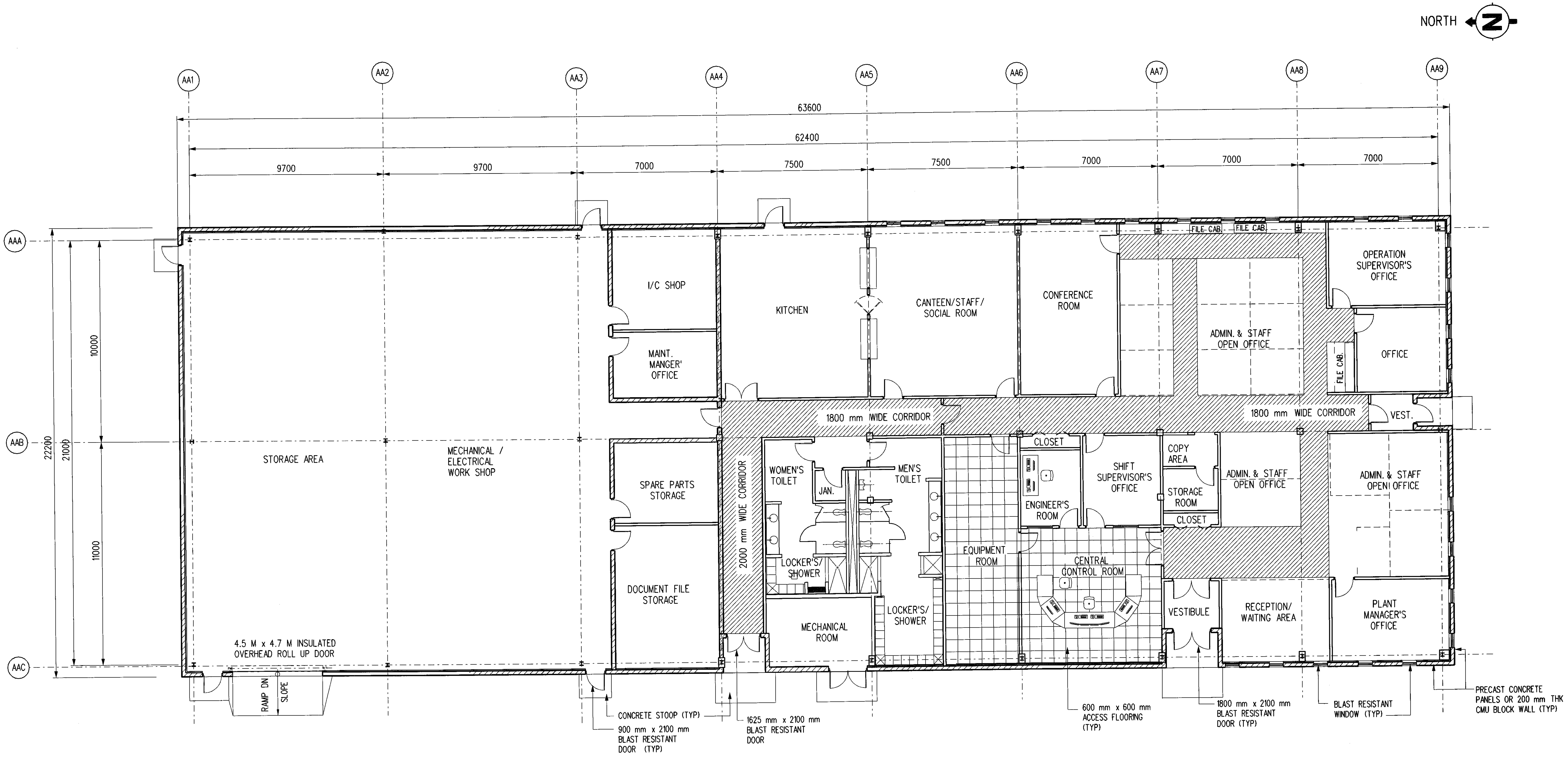
CO2 KARSTO PROJECT

Owner Drawing No.
10112936-PB-C-TED-0005

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

ACCESS ROADS
AND FINISHED GRADING PLAN

Sheet Size 594 X 841 "A1"	Scale 1:400	
JOB NO.	DRAWING NO.	REV.
25474-000	CS-0000-00001	0



GROUND FLOOR PLAN

NOTES:

1. ALL THE DIMENSIONS ARE IN MILLIMETER UNLESS NOTED OTHERWISE.
2. ALL INTERIOR AND EXTERIOR SINGLE DOORS SHALL BE 900 mm WIDE BY 2100 mm HIGH UNLESS NOTED OTHERWISE. ALL DOUBLE DOORS SHALL BE 1800 mm WIDE BY 2100 mm HIGH FOR BOTH INTERIOR AND EXTERIOR DOORS UNLESS NOTED OTHERWISE.
3. ALL WINDOW SIZES SHALL BE AS INDICATED ON ELEVATION DRAWING.
4. ALL FURNITURE AND EQUIPMENT SHOWN ARE NOT PART OF CONTRACT AND SHALL BE PROVIDED BY OTHERS.

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
△								
△								
△								
1	12/11/08	REVISED TO INCORPORATE COMMENTS AND ISSUED FOR APPROVAL			☒			
0	20/Nov/08	ISSUED FOR APPROVAL	NP	AJ	☒	NP	BR	AG

Owner
GASSNOVA

CO2 KARSTO PROJECT

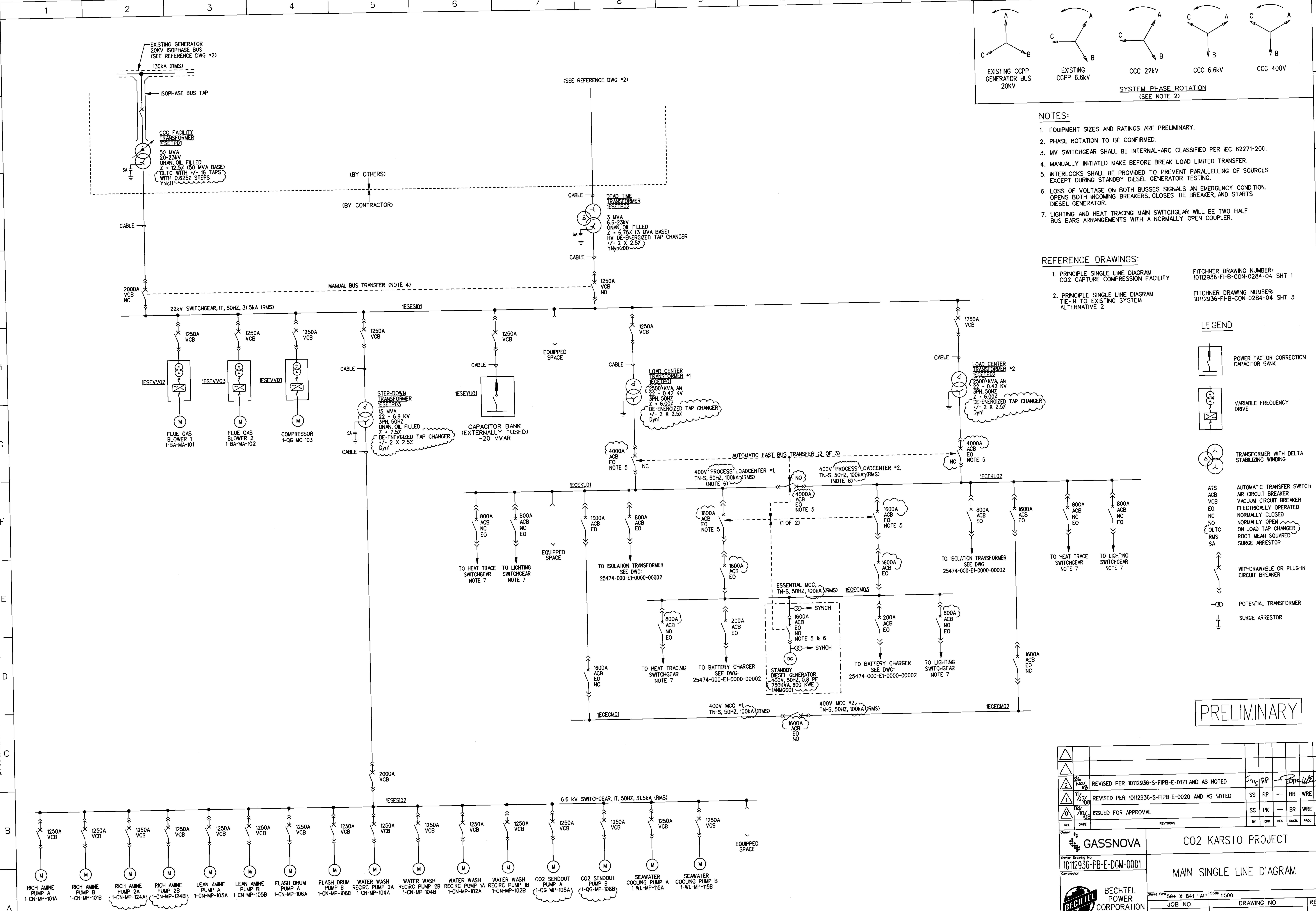
Owner Drawing No.
10112936-PB-C-PLN-0005

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CONCEPTUAL PLAN
CONTROL/WORKSHOP/STORE BUILDING

Sheet Size 594 X 841 "A1"
Scale 1:100

JOB NO.	DRAWING NO.	REV.
25474-000	A1-3110-00001	1



SYSTEM PHASE ROTATION
(SEE NOTE 2)

NOTES:

1. EQUIPMENT SIZES AND RATINGS ARE PRELIMINARY.
2. PHASE ROTATION TO BE CONFIRMED.
3. MV SWITCHGEAR SHALL BE INTERNAL-ARC CLASSIFIED PER IEC 62271-200.
4. MANUALLY INITIATED MAKE BEFORE BREAK LOAD LIMITED TRANSFER.
5. INTERLOCKS SHALL BE PROVIDED TO PREVENT PARALLELLING OF SOURCES EXCEPT DURING STANDBY DIESEL GENERATOR TESTING.
6. LOSS OF VOLTAGE ON BOTH BUSSES SIGNALS AN EMERGENCY CONDITION, OPENS BOTH INCOMING BREAKERS, CLOSES TIE BREAKER, AND STARTS DIESEL GENERATOR.
7. LIGHTING AND HEAT TRACING MAIN SWITCHGEAR WILL BE TWO HALF BUS BARS ARRANGEMENTS WITH A NORMALLY OPEN COUPLER.

REFERENCE DRAWINGS:

1. PRINCIPLE SINGLE LINE DIAGRAM CO2 CAPTURE COMPRESSION FACILITY	FITCHNER DRAWING NUMBER: 10112936-FI-B-CON-0284-04 SHT 1
2. PRINCIPLE SINGLE LINE DIAGRAM TIE-IN TO EXISTING SYSTEM ALTERNATIVE 2	FITCHNER DRAWING NUMBER: 10112936-FI-B-CON-0284-04 SHT 3

LEGEND

	POWER FACTOR CORRECTION CAPACITOR BANK
	VARIABLE FREQUENCY DRIVE
	TRANSFORMER WITH DELTA STABILIZING WINDING
ATS	AUTOMATIC TRANSFER SWITCH
ACB	AIR CIRCUIT BREAKER
VCB	VACUUM CIRCUIT BREAKER
EO	ELECTRICALLY OPERATED
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OLTC	ON-LOAD TAP CHANGER
RMS	ROOT MEAN SQUARED
SA	SURGE ARRESTOR
	WITHDRAWABLE OR PLUG-IN CIRCUIT BREAKER
—ꝏ	POTENTIAL TRANSFORMER
	SURGE ARRESTOR

PRELIMINARY

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
2	26 Nov 08	REVISED PER 10112936-S-FIPB-E-0171 AND AS NOTED	SMS	RP	—	BR	WE	
1	11/07/08	REVISED PER 10112936-S-FIPB-E-0020 AND AS NOTED	SS	RP	—	BR	WRE	
0	08/10/08	ISSUED FOR APPROVAL	SS	PK	—	BR	WRE	

Owner
GASSNOVA

Owner Drawing No.
10112936-PB-E-DGM-0001

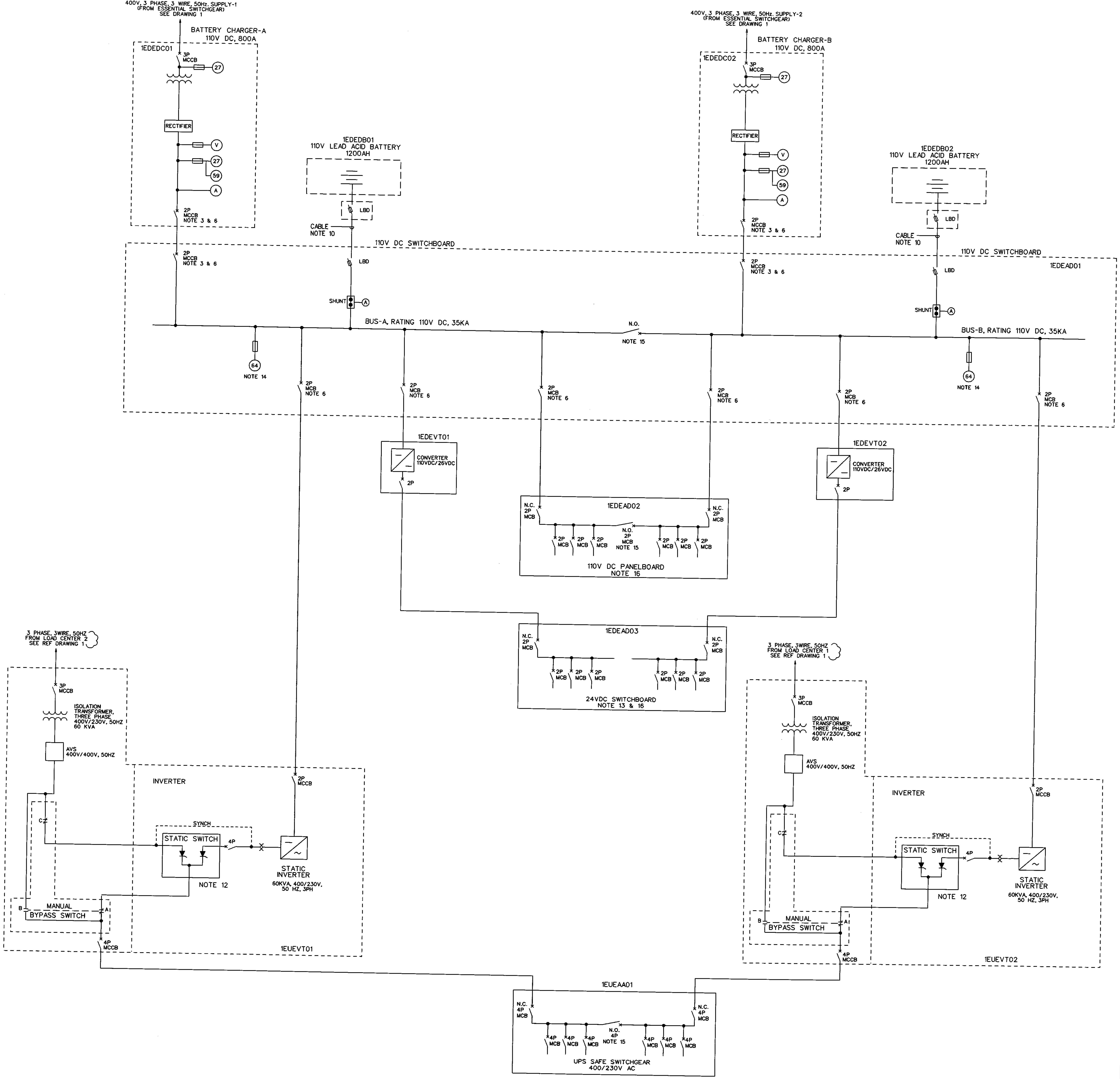
Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

MAIN SINGLE LINE DIAGRAM

Sheet Size 594 X 841 "A1"
Scale 1:500

JOB NO.	DRAWING NO.	REV.
25474-000	E1-0000-00001	2



NOTES:

1. ALL MEASUREMENT AND BYPASS SWITCH POSITIONS TO BE READ ON THE GRAPHICAL DISPLAY.
2. A COMMON TROUBLE SIGNAL OUTPUT (OPEN ON TROUBLE i.e. SERIES COMBINATION OF DRY CONTACTS AS REQUIRED)WILL BE PROVIDED FOR REMOTE ALARM AND DISCONNECTION.
3. MAGNETIC BREAKERS WITH ADJUSTABLE MAGNETIC TRIP RATINGS.
4. NEUTRAL OF UPS SHALL BE EARTHED AT ONE POINT AT INVERTER. NEUTRAL SHALL BE ISOLATED FROM EARTH AT THE TRANSFORMER/ DISTRIBUTION PANEL SIDE.
5. EARTH NEUTRAL AT INVERTER OUTPUT.
6. A CONTACT WILL BE PROVIDED EACH FOR COMMON REMOTE ALARM AS WELL AS FOR LOCAL OPEN INDICATION FOR EACH FEEDER BREAKER.
7. EACH BATTERY CHARGER AND BATTERY IS SIZED TO FEED 100% OF LOAD.
8. EQUIPMENT AND BREAKER SIZING TO BE CONFIRMED (LATER).
9. SYSTEM VOLTAGE VARIATIONS ARE AS FOLLOWS:
    110V DC +10%, -15%
    230V AC +/- 10%
    24V DC (20V TO 30V)
10. CABLES FROM BATTERIES SHALL BE SIZED TO CARRY FULL FAULT CURRENT.
11. ALL SWITCHBOARDS AND PANELBOARDS WILL BE PROVIDED WITH 30% SPARE SPACE.
12. DURING NORMAL OPERATION, THE INVERTER SHALL SUPPY POWER TO THE LOADS. UPON LOSS OF DC POWER, THE STATIC SWITCH WILL AUTOMATICALLY TRANSFER LOADS TO ISOLATION TRANSFORMER.
13. NEGATIVE OF 24V DC SYSTEM TO BE SOLIDLY EARTHED.
14. LOCAL AND REMOTE ALARM INDICATION SHALL BE PROVIDED.
15. DURING NORMAL OPERATION, THE TIE BREAKER SHALL BE OPEN. NO AUTOMATIC TRANSFER IS PROVIDED.
16. CONSUMERS WILL BE DOUBLE FED WITH DIODE DC-COUPLING CIRCUITS LOCAL TO CONSUMERS.

REFERENCE DRAWINGS:

1. MAIN SINGLE LINE DIAGRAM 25474-000-E1-0000-00001

LEGEND:

	CIRCUIT BREAKER
	LOAD BREAK DISCONNECT (LBD)
	SHUNT
	FUSE
	DC TO DC CONVERTER
	DC TO AC CONVERTER
AVS	AUTOMATIC VOLTAGE STABILIZER
2P	2 POLE
4P	4 POLE
27	UNDERVOLTAGE
59	OVERVOLTAGE
64	EARTH FAULT SUPERVISION
MCB	MINIATURE CIRCUIT BREAKER
MCCB	MOULDED CASE CIRCUIT BREAKER
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
Ⓥ	VOLTMETER
Ⓐ	AMMETER

PRELIMINARY

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
△								
△								
2	26 NOV 08	REVISED PER 10112936-S-P-FIPB-E-0067	ms	RP	—	Bre	WE	
1	11/07/08	REVISED PER 10112936-S-P-FIPB-E-0022 AND REDRAWN	SS	RP	—	BR	WRE	
0	08/10/08	ISSUED FOR APPROVAL	SS	PK	—	BR	WRE	

Owner
GASSNOVA

Owner Drawing No.
10112936-PB-E-DGM-0002

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

DC AND UPS SINGLE LINE DIAGRAM

Sheet Size	Scale	
594 X 841 "A1"	1:500	
JOB NO.	DRAWING NO.	REV.
25474-000	E1-0000-00002	2

NOTES

1. THIS DRAWING IS INTENDED TO BE READ IN CONJUNCTION WITH THE DISCRIPTION OF REQUIRED INFRASTURCTURE IMPROVEMENTS OUTSIDE PLANT BATTERY LIMITS 25474-000-30Y-C01G-00002.
2. ALL DIMENSIONS AND ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
3. FOR CONTOUR ELEVATIONS AND VERTICAL SLOPES ON EMBANKMENTS SEE ROUGH GRADING PLAN DRAWING 000-CG-0000-00001.
4. FOR FINISH GRADING AND PAVING ELEVATIONS SEE ACCESS ROAD AND FINISH GRADING PLAN DRAWING 000-CS-0000-00001.

LEGEND

①	CONSTRUCTION OFFICES
②	CRAFT FACILITIES
③	SAFETY OFFICE
④	WAREHOUSE
⑤	BATCH PLANT (OFF SITE)
⑥	SUBCONTRACTOR FACILITIES
⑦	HAZARDOUS WASTE TEMPORARY STORAGE
⑧	TEMPORARY PARKING
⑨	FABRICATION SHOP
⑩	TOILET FACILITIES

REFERENCE DRAWINGS

000-CD-0000-00001	SITE DRAINAGE PLAN
000-CG-0000-00001	ROUGH GRADING PLAN
000-CS-0000-00001	ACCESS ROAD & FINISHED GRADING PLAN
000-CY-0000-00001	SITE SUBSURFACE PLAN
000-CY-0000-00002	UNDERGROUND STRUCTURES TYPICAL SECTIONS & DETS. (SHEET 1 OF 2)
000-CY-0000-00003	UNDERGROUND STRUCTURES TYPICAL SECTIONS & DETS. (SHEET 2 OF 2)

NO.	DATE	REVISIONS	BY	CHK	DES	ENGR.	PROJ	APPR
△								
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△								
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0	4 DEC 08	ISSUED FOR COMMENT	RS	SRN	SRN			

Owner
GASSNOVA

Owner Drawing No.
10112936-PB-C-DRW-0003

Contractor
BECHTEL POWER CORPORATION
FREDERICK, MARYLAND

CO2 KARSTO PROJECT

CONSTRUCTION FACILITIES

Sheet Size 594 X 841 "A1"	Scale 1:500	
JOB NO.	DRAWING NO.	REV.
25474-000	CO-0000-00001	0

Karsto CCC Plant
FEED Study Documents List

Sorted by Client Document Number

Client Document Number	Bechtel Document Number	Title	Revision	Date on Document
10112936-FI-Z-LST-0004	25474-000-3IC-G01G-00001	Interface Register CO2 Karsto	0	11/7/2008 0:00
10112936-PB-A-GEA-0001	25474-001-2RM-R01G-00001	Karsto - Risk Management System	1	10/24/2008 0:00
10112936-PB-A-HSE-0001	25474-001-2HS-G01G-00001	Karsto - HSE Plan	1	10/2/2008 0:00
10112936-PB-A-PPR-0002	25474-001-GPP-GAM-00002	General Project Procecdure for Communication Control	2	10/24/2008 0:00
10112936-PB-A-QAP-0001	25474-001-GQP-GAQ-00001	Karsto - Quality Plan	2	11/4/2008 0:00
10112936-PB-A-QAR-0001	25474-001-GQP-GAQ-00002	Karsto - Plan for Quality Audits and Surveillance	0	9/16/2008 0:00
10112936-PB-C-DOC-0001	25474-000-3YD-A01G-00001	Architectural Descriptions and Design Reports	0	11/20/2008 0:00
10112936-PB-C-DOC-0002	25474-000-3YD-A01G-00002	Relevant Architectural Analysis	0	11/20/2008 0:00
10112936-PB-C-DRW-0001	25474-000-30Y-C01G-00003	Plant Area Drawings Surrounding Infrastructure and Security Fencing	0	12/5/2008 0:00
10112936-PB-C-DRW-0002	25474-000-30Y-C01G-00004	Site Preparation and Leveling Drawings	0	12/6/2008 0:00
10112936-PB-C-DRW-0003	25474-000-C0-0000-00001	Construction Facilities	0	12/5/2008 0:00
10112936-PB-C-PAL-0001	25474-000-30X-C15G-00002	Preliminary List of Equipment and Piping	0	11/26/2008 0:00
10112936-PB-C-PLN-0001	25474-000-AL-1000-00001	Landscape Plan	1	12/5/2008 0:00
10112936-PB-C-PLN-0002	25474-000-A1-4810-00001	Conceptual Plan - Flue Gas Blower Building	0	11/20/2008 0:00
10112936-PB-C-PLN-0003	25474-000-A1-6310-00001	Conceptual Plan - CO2 Compressor Building	0	11/20/2008 0:00
10112936-PB-C-PLN-0004	25474-000-A1-6110-00001	Conceptual Plan - Electrical Switchgear Building	0	11/20/2008 0:00
10112936-PB-C-PLN-0005	25474-000-A1-3110-00001	Conceptual Plan - Control/Workshop/Store Building	1	12/11/2008 0:00
10112936-PB-C-PLN-0006	25474-000-A2-3190-00001	Conceptual Elevations - Control/Workshop/Store Building	0	11/20/2008 0:00
10112936-PB-C-PLN-0007	25474-000-A1-0310-00001	Main Area Plans	0	11/21/2008 0:00
10112936-PB-C-TED-0001	25474-000-30Y-A01G-00001	Architectural Design Premises/Criteria	1	11/11/2008 0:00
10112936-PB-C-TED-0002	25474-000-30Y-C01G-00001	Design Philosophy and Acceptance Criteria for Civil Works	1	11/7/2008 0:00
10112936-PB-C-TED-0003	25474-000-CG-0000-00001	Rough Grading Plan	1	11/26/2008 0:00
10112936-PB-C-TED-0004	25474-000-CD-0000-00001	Site Drainage Plan	0	11/26/2008 0:00
10112936-PB-C-TED-0005	25474-000-CS-0000-00001	Access Roads and Finished Grading Plan	1	12/22/2008 0:00
10112936-PB-C-TED-0006	25474-000-DB-0100-00001	Ductwork Foundation Plan W/Typical Sections & Details Sheet 1 Of 3	0	11/19/2008 0:00
10112936-PB-C-TED-0007	25474-000-DB-0100-00002	Ductwork Foundation Plan W/Typical Sections & Details Sheet 2 Of 3	0	11/19/2008 0:00
10112936-PB-C-TED-0008	25474-000-DB-0100-00003	Ductwork Foundation Plan W/Typical Sections & Details Sheet 3 Of 3	0	11/19/2008 0:00
10112936-PB-C-TED-0009	25474-000-DB-0200-00001	CCC Plant Foundation Plan with Typical Sections and Details Sheet 1 of 4	0	11/20/2008 0:00
10112936-PB-C-TED-0010	25474-000-DB-0200-00002	CCC Plant Foundation Plan with Typical Sections and Details Sheet 2 of 4	0	11/20/2008 0:00
10112936-PB-C-TED-0011	25474-000-DB-0200-00003	CCC Plant Foundation Plan with Typical Sections and Details Sheet 3 of 4	0	11/20/2008 0:00

Client Document Number	Bechtel Document Number	Title	Revision	Date on Document
10112936-PB-C-TED-0012	25474-000-DB-0200-00004	CCC Plant Foundation Plan with Typical Sections and Details Sheet 4 of 4	0	11/20/2008 0:00
10112936-PB-C-TED-0013	25474-000-CY-0000-00001	Site Subsurface Plan	0	11/19/2008 0:00
10112936-PB-C-TED-0014	25474-000-CY-0000-00002	Underground Structures Typical Sections & Details (Sheet 1 of 2)	0	11/19/2008 0:00
10112936-PB-C-TED-0015	25474-000-CY-0000-00003	Underground Structures Typical Sections & Details (Sheet2 of 2)	0	11/19/2008 0:00
10112936-PB-C-TED-0016	25474-000-30Y-S01G-00002	Building Structural Design Requirements	0	11/21/2008 0:00
10112936-PB-C-TED-0017	25474-000-30Y-C01G-00002	Required Infrastructure Improvements Outside Plant Battery Limits	0	12/6/2008 0:00
10112936-PB-E-DAS-0001	25474-000-3SD-E000-00001	Data Sheets of Main Electrical Equipment	0	12/5/2008 0:00
10112936-PB-E-DGM-0001	25474-000-E1-0000-00001	Main Single Line Diagram	1	11/26/2008 0:00
10112936-PB-E-DGM-0002	25474-000-E1-0000-00002	DC and UPS Single Line Diagram	2	11/26/2008 0:00
10112936-PB-E-DRW-0001	25474-000-E4-0000-00001	Electrical Arrangement Drawings	0	11/19/2008 0:00
10112936-PB-E-PAL-0001	25474-000-E8-0000-00001	Electrical Consumers List	2	12/4/2008 0:00
10112936-PB-E-TDO-0001	25474-000-E0C-ES-00001	Load Flow Calculations	0	11/21/2008 0:00
10112936-PB-E-TDO-0002	25474-000-E0C-ES-00002	Short-Circuit Calculations	0	11/21/2008 0:00
10112936-PB-E-TDO-0003	25474-000-E0C-ES-00003	Transient Stability Calculations	1	11/21/2008 0:00
10112936-PB-E-TDO-0004	25474-000-E0C-ES-00004	Harmonic Distortion Study	0	11/21/2008 0:00
10112936-PB-E-TDO-0005	25474-000-30R-E21G-00001	Electrical Load Summary	0	11/20/2008 0:00
10112936-PB-E-TDO-0006	25474-000-E4-0310-00001	Equipment Location Plan - Electrical Switchgear Building	0	11/20/2008 0:00
10112936-PB-E-TDO-0007	25474-000-ER-0310-00001	Electrical Routing Plan - Cable Ladder - CCC Facility West Side	0	11/20/2008 0:00
10112936-PB-E-TDO-0008	25474-000-ER-0310-00002	Electrical Routing Plan - Cable Ladder - CCC Facility East Side	0	11/20/2008 0:00
10112936-PB-E-TDO-0009	25474-000-ER-0310-00003	Electrical Routing Plan - Electrical Switchgear Building	0	11/20/2008 0:00
10112936-PB-E-TDO-0010	25474-000-ER-0300-00001	Electrical Routing Plan - Cable Trench	0	11/20/2008 0:00
10112936-PB-E-TDO-0011	25474-000-EG-0300-00001	Electrical Earthing and Lightning Protection Plan	0	12/5/2008 0:00
10112936-PB-E-TED-0001	25474-000-3DR-E12G-00001	Electrical Power System Design Philosophy	2	12/1/2008 0:00
10112936-PB-E-TED-0002	25474-000-30Y-E01G-00001	Design Basis of Electrical Tie-Ins from External Facilities	0	10/7/2008 0:00
10112936-PB-E-TED-0003	25474-000-3BD-E12G-00001	Design Basis for Switchgear Protection and Control	1	11/26/2008 0:00
10112936-PB-E-TED-0004	25474-000-3BD-E12G-00002	Standy-by Emergency Diesel Generator Design Basis	0	11/19/2008 0:00
10112936-PB-E-TED-0005	25474-000-30R-E21G-00002	Electrical Equipment Sizes	0	11/20/2008 0:00
10112936-PB-E-TSP-0001	25474-000-3PS-E000-00001	Specifications of Main Electrical Equipment	0	12/4/2008 0:00
10112936-PB-G-CRE-0001	25474-000-G38-GAB-00001	CAPEX Cost Estimate	0	1/12/2009
10112936-PB-G-CRE-0002	25474-000-G38-GAB-00002	OPEX Cost Estimate	0	1/12/2009

Karsto CCC Plant
FEED Study Documents List

Sorted by Client Document Number

Client Document Number	Bechtel Document Number	Title	Revision	Date on Document
10112936-PB-G-DAL-0001	25474-001-30R-G01G-00002	Karsto - Current CDR List with Status of Documents and Drawings	21	1/12/2009 0:00
10112936-PB-G-DOC-0001	25474-000-G27-GZC-00047	Karsto - Owner's Engineering Document Form - Table of Content for Karsto FEED Study Report	0	10/17/2008 0:00
10112936-PB-G-DOC-0001	25474-001-30R-G01G-00001	Karsto - Table of Contents for Karsto FEED Study Report	1	10/2/2008 0:00
10112936-PB-G-DOC-0002	25474-000-M0X-0000-00006	Material Takeoff (MTO) Main Components	0	12/5/2008 0:00
10112936-PB-G-DOC-0003	25474-000-2RM-R01G-00002	Risk Management Document	0	1/12/2009
10112936-PB-G-DOC-0004	25474-000-G67-GAX-00001	Guarantees on Key Parameters	0	1/12/2009
10112936-PB-G-DOC-0005	25474-000-30R-G04G-00001	FEED Study Report	0	1/12/2009
10112936-PB-G-DRW-0001	25474-000-P1-0010-00001	General Arrangement Plan	0	11/19/2008 0:00
10112936-PB-G-DRW-0002	25474-000-P1-0310-00001	Main Equipment Layout Flue Gas Blower/Absorber Area	1	12/4/2008 0:00
10112936-PB-G-DRW-0003	25474-000-P1-0310-00002	Main Equipment Layout - Stripper Area & CO2 Compressor Building	1	12/4/2008 0:00
10112936-PB-G-DRW-0004	25474-000-P1-0310-00003	Main Equipment Layout - Control/Workshop/Store Building, Switchgear Building & Tank Farm	1	12/4/2008 0:00
10112936-PB-G-DRW-0005	25474-000-P4-0010-00009	3D Model Composite Extraction End View and Elevation	0	12/5/2008 0:00
10112936-PB-G-DRW-0006	25474-000-P4-0010-00010	3D Model Composite Extraction Isometric View	0	12/5/2008 0:00
10112936-PB-G-DRW-0007	25474-000-P1-0010-00002	CCCP Battery Limits Interface Tie -Point Plan	0	12/19/2008 0:00
10112936-PB-G-PAL-0001	25474-000-G07-GPX-00003	Preliminary Vendor-Subcontractor List for Main Components	0	12/22/2008 0:00
10112936-PB-G-PPL-0001	25474-001-GQP-GAQ-00004	Karsto - Mobilization Plan	1	10/23/2008 0:00
10112936-PB-G-PPL-0002	25474-000-G07-GPX-00002	Procurement Milestones for Long Lead Items	0	12/22/2008 0:00
10112936-PB-G-PPL-0003	25474-000-GDS-GAM-00002	Overall Time Schedule	0	1/12/2009
10112936-PB-H-TED-0001	25474-000-30Y-M83G-00001	HVAC Design and Control Philosophy	0	11/14/2008 0:00
10112936-PB-H-TED-0002	25474-000-3YD-M63G-00001	HVAC System Design and Description	0	11/20/2008 0:00
10112936-PB-I-DGM-0001	25474-000-J4-JD-00001	ESD / PSD Cause & Effect Diagram	1	12/4/2008 0:00
10112936-PB-I-DGM-0002	25474-000-J4-JD-00002	Fire & Gas System Cause & Effect Diagram	1	12/4/2008 0:00
10112936-PB-I-DOC-0001	25474-000-3YD-J01G-00005	Narrative of Information Management System	0	12/4/2008 0:00
10112936-PB-I-DOC-0002	25474-000-J0-0000-00001	Instrument Index for CO2 Capture Facility Karsto Norway	0	12/4/2008 0:00
10112936-PB-I-DOC-0003	25474-000-J0-JD-00001	IO Estimation	0	12/4/2008 0:00
10112936-PB-I-DRW-0001	25474-000-JD-JD-00001	SAS Architecture Diagram	0	11/3/2008 0:00
10112936-PB-I-DRW-0002	25474-000-3YD-J01G-00002	Safety and Automation System Narrative	1	12/4/2008 0:00
10112936-PB-I-DRW-0003	25474-000-3YD-J01G-00003	Continuous Gas Monitoring System (CGMS) Description	1	12/22/2008 0:00
10112936-PB-I-DRW-0004	25474-000-J0-3110-00001	Central Control Room Conceptual Layout	1	12/22/2008 0:00
10112936-PB-I-DRW-0005	25474-000-J0-4010-00001	Compressor Building Analyzer Room Conceptual Layout	0	11/19/2008 0:00
10112936-PB-I-DRW-0006	25474-000-J0-4410-00001	CGMS Shelter Conceptual Layout	0	11/19/2008 0:00
10112936-PB-I-DRW-0007	25474-000-E6-EEC-00001	CCTV Conceptual Block Diagram	0	11/20/2008 0:00

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10112936-PB-I-DRW-0009	25474-000-E6-EFV-00001	Telephone System Conceptual Block Diagram	0	11/20/2008 0:00
10112936-PB-I-LST-0001	25474-000-G27-GZC-00327	Owner's Engineer Document Review Form -Signal exchange list with external systems	0	12/22/2008 0:00
10112936-PB-I-LST-0001	25474-000-J0-JD-00002	Signal Exchange List	0	12/5/2008 0:00
10112936-PB-I-LST-0002	25474-000-J0-JD-00005	Instrument Air Consumption List	0	12/16/2008 0:00
10112936-PB-I-LST-0003	25474-000-J0-JD-00004	Automation Systems UPS/DC	0	12/16/2008 0:00
10112936-PB-I-PAL-0002	25474-000-J0-JD-00003	List of Open Loop Contorls	0	12/5/2008 0:00
10112936-PB-I-PAL-0003	25474-000-J0-0000-00002	List of Analog Instruments	0	12/5/2008 0:00
10112936-PB-I-PAL-0004	25474-000-J0-0000-00003	List of Control Valves	0	12/5/2008 0:00
10112936-PB-I-PAL-0005	25474-000-J0-0000-00004	List of Pneumatic On/Off Drives	0	12/5/2008 0:00
10112936-PB-I-PLN-0001	25474-000-J0-0010-00001	Conceptual Location Plan of Gas Analyzing and Monitoring Equipment	0	12/4/2008 0:00
10112936-PB-I-TD0-0003	25474-000-EL-0310-00001	Control System Data Highway Routing Scheme	0	11/20/2008 0:00
10112936-PB-I-TDO-0001	25474-000-3YD-J01G-00001	SAS Design Philosophy	0	11/7/2008 0:00
10112936-PB-I-TDO-0002	25474-000-30Y-E44G-00001	Instrument Earthing Philosophy	0	11/20/2008 0:00
10112936-PB-I-TED-0001	25474-000-3YD-J01G-00004	Description of F&G Monitoring and Alarm System	0	11/19/2008 0:00
10112936-PB-L-DRW-0001	25474-000-P4-0010-00001	Piping Arrangement Overall Piping Plan	0	11/20/2008 0:00
10112936-PB-L-DRW-0002	25474-000-P4-0010-00002	Piping Arrangement Plan View at Grade (EL. +7.0M)	0	11/20/2008 0:00
10112936-PB-L-DRW-0003	25474-000-P4-0010-00003	Piping Arrangement Plan View at (EL. +16.95M)	0	11/20/2008 0:00
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10112936-PB-L-DRW-0005	25474-000-P4-0010-00005	Piping Arrangement Sections and Elevations	0	11/20/2008 0:00
10112936-PB-L-DRW-0006	25474-000-P4-0010-00006	Piping Arrangement Sections and Elevations	0	11/20/2008 0:00
10112936-PB-L-DRW-0007	25474-000-P4-0010-00007	Piping Arrangement Sections and Elevations	0	11/20/2008 0:00
10112936-PB-L-DRW-0008	25474-000-P4-0010-00008	Piping Arrangement Sections and Elevations	0	11/20/2008 0:00
10112936-PB-L-LST-0002	25474-000-M0X-0000-00004	Storage and Transport Systems	0	11/12/2008 0:00
10112936-PB-L-TED-0001	25474-000-3DS-P72G-00001	Pipe Class Selection	0	11/13/2008 0:00
10112936-PB-L-TED-0002	25474-000-3DG-P70G-00001	Selection And Application of Valves	0	12/5/2008 0:00
10112936-PB-L-TED-0003	25474-000-30R-M90G-00001	LCC Pipe Design	0	12/7/2008 0:00
10112936-PB-M-TDO-0001	25474-000-G65-GEN-00001	Corrosion Evaluation for Main Systems CO2 Capture Facility	0	11/20/2008 0:00
10112936-PB-M-TDO-0002	25474-000-G65-GEN-00002	Durability Report (Material Selection Philosophy) CO2 Capture Facility	0	11/20/2008 0:00
10112936-PB-N-DRW-0001	25474-000-S0-0000-00001	Structural Steel Sheet Typical Sections and Details	0	10/24/2008 0:00
10112936-PB-N-DRW-0002	25474-000-S0-0000-00002	Structural Steel Sheet Typical Sections and Details	0	10/24/2008 0:00
10112936-PB-N-DRW-0003	25474-000-S0-0010-00003	Structural Steel Sheet Typical Sections and Details	0	10/24/2008 0:00
10112936-PB-N-DRW-0004	25474-000-S0-0010-00004	Structural Steel Sheet Typical Sections and Details	0	10/24/2008 0:00

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10112936-PB-N-TDO-0002	25474-000-30X-C15G-00001	Foundation Loads	0	11/20/2008 0:00
10112936-PB-N-TED-0001	25474-000-30Y-S01G-00001	Structural Design Philosophy and Acceptance Criteria	1	11/26/2008 0:00
10112936-PB-O-DOC-0001	25474-000-4CR-T01G-00001	Constructability Report	0	11/14/2008 0:00
10112936-PB-O-DOC-0002	25474-000-4CY-T01G-00001	Material Preservation and Storage Philosophy	0	11/20/2008 0:00
10112936-PB-O-DOC-0003	25474-000-517-U07G-00001	Operating and Maintenance Philosophy	1	12/12/2008 0:00
10112936-PB-O-DOC-0004	25474-000-517-U07G-00002	Operating Staff Concept	1	12/12/2008 0:00
10112936-PB-O-DOC-0005	25474-000-583-U07G-00001	Mechanical Testing and Completion Schedule	0	12/6/2008 0:00
10112936-PB-O-DOC-0006	25474-000-512-U07G-00001	Cold Commissioning Schedule	0	12/6/2008 0:00
10112936-PB-O-DOC-0007	25474-000-512-U07G-00002	Hot Commissioning Schedule	0	12/6/2008 0:00
10112936-PB-O-DOC-0008	25474-000-586-U07G-00001	Performance Guarantee Test Procedure	0	12/7/2008 0:00
10112936-PB-O-DOC-0009	25474-000-552-U07G-00001	Recommended Spare and Wear Parts	0	12/6/2008 0:00
10112936-PB-O-LST-0001	25474-000-514-U07G-00001	List of Consumables	0	12/2/2008 0:00
10112936-PB-O-TDO-0001	25474-000-4CY-T01G-00002	Erection Concept and Access Requirements for Operation and Maintenance	0	1/5/2009 0:00
10112936-PB-P-DAS-0001	25474-000-M5D-CN-00011	Vessel Data Sheet	1	11/19/2008 0:00
10112936-PB-P-DAS-0002	25474-000-M5D-CN-00012	Process Data Sheet Trays and Packing	1	11/19/2008 0:00
10112936-PB-P-DAS-0003	25474-000-M5D-CN-00031	Heat Exchanger (Plate) Data Sheet	1	11/19/2008 0:00
10112936-PB-P-DAS-0004	25474-000-M5D-CN-00051	Vessel Data Sheet	1	11/19/2008 0:00
10112936-PB-P-DAS-0005	25474-000-M5D-CN-00052	Process Data Sheet Trays and Packing	1	11/19/2008 0:00
10112936-PB-P-DAS-0006	25474-000-M5D-QG-00011	Process Data Sheet Compressors	0	10/7/2008 0:00
10112936-PB-P-DAS-0007	25474-000-M5D-BA-00011	Process Data Sheet Blowers	0	10/8/2008 0:00
10112936-PB-P-DAS-0008	25474-000-M5D-BA-00012	General Package Datasheet	0	10/7/2008 0:00
10112936-PB-P-DAS-0012	25474-000-M5D-CN-00013	Heat Exchanger (Plate) Dtat Sheet	0	11/14/2008 0:00
10112936-PB-P-DAS-0013	25474-000-3SD-M000-00001	Utility Data Sheet	0	12/5/2008 0:00
10112936-PB-P-DGM-0001	25474-000-M6-BA-00001	Flue Gas Duct System	0	11/13/2008 0:00
10112936-PB-P-DGM-0002	25474-000-M6-BA-00002	Flue Gas Duct System	0	11/13/2008 0:00
10112936-PB-P-FLD-0001	25474-000-M5-YA-00001	Block Flow Diagram	1	11/12/2008 0:00
10112936-PB-P-FLD-0002	25474-000-M5J-YA-00001	Symbols and Legends	0	10/10/2008 0:00
10112936-PB-P-FLD-0003	25474-000-M5-BA-00001	Process Flow Diagram - Blower and Quench Section	1	11/12/2008 0:00
10112936-PB-P-FLD-0004	25474-000-M5-CN-00001	Process Flow Diagram - Absorber T-101	1	11/12/2008 0:00
10112936-PB-P-FLD-0005	25474-000-M5-CN-00002	Process Flow Diagram - Absorber T-102	1	11/12/2008 0:00
10112936-PB-P-FLD-0006	25474-000-M5-CN-00003	Process Flow Diagram - Lean Amine Cooling Sheet 1 of 2	1	11/12/2008 0:00
10112936-PB-P-FLD-0007	25474-000-M5-CN-00004	Process Flow Diagram - Lean Amine Cooling Sheet 2 of 2	1	11/12/2008 0:00
10112936-PB-P-FLD-0008	25474-000-M5-CN-00005	Process Flow Diagram Stipper	1	11/12/2008 0:00
10112936-PB-P-FLD-0009	25474-000-M5-CY-00001	Process Flow Diagram - Fresh and Lean Amine Storage	1	11/12/2008 0:00
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10112936-PB-P-FLD-0012	25474-000-M5-WP-00001	Process Flow Diagram - Process Water System	0	11/12/2008 0:00
10112936-PB-P-FLD-0013	25474-000-M5-WL-00001	Closed Cooling Water System	0	11/13/2008 0:00
10112936-PB-P-FLD-0014	25474-000-M5-SC-00001	LP Condensate Return System	0	11/13/2008 0:00
10112936-PB-P-HMB-0001	25474-000-M4-CN-00001	Heat and Mass Balance Diagrams	1	11/14/2008 0:00
10112936-PB-P-HMB-0002	25474-000-M4-CN-00002	Heat and Mass Balance Diagrams	1	11/14/2008 0:00
10112936-PB-P-LCL-0001	25474-000-M0X-0000-00002	Line List	0	11/14/2008 0:00
10112936-PB-P-LST-0001	25474-000-M0X-0000-00003	Utility Consumption List	0	11/14/2008 0:00
10112936-PB-P-PID-0001	25474-000-M6J-YA-00001	Symbols and Legends	0	11/13/2008 0:00
10112936-PB-P-PID-0002	25474-000-M6J-YA-00002	Symbols and Legends	0	11/13/2008 0:00
10112936-PB-P-PID-0003	25474-000-M6J-YA-00003	Symbols and Legends	0	11/13/2008 0:00
10112936-PB-P-PID-0004	25474-000-M6J-YA-00004	Symbols and Legends	0	11/13/2008 0:00
10112936-PB-P-PID-0005	25474-000-M6J-YA-00005	Symbols and Legends	0	11/13/2008 0:00
10112936-PB-P-PID-0006	25474-000-M6-CN-00010	Piping & Instrument Diagram CO2 Absorber T-101 (Amine Section)	0	11/12/2008 0:00
10112936-PB-P-PID-0007	25474-000-M6-CN-00020	Piping & Instrument Diagram CO2 Absorber T-101 (Wash Water Cooling Section)	0	11/12/2008 0:00
10112936-PB-P-PID-0008	25474-000-M6-CN-00030	Piping & Instrument Diagram Absorber 1 Wash Water Cooling Syster	0	11/12/2008 0:00
10112936-PB-P-PID-0009	25474-000-M6-CN-00040	Piping & Instrumentation Diagram Absorber 1 Rich Amine Pumpls	0	11/12/2008 0:00
10112936-PB-P-PID-0010	25474-000-M6-CN-00045	Piping & Instrumentation Diagram Absorber 2 Rich Amine Pumps	0	11/13/2008 0:00
10112936-PB-P-PID-0011	25474-000-M6-CN-00050	Piping & Instrument Diagram CO2 Absorber T-102 (Amine Section)	0	11/12/2008 0:00
10112936-PB-P-PID-0012	25474-000-M6-CN-00060	Piping & Instrument Diagram CO2 Absorber T-102 (Wash Water Cooling Section)	0	11/12/2008 0:00
10112936-PB-P-PID-0013	25474-000-M6-CN-00070	Piping & Instrument Diagram Absorber 2 Wash Water Cooling System	0	11/12/2008 0:00
10112936-PB-P-PID-0014	25474-000-M6-CN-00080	Piping & Instrument Diagram Lean Amine Cooling System	0	11/12/2008 0:00
10112936-PB-P-PID-0015	25474-000-M6-CN-00081	Piping & Instrument Diagram Lean Amine /Rich Amine Heat Exchangers Shet 1 of 4	0	11/12/2008 0:00
10112936-PB-P-PID-0016	25474-000-M6-CN-00082	Piping & Instrument Diagram Lean Amine /Rich Amine Heat Exchangers Sheet 2 of 4	0	11/12/2008 0:00

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10112936-PB-P-PID-0018	25474-000-M6-CN-00084	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Lean Amine /Rich Amine Heat Exchangers Sheet 4 of 4	0	11/12/2008 0:00
10112936-PB-P-PID-0019	25474-000-M6-CN-00085	Piping & Instrument Diagram Semi-Lean Amine / Rich Amine Heat Exchanger	0	11/13/2008 0:00
10112936-PB-P-PID-0020	25474-000-M6-CN-00090	Piping & Instrument Diagram Lean Amine System Side Stream Filters	0	11/13/2008 0:00
10112936-PB-P-PID-0021	25474-000-M6-CN-00100	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Flash Feed Heaters	0	11/12/2008 0:00
10112936-PB-P-PID-0022	25474-000-M6-CN-00110	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Semi-Lean Amine Flash System	0	11/12/2008 0:00
10112936-PB-P-PID-0023	25474-000-M6-CN-00120	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Amine Stripper (Packed Section)	0	11/12/2008 0:00
10112936-PB-P-PID-0024	25474-000-M6-CN-00130	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Amine Stirpper (Trayed Section)	0	11/12/2008 0:00
10112936-PB-P-PID-0025	25474-000-M6-CN-00140	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Stripper Reflus Section	0	11/13/2008 0:00
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10112936-PB-P-PID-0030	25474-000-M6-CN-00190	Piping & Instrument Diagram Chemical Feed Package	0	11/13/2008 0:00
10112936-PB-P-PID-0031	25474-000-M6-CY-00010	Piping & Instrument Diagram Lean Amine Piping & Instrument Diagram Fresh & Lean Amine Storage	0	11/12/2008 0:00
10112936-PB-P-PID-0032	25474-000-M6-QG-00010	Piping & Instrument Diagram CO2 Compressor Suction Drum-CO2 Product System	0	11/14/2008 0:00
10112936-PB-P-PID-0033	25474-000-M6-QG-00020	Piping & Instrument Diagram CO2 Compressor 1st Stage	0	11/14/2008 0:00
10112936-PB-P-PID-0034	25474-000-M6-QG-00030	Piping & Instrument Diagram CO2 Compressor 1st Stage Steam Generator And Intercooler	0	11/14/2008 0:00
10112936-PB-P-PID-0035	25474-000-M6-QG-00040	Piping & Instrument Diagram CO2 Compressor 1st Stage Interstage Knock-Out Drum	0	11/14/2008 0:00
10112936-PB-P-PID-0036	25474-000-M6-QG-00050	Piping & Instrument Diagram CO2 Compressor 2nd Stage	0	11/14/2008 0:00

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10112936-PB-P-PID-0040	25474-000-M6-QG-00090	Piping & Instrument Diagram CO2 Compressor 3rd Stage	0	11/14/2008 0:00
10112936-PB-P-PID-0041	25474-000-M6-QG-00100	Piping & Instrument Diagram CO2 Compressor 3rd Stage Steam Generator And Intercooler	0	11/14/2008 0:00
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10112936-PB-P-PID-0043	25474-000-M6-WP-00010	Piping & Instrument Diagram Absorber Makeup Water Pump	0	11/13/2008 0:00
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10112936-PB-P-PID-0045	25474-000-M6-AB-00002	LP Steam System	0	11/13/2008 0:00
10112936-PB-P-PID-0046	25474-000-M6-AB-00003	HP Steam System	0	11/13/2008 0:00
10112936-PB-P-PID-0047	25474-000-M6-PA-00001	Compressed Air System	0	11/13/2008 0:00
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10112936-PB-P-PID-0060	25474-000-M6-SB-00001	Piping & Instrument Diagram Auxiliary Boiler System	0	11/13/2008 0:00
10112936-PB-P-TDO-0001	25474-000-M4C-CN-00001	Calculation Cover Sheet - Capture Simulation - Normal Case	1	11/14/2008 0:00
10112936-PB-P-TDO-0002	25474-000-M4C-CN-00002	Calculation Cover Sheet - Column Flooding Factors	0	10/10/2008 0:00
10112936-PB-P-TDO-0003	25474-000-M4C-CN-00003	Calculation Cover Sheet - CO2 Absorber sizing calculations	1	11/19/2008 0:00
10112936-PB-P-TDO-0004	25474-000-M4C-CN-00004	Calculation Cover Sheet - Stripper Sizing Calculations	1	11/19/2008 0:00
10112936-PB-P-TDO-0005	25474-000-M4C-CN-00005	Calculation Cover Sheet - Vessel Sizing	0	10/10/2008 0:00

Client Document Number	Bechtel Document Number	Title	Revision	Date on Document
10112936-PB-P-TDO-0006	25474-000-M4C-CN-00006	Calculation Cover Sheet - Dosing Rate For Degraded MEA Neutralization	0	10/10/2008 0:00
10112936-PB-P-TDO-0007	25474-000-M5A-CN-00001	Effluent Production	0	10/10/2008 0:00
10112936-PB-P-TDO-0008	25474-000-30R-M84G-00001	Cooling Philosophy Study	1	11/11/2008 0:00
10112936-PB-P-TDO-0009	25474-000-M4C-CN-00007	Calculation Cover Sheet - Heat Exchanger Fouling Factors	0	10/10/2008 0:00
10112936-PB-P-TDO-0010	25474-000-M5C-CN-00002	Calculation - Process Line Sizing	0	11/14/2008 0:00
10112936-PB-P-TDO-0011	25474-000-H1-0000-00002	Amine Emissions Abatement	0	11/12/2008 0:00
10112936-PB-P-TDO-0012	25474-000-30R-M01G-00001	Hydraulic and Mechanical Study of the Amine Tower and Stripper Column Design	0	11/12/2008 0:00
10112936-PB-P-TDO-0013	25474-000-30R-M01G-00002	Depressurization and Draining Philosophy	0	11/12/2008 0:00
10112936-PB-P-TDO-0014	25474-000-30R-M01G-00003	Energy Consumption Optimization	0	11/14/2008 0:00
10112936-PB-P-TDO-0015	25474-000-30R-M01G-00005	Reliability, Availability, Maintainability Analysis (RAM)	0	12/15/2008 0:00
10112936-PB-P-TED-0001	25474-001-30R-G01G-00003	Karsto - FEED Contractor Technologies and References	1	10/23/2008 0:00
10112936-PB-P-TED-0002	25474-000-3YD-M18G-00001	Process Description	1	11/14/2008 0:00
10112936-PB-P-TED-0003	25474-000-3YD-MYAG-00002	Utility System Description	0	11/14/2008 0:00
10112936-PB-Q-PPL-0001	25474-001-GQP-GAQ-00003	Karsto - Plan for Examination	1	10/24/2008 0:00
10112936-PB-R-DAS-0001	25474-000-3SD-MBPD-00001	Mechanical Data Sheet for Auxiliary Boiler	0	12/5/2008 0:00
10112936-PB-R-DAS-0002	25474-000-3SD-MPVW-00001	Mechanical Data Sheet for Seawater Cooling Pumo	0	12/5/2008 0:00
10112936-PB-R-DAS-0003	25474-000-3SD-MPCG-00001	Mechanical Data Sheet for Seawater Cooling Booster Pump	0	12/5/2008 0:00
10112936-PB-R-DAS-0004	25474-000-3SD-MPGC-00001	Mechanical Data Sheet for LP Condensate Return Pump	0	12/5/2008 0:00
10112936-PB-R-DAS-0005	25474-000-3SD-MCRA-00001	Mechanical Data Sheet for Air Compressor	0	12/5/2008 0:00
10112936-PB-R-DAS-0006	25474-000-3SD-MCRA-00002	Mechanical Data Sheet for Air Dryer	0	12/5/2008 0:00
10112936-PB-R-PAL-0001	25474-000-M0X-0000-00001	Mechanical Equipment List	1	12/7/2008 0:00
10112936-PB-R-TDO-0001	25474-000-30R-M01G-00004	Driver Selection Study	0	11/11/2008 0:00
10112936-PB-R-TDO-0002	25474-000-G07-GPX-00001	Equipment Vendor References	1	12/22/2008 0:00
10112936-PB-R-TDO-0003	25474-000-M0X-0000-00005	Main Equipment Outlines & Weights	0	11/21/2008 0:00
10112936-PB-S-HSE-0001	25474-000-U0Y-0000-00001	Health Design Philosophy	0	10/10/2008 0:00
10112936-PB-S-HSE-0002	25474-000-U6D-CN-00001	Material Safety Data Sheets for Main Chemicals	0	10/10/2008 0:00
10112936-PB-S-HSE-0003	25474-000-U4R-0000-00001	HAZID Report	0	10/23/2008 0:00
10112936-PB-S-HSE-0004	25474-000-U6D-0000-00001	Discharge and Emissions Data Forms	0	11/11/2008 0:00
10112936-PB-S-HSE-0005	25474-000-H1-0000-00001	Emission Dispersion Parameters	0	11/15/2008 0:00
10112936-PB-S-HSE-0006	25474-000-U1Y-0000-00001	Fire & Explosion Strategy	0	11/28/2008 0:00
10112936-PB-S-HSE-0007	25474-000-U0Y-0000-00002	Occupational Health Area Charts	1	12/4/2008 0:00
10112936-PB-S-HSE-0008	25474-000-U0Y-0000-00003	Concept Occupational Health Impact Assessment	0	11/21/2008 0:00
10112936-PB-S-HSE-0009	25474-000-U3R-0000-00001	Layout Safety Review	1	12/4/2008 0:00
10112936-PB-S-HSE-0010	25474-000-U5Y-0000-00001	Hazardous Area Classification Drawing (Preliminary)	0	11/30/2008 0:00

Client Document Number	Bechtel Document Number	Title	Revision	Date on Document
10112936-PB-S-HSE-0011	25474-000-U2-0000-00001	Escape Route Drawing General Arrangement Plan (Preliminary) Sheet 1 of 5	0	12/5/2008 0:00
10112936-PB-S-HSE-0012	25474-000-U0Y-0000-00004	Coarse Noise Evaluation	1	12/22/2008 0:00
10112936-PB-S-HSE-0013	25474-000-U4R-0000-00003	HazOp Report	0	12/5/2008 0:00
10112936-PB-S-HSE-0014	25474-000-U7Y-0000-00001	Contribution to Quantitative Risk Analysis	0	12/5/2008 0:00
10112936-PB-S-HSE-0015	25474-000-U2Y-0000-00001	Escape, Evacuation, and Rescue Strategy	0	12/5/2008 0:00
10112936-PB-S-HSE-0016	25474-000-U2-0000-00002	Escape Route Drawing General Arrangement Plan (Preliminary) Sheet 2 of 5	0	12/5/2008 0:00
10112936-PB-S-HSE-0017	25474-000-U2-0000-00003	Escape Route Drawing General Arrangement Plan (Preliminary) Sheet 3 of 5	0	12/5/2008 0:00
10112936-PB-S-HSE-0018	25474-000-U2-0000-00004	Escape Route Drawing General Arrangement Plan (Preliminary) Sheet 4 of 5	0	12/5/2008 0:00
10112936-PB-S-HSE-0019	25474-000-U2-0000-00005	Escape Route Drawing General Arrangement Plan (Preliminary) Sheet 5 of 5	1	12/11/2008 0:00
Total number = 276				

Karsto CCC Plant
Owner's Engineer Document Reviews - List

Sorted by Client Status Code (reverse order),
Response Status, and Doc Submitted For..

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-P-0034	25474-000-G27-GZC-00074	Owner's Engineer Document Review Form - Cooling Philosophy Study	Code 3	Closed	11/11/2008 9:46	10112936-PB-P-TDO-0008	A
10112936-S-FIPB-C-0203	25474-000-G27-GZC-00268	Owner's Engineer Document Review Form - Conceptual Plan Control Workshop Store Building	Code 3	Closed	12/9/2008 11:29	10112936-PB-C-PLN-0005	A
10112936-S-FIPB-E-0066	25474-000-G27-GZC-00106	Owner's Engineer Document Review Form -Main Single Line Diagram	Code 3	Closed	11/14/2008 14:01	10112936-PB-E-DGM-0001	A
10112936-S-FIPB-E-0117	25474-000-G27-GZC-00108	Owner's Engineer Document Review - Electrical Power System Design Philosophy	Code 3	Closed	11/19/2008 14:59	10112936-PB-E-TED-0001	A
10112936-S-FIPB-E-0132	25474-000-G27-GZC-00109	Owner's Engineer Document Review - Basic Architecture and Specification for Integrated Switchgear Protection	Code 3	Closed	11/19/2008 14:59	10112936-PB-E-TED-0003	A
10112936-S-FIPB-G-0188	25474-000-G27-GZC-00243	Owner's Engineer Document Review Form - Main Equipment Layout Flue Gas Blower	Code 3	Closed	12/4/2008 9:58	10112936PB-G-DRW-0002	A
10112936-S-FIPB-G-0208	25474-000-G27-GZC-00245	Owner's Engineer Document Review Form - Layout drawings of main equipment - Main Equipment Layout Stripper Area CO2 Compressor Building	Code 3	Closed	12/4/2008 9:58	10112936-PB-G-DRW-0003	A
10112936-S-FIPB-G-0183	25474-000-G27-GZC-00242	Owner's Engineer Document Review Form - Main Equipment Layout Control Workshop Store Building Switchgear Building Tank Farm	Code 3	Closed	12/4/2008 9:58	10112936-PB-G-DRW-0004	A
10112936-S-FIPB-N-0146	25474-000-G27-GZC-00199	Owner's Engineer Document Review Form - Description of Design Philosophy and Acceptance Criteria for Structural Desing	Code 3	Closed	11/25/2008 8:45	10112936-PB-N-TED-0001	A
10112936-S-FIPB-Q-0003	25474-000-G27-GZC-00050	Karsto - Owner's Engineering Document Review Form - Plan for Examination	Code 2	Closed	10/1/2008 11:35	10112936-PB-A-PAM-0001	A
10112936-S-FIPB-A-0011	25474-000-G27-GZC-00046	Karsto - Owner's Engineering Document Form - Mobilization Plan	Code 2	Closed	10/1/2008 11:35	10112936-PB-A-PPL-0001	A
10112936-S-FIPB-A-0052	25474-000-G27-GZC-00086	Owner's Engineer Document Review Form - Comminication Control Procedure (Coordination Procedure)	Code 2	Closed	11/5/2008 10:20	10112936-PB-A-PPR-0002	A
10112936-S-FIPB-Q-0002	25474-000-G27-GZC-00049	Karsto - Owner's Enginnering Document Review Form - Quality Plan	Code 2	Closed	10/1/2008 11:35	10112936-PB-A-QAP-0001	A
10112936-S-FIPB-E-0171	25474-000-G27-GZC-00118	Owner's Engineer Document Review - Main Single Line Diagram	Code 2	Closed	11/21/2008 12:30	10112936-PB-E-DGM-0001	A
10112936-S-FIPB-E-0050	25474-000-G27-GZC-00085	Owner's Engineer Document Review Form - Design Basis	Code 2	Closed	10/28/2008 14:06	10112936-PB-E-TED-0002	A
10112936-S-FIPB-P-0026	25474-000-G27-GZC-00062	Owner's Engineering Document Review Form - Lean Amine Cooling 1/2	Code 2	Closed	10/22/2008 14:28	10112936-PB-P-FLD-0004 - 0005	A
10112936-S-FIPB-G-0189	25474-000-G27-GZC-00244	Owner's Engineer Document Review Form - General Arrangement Plan	Code 2	Closed	12/4/2008 9:58	10112936-PB-G-DRW-0001	A
10112936-S-FIPB-I-0119	25474-000-G27-GZC-00120	Owner's Engineer Document Review - Continuous Gas Monitoring System - CGMS	Code 2	Closed	11/21/2008 12:30	10112936-PB-I-DRW-0003	A
10112936-S-FIPB-I-0059	25474-000-G27-GZC-00119	Owner's Engineer Document Review - Safety and Automation (SAS) operating and control philosophy	Code 2	Closed	11/21/2008 12:30	10112936-PB-I-TDO-0001	A

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-P-0021	25474-000-G27-GZC-00064	Owner's Engineering Document Review Form - Block Flow Diagram	Code 2	Closed	10/22/2008 14:42	10112936-PB-P-FLD-0001	A
10112936-S-FIPB-P-0025	25474-000-G27-GZC-00063	Owner's Engineering Document Review Form - Blower & Quench Section	Code 2	Closed	10/22/2008 14:33	10112936-PB-P-FLD-0003	A
10112936-S-FIPB-P-0028	25474-000-G27-GZC-00061	Owner's Engineering Document Review Form - Lean Amine Cooling 1/2	Code 2	Closed	10/22/2008 14:23	10112936-PB-P-FLD-0006	A
10112936-S-FIPB-P-0029	25474-000-G27-GZC-00060	Owner's Engineering Document Review Form - Lean Amine Cooling 2/2	Code 2	Closed	10/22/2008 14:19	10112936-PB-P-FLD-0007	A
10112936-S-FIPB-P-0030	25474-000-G27-GZC-00059	Owner's Engineering Document Review Form - Stripper	Code 2	Closed	10/22/2008 14:12	10112936-PB-P-FLD-0008	A
10112936-S-FIPB-P-0031	25474-000-G27-GZC-00058	Owner's Engineering Document Review Form - Fresh & Lean Amine Storage	Code 2	Closed	10/22/2008 14:07	10112936-PB-P-FLD-0009	A
10112936-S-FIPB-P-0032	25474-000-G27-GZC-00057	Owner's Engineering Document Review Form - Compression & Drying 1/2	Code 2	Closed	10/22/2008 13:57	10112936-PB-P-FLD-0010	A
10112936-S-FIPB-P-0033	25474-000-G27-GZC-00056	Owner's Engineering Document Review Form - Compression & Drying 2/2	Code 2	Closed	10/22/2008 13:48	10112936-PB-P-FLD-0011	A
10112936-S-FIPB-A-0008	25474-000-G27-GZC-00045	Karsto - Owner's Engineering Document Review Form - Coordination Procedure	Code 2	Closed	10/1/2008 11:16	10112936-PB-Z-PPR-0002	A
10112936-S-FIPB-C-0231	25474-000-G27-GZC-00270	Owner's Engineer Document Review Form - Architectural descriptions and design reports	Code 2	Closed	12/9/2008 11:29	10112936-PB-C-DOC-0001	C
10112936-S-FIPB-C-0017	25474-000-G27-GZC-00070	Owner's Engineer Document Review Form - Defination of architectural design premises	Code 2	Closed	10/27/2008 16:07	10112936-PB-C-TED-0001	C
10112936-S-FIPB-C-0015	25474-000-G27-GZC-00069	Owner's Engineering Document Review Form - Description of design philosophy and acceptance criteria for civil works	Code 2	Closed	10/27/2008 15:34	10112936-PB-C-TED-0002	C
10112936-S-FIPB-C-0145	25474-000-G27-GZC-00191	Owner's Engineer Document Review - Description and drawings of site preparation and leveling requirements	Code 2	Closed	11/21/2008 15:30	10112936-PB-C-TED-0003	C
10112936-S-FIPB-C-0205	25474-000-G27-GZC-00248	Owner's Engineer Document Review Form - Ductwork Foundation Plan	Code 2	Closed	12/5/2008 9:55	10112936-PB-C-TED-0006-7-8	C
10112936-S-FIPB-C-0212	25474-000-G27-GZC-00249	Owner's Engineer Document Review Form - CCC Plant Foundation Plan with typical sections and details	Code 2	Closed	12/5/2008 9:55	10112936-PB-C-TED-0009-10 -11 -12	C
10112936-S-FIPB-C-0222	25474-000-G27-GZC-00250	Owner's Engineer Document Review Form - Arrangement of underground structural design (caverns and tunels)	Code 2	Closed	12/5/2008 9:55	10112936-PB-C-TED-0014-15	C
10112936-S-FIPB-G-0005	25474-000-G27-GZC-00044	Karsto - Owner's Engineer Document Review - Risk Management Plan	Code 2	Closed	9/30/2008 11:30	10112936-PB-G-DOC-0001	C
10112936-S-FIPB-I-0220	25474-000-G27-GZC-00260	Owner's Engineer Document Review Form - Cause and Effect Diagrams	Code 2	Closed	12/5/2008 14:31	10112936-PB-I-DGM-0001-2	C
10112936-S-FIPB-I-0162	25474-000-G27-GZC-00121	Owner's Engineer Document Review - Narrative of proposed SAS including system architecture drawing (SAS Topology)	Code 2	Closed	11/21/2008 12:30	10112936-PB-I-DRW-0001 and -0002	C
10112936-S-FIPB-I-0185	25474-000-G27-GZC-00257	Owner's Engineer Document Review Form - Central Control Room Concetual Layour	Code 2	Closed	12/5/2008 14:31	10112936-PB-I-DRW-0004	C
10112936-S-FIPB-O-0211	25474-000-G27-GZC-00254	Owner's Engineer Document Review Form - Operation and Maintenance philosophy	Code 2	Closed	12/5/2008 9:55	10112936-PB-O-DOC-0003	C

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-O-0209	25474-000-G27-GZC-00253	Owner's Engineer Document Review Form - Operating staff concept	Code 2	Closed	12/5/2008 9:55	10112936-PB-O-DOC-0004	C
10112936-S-FIPB-P-0051	25474-000-G27-GZC-00054	Owner's Engineering Document Review Form - Heat and Mass Balance Diagram	Code 2	Closed	10/22/2008 13:00	10112936-PB-P-HMB-0001 -0002	C
10112936-S-FIPB-P-0009	25474-000-G27-GZC-00048	Karsto - Owner's Engineering Document Review Form - Technologies and References	Code 2	Closed	10/1/2008 11:35	10112936-PB-P-TED-0001	C
10112936-S-FIPB-P-0019	25474-000-G27-GZC-00065	Owner's Engineering Document Review Form - Process Description	Code 2	Closed	10/22/2008 14:53	10112936-PB-P-TED-0001	C
10112936-S-FIPB-S-0016	25474-000-G27-GZC-00067	Owner's Engineering Document Review Form - Health Design Philosophy	Code 2	Closed	10/24/2008 13:28	10112936-PB-S-HSE-0001	C
10112936-S-FIPB-S-0174	25474-000-G27-GZC-00261	Owner's Engineer Document Review Form - Occupational Health Area Charts	Code 2	Closed	12/5/2008 14:31	10112936-PB-S-HSE-0007	C
10112936-S-FIPB-S-0219	25474-000-G27-GZC-00262	Owner's Engineer Document Review Form - Layout Safety Review Report	Code 2	Closed	12/5/2008 14:31	10112936-PB-S-HSE-0009	C
10112936-S-FIPB-S-0175	25474-000-G27-GZC-00246	Owner's Engineer Document Review Form - Noise and vibration assessment (Coarse noise evaluation)	Code 2	Closed	12/4/2008 9:58	10112936-PB-S-HSE-0012	C
10112936-S-FIPB-S-0123	25474-000-G27-GZC-00235	Owner's Engineer Document Review Form - Emission Dispersion Parameters	Code 1	Closed	12/2/2008 17:07	10112936-PB-S-HSE-0005	C
10112936-S-FIPB-P-0035	25474-000-G27-GZC-00075	Owner's Engineer Document Review Form - CCS Simulation Normal Case	Code 2	Closed	10/27/2008 18:17	10112936-PB-P-TDO-0001	I
10112936-S-FIPB-G-0053	25474-000-G27-GZC-00087	Owner's Engineer Document Review Form - Mobilization Plan	Code 2	Closed	11/5/2008 10:20	10112936-PB-G-PPL-0001	I
10112936-S-FIPB-P-0036	25474-000-G27-GZC-00076	Owner's Engineer Document Review Form - Vessel Data Sheet (Absorber)	Code 2	Closed	10/28/2008 9:06	10112936-PB-P-DAS-0001	I
10112936-S-FIPB-P-0037	25474-000-G27-GZC-00077	Owner's Engineer Document Review Form - Absorber Internals	Code 2	Closed	10/28/2008 9:16	10112936-PB-P-DAS-0002	I
10112936-S-FIPB-P-0038	25474-000-G27-GZC-00078	Owner's Engineer Document Review Form - Lean Rich Amine heat Exchangers	Code 2	Closed	10/28/2008 10:44	10112936-PB-P-DAS-0003	I
10112936-S-FIPB-P-0039	25474-000-G27-GZC-00079	Owner's Engineer Document Review Form - Vessel Data Sheet (Stripper)	Code 2	Closed	10/28/2008 10:54	10112936-PB-P-DAS-0004	I
10112936-S-FIPB-P-0040	25474-000-G27-GZC-00080	Owner's Engineer Document Review Form - Stripper Internals	Code 2	Closed	10/28/2008 10:59	10112936-PB-P-DAS-0005	I
10112936-S-FIPB-P-0041	25474-000-G27-GZC-00055	Owner's Engineering Document Review Form - Compressor	Code 2	Closed	10/28/2008 11:29	10112936-PB-P-DAS-0006	I
10112936-S-FIPB-P-0042	25474-000-G27-GZC-00081	Owner's Engineer Document Review Form - Blowers	Code 2	Closed	10/28/2008 13:24	10112936-PB-P-DAS-0007	I
10112936-S-FIPB-P-0043	25474-000-G27-GZC-00082	Owner's Engineer Document Review Form - Flue Gas Water Fogger System	Code 2	Closed	10/28/2008 13:32	10112936-PB-P-DAS-0008	I
10112936-S-FIPB-P-0045	25474-000-G27-GZC-00083	Owner's Engineer Document Review Form - Absorber Sizing Calculations	Code 2	Closed	10/28/2008 13:50	10112936-PB-P-TDO-0003	I
10112936-S-FIPB-P-0046	25474-000-G27-GZC-00084	Owner's Engineer Document Review Form - Stripper Sizing Calculations	Code 2	Closed	10/28/2008 13:57	10112936-PB-P-TDO-0004	I
10112936-S-FIPB-P-0131	25474-000-G27-GZC-00168	Owner's Engineer Document Review - Equipment Vendor References	Code 2	Closed	11/21/2008 12:30	10112936-PB-R-TDO-0002	I
10112936-S-FIPB-A-0027	25474-000-G27-GZC-00089	Owner's Engineer Document Review Form - Description of Risk Management System	Code 1	No action required	11/6/2008 14:06	10112936-PB-A-GEA-0001	A

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-S-0013	25474-000-G27-GZC-00043	Karsto - Owner's Engineer Document Review - HSE Plan	Code 1	No action required	10/9/2008 13:44	10112936-PB-A-HSE-0001	A
10112936-S-FIFR-Q-0004	25474-000-G27-GZC-00051	Karsto - Owner's Engineering Document Review Form - Plan for Quality Audits and Surveillance	Code 1	No action required	10/1/2008 11:35	10112936-PB-A-QAR-0001	A
10112936-S-FIPB-C-0200	25474-000-G27-GZC-00265	Owner's Engineer Document Review Form - Conceptual Plan Flue Gas Blower Building	Code 1	No action required	12/9/2008 11:29	10112936-PB-C-PLN-0002	A
10112936-S-FIPB-C-0204	25474-000-G27-GZC-00269	Owner's Engineer Document Review Form - Conceptual Elevations Control Workshop Store Building	Code 1	No action required	12/9/2008 11:29	10112936-PB-C-PLN-0006	A
10112936-S-FIPB-C-0159	25474-000-G27-GZC-00198	Owner's Engineer Document Review Form - Defination of Architectural Design Premises	Code 1	No action required	11/25/2008 8:45	10112936-PB-C-TED-0001	A
10112936-S-FIPB-C-0160	25474-000-G27-GZC-00192	Owner's Engineer Document Review - Description of design philosophy and acceptance criteria for civil works	Code 1	No action required	11/21/2008 15:30	10112936-PB-C-TED-0002	A
10112936-S-FIPB-E-0214	25474-000-G27-GZC-00233	Owner's Engineer Document Review Form - Main Single Line Diagram	Code 1	No action required	12/2/2008 16:38	10112936-PB-E-DGM-0001	A
10112936-S-FIPB-E-0215	25474-000-G27-GZC-00225	Owner's Engineer Document Review Form - DC and UPS Single Line Diagram	Code 1	No action required	12/2/2008 16:15	10112936-PB-E-DGM-0002	A
10112936-S-FIPB-E-0217	25474-000-G27-GZC-00227	Owner's Engineer Document Review Form - Basic architecture and specification for integrated switchgear protection and control system	Code 1	No action required	12/2/2008 16:15	10112936-PB-E-TED-0003	A
10112936-S-FIPB-G-0284	25474-000-G27-GZC-00324	Owner's Engineer Document Review Form -Main Equipment Layout Flue Gas Blower	Code 1	No action required	12/23/2008 9:50	10112936-PB-G-DRW-0002	A
10112936-S-FIPB-G-0285	25474-000-G27-GZC-00325	Owner's Engineer Document Review Form - Layout drawings of main equipment - Main Equipment Layout Stripper Area -CO2	Code 1	No action required	12/23/2008 9:50	10112936-PB-G-DRW-0003	A
10112936-S-FIPB-G-0286	25474-000-G27-GZC-00326	Owner's Engineer Document Review Form - Main Equipment Layout Control Workshop Store Building Switchgear Building Tank Farm	Code 1	No action required	12/23/2008 9:50	10112936-PB-G-DRW-0004	A
10112936-S-FIPB-N-0213	25474-000-G27-GZC-00289	Owner's Engineer Document Review Form - Description fo design philosophy and acceptance criteria for structural design	Code 1	No action required	12/11/2008 10:29	10112936-PB-N-TED-0001	A
10112936-S-FIPB-P-0078	25474-000-G27-GZC-00210	Owner's Engineer Document Review Form - Block Flow Diagram	Code 1	No action required	12/2/2008 10:42	10112936-PB-P-FLD-0001	A
10112936-S-FIPB-P-0024	25474-000-G27-GZC-00066	Owner's Engineering Document Review Form - Symbols & Legends	Code 1	No action required	10/24/2008 13:28	10112936-PB-P-FLD-0002	A
10112936-S-FIPB-P-0150	25474-000-G27-GZC-00181	Owner's Engineer Document Review - PFD Absorber T101 and T102	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0004, 10112936-PB-P-FLD-0005	A
10112936-S-FIPB-P-0154	25474-000-G27-GZC-00184	Owner's Engineer Document Review - PFD Lean Amine Cooling 2/2	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0007	A
10112936-S-FIPB-P-0155	25474-000-G27-GZC-00185	Owner's Engineer Document Review - PFD Stripper	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0008	A
10112936-S-FIPB-P-0156	25474-000-G27-GZC-00186	Owner's Engineer Document Review - PFD Fresh & Lean Amine Storage	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0009	A
10112936-S-FIPB-P-0157	25474-000-G27-GZC-00187	Owner's Engineer Document Review - PFD Compression & Drying 1/2	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0010	A

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-P-0158	25474-000-G27-GZC-00188	Owner's Engineer Document Review - PFD Compression & Drying 2/2	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0011	A
10112936-S-FIPB-P-0151	25474-000-G27-GZC-00182	Owner's Engineer Document Review - PFD Process Water System	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0012	A
10112936-S-FIPB-P-0110	25474-000-G27-GZC-00163	Owner's Engineer Document Review - Seawater Cooling System	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0013	A
10112936-S-FIPB-P-0109	25474-000-G27-GZC-00162	Owner's Engineer Document Review - LP Condensate Return System	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-FLD-0014	A
10112936-S-FIPB-P-0114	25474-000-G27-GZC-00167	Owner's Engineer Document Review - P&ID Symbols and Legends	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0001	A
10112936-S-FIPB-P-0111	25474-000-G27-GZC-00164	Owner's Engineer Document Review - P&ID Symbols and Legends	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0002	A
10112936-S-FIPB-P-0112	25474-000-G27-GZC-00165	Owner's Engineer Document Review - P&ID Symbols and Legends	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0003	A
10112936-S-FIPB-P-0103	25474-000-G27-GZC-00156	Owner's Engineer Document Review - P&ID Symbols and Legends	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0004	A
10112936-S-FIPB-P-0107	25474-000-G27-GZC-00160	Owner's Engineer Document Review - P&ID Symbols and Legends	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0005	A
10112936-S-FIPB-P-0083	25474-000-G27-GZC-00137	Owner's Engineer Document Review - P&ID Absorber 2 Rich Amine Pumps	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0010	A
10112936-S-FIPB-P-0072	25474-000-G27-GZC-00127	Owner's Engineer Document Review - P&ID Heat Exchangers Sheet 1-4 of 4	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0015 through -0018	A
10112936-S-FIPB-P-0081	25474-000-G27-GZC-00135	Owner's Engineer Document Review - P&ID Semi Lean Amine and Rich Amine Heat Exchanger	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0019	A
10112936-S-FIPB-P-0080	25474-000-G27-GZC-00134	Owner's Engineer Document Review - P&ID Side Stream Filters	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0020	A
10112936-S-FIPB-P-0073	25474-000-G27-GZC-00128	Owner's Engineer Document Review - P&ID Flash Feed Heaters	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0021	A
10112936-S-FIPB-P-0074	25474-000-G27-GZC-00129	Owner's Engineer Document Review - P&ID Semi-Lean Amine Flash System	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0022	A
10112936-S-FIPB-P-0084	25474-000-G27-GZC-00138	Owner's Engineer Document Review - P&ID Stripper Reboiler	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0026, 0027	A
10112936-S-FIPB-P-0086	25474-000-G27-GZC-00140	Owner's Engineer Document Review - P&ID Lean Amine Pump	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0028	A
10112936-S-FIPB-P-0136	25474-000-G27-GZC-00172	Owner's Engineer Document Review - P&ID CO2 Compressor 1st Stage-Interstage Knockout Drum	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0035	A
10112936-S-FIPB-P-0139	25474-000-G27-GZC-00175	Owner's Engineer Document Review - P&ID CO2 Compressor 2nd stage Interstage Knock-Out Drum	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0038	A
10112936-S-FIPB-P-0079	25474-000-G27-GZC-00133	Owner's Engineer Document Review - P&ID Absorber Makeup Water Pump	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0043	A
10112936-S-FIPB-P-0105	25474-000-G27-GZC-00158	Owner's Engineer Document Review - P&ID LP Steam System 2	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0045	A
10112936-S-FIPB-P-0102	25474-000-G27-GZC-00155	Owner's Engineer Document Review - P&ID Compressed Air System 1	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0047	A
10112936-S-FIPB-P-0098	25474-000-G27-GZC-00151	Owner's Engineer Document Review - P&ID Fire Protection System	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0049	A

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10112936-S-FIPB-P-0093	25474-000-G27-GZC-00146	Owner's Engineer Document Review - P&ID Auxiliary Boiler System	Code 1	No action required	11/21/2008 12:30	10112936-PB-P-PID-0060	A
10112936-S-FIPB-Q-0057	25474-000-G27-GZC-00092	Owner's Engineer Document Review Form - Plan for Examination	Code 1	No action required	11/6/2008 14:07	10112936-PB-Q-PPL-0001	A
10112936-S-FIPB-Q-0056	25474-000-G27-GZC-00091	Owner's Engineer Document Review Form - Project Quality Plan	Code 1	No action required	11/6/2008 14:07	10112936-PB-Q-QAP-0001	A
10112936-S-FIPB-S-0266	25474-000-G27-GZC-00342	Owner's Engineer Document Review Form -HAZOP (Hazard and Operability) report	Code 1	No action required	12/23/2008 9:50	10112936-PB-S-HSE-0013	A
10112936-S-FIPB-C-0232	25474-000-G27-GZC-00271	Owner's Engineer Document Review Form - Relevant Architectural Analysis	Code 1	No action required	12/9/2008 11:29	10112936-PB-C-DOC-0002	C
10112936-S-FIPB-C-0182	25474-000-G27-GZC-00264	Owner's Engineer Document Review Form - Area plan for such defined Main area	Code 1	No action required	12/9/2008 11:29	10112936-PB-C-PLN-0007	C
10112936-S-FIPB-C-0193	25474-000-G27-GZC-00288	Owner's Engineer Document Review Form - Description and drawings of site preparation and leveling requirements	Code 1	No action required	12/11/2008 10:29	10112936-PB-C-TED-0003	C
10112936-S-FIPB-C-0225	25474-000-G27-GZC-00300	Owner's Engineer Document Review Form - Descriptions and drawings of drainage and underground pressurized piping	Code 1	No action required	12/16/2008 9:15	10112936-PB-C-TED-0004	C
10112936-S-FIPB-C-0252	25474-000-G27-GZC-00272	Owner's Engineer Document Review Form - Description and Drawings of Structural Design Requirements for Buildings	Code 1	No action required	12/9/2008 11:29	10112936-PB-C-TED-0016	C
10112936-S-FIPB-H-0118	25474-000-G27-GZC-00218	Owner's Engineer Document Review Form - HVAC Design and Control Philosophy	Code 1	No action required	12/2/2008 15:50	10112936-PB-H-TED-0001	C
10112936-S-FIPB-I-0287	25474-000-G27-GZC-00344	Owner's Engineer Document Review Form -Cause and Effect Diagrams	Code 1	No action required	1/9/2009 8:01	10112936-PB-I-DGM-0001-0002	C
10112936-S-FIPB-I-0288	25474-000-G27-GZC-00345	Owner's Engineer Document Review Form -Narrative of proposed SAS	Code 1	No action required	1/9/2009 8:01	10112936-PB-I-DRW-0002	C
10112936-S-FIPB-I-0190	25474-000-G27-GZC-00258	Owner's Engineer Document Review Form - Instrument Earthing Philosophy	Code 1	No action required	12/5/2008 14:31	10112936-PB-I-TDO-0002	C
10112936-S-FIPB-I-0173	25474-000-G27-GZC-00256	Owner's Engineer Document Review Form - Description of F&G Monitoring and Alarm System incl. block diagram	Code 1	No action required	12/5/2008 14:31	10112936-PB-I-TED-0001	C
10112936-S-FIPB-L-0207	25474-000-G27-GZC-00251	Owner's Engineer Document Review Form - Piping Arrangement - Overall Piping Plan	Code 1	No action required	12/5/2008 9:55	10112936-PB-L-DRW-0001-2-3-4-5-6-7-8	C
10112936-S-FIPB-L-0251	25474-000-G27-GZC-00329	Owner's Engineer Document Review Form - LCC Pipe Design	Code 1	No action required	12/23/2008 9:50	10112936-PB-L-TED-0003	C
10112936-S-FIPB-N-0163	25474-000-G27-GZC-00252	Owner's Engineer Document Review Form - Typical drawings of outfitting structural steel (ladders, handrails, grating, platforms, connections)	Code 1	No action required	12/5/2008 9:55	10112936-PB-N-DRW-0001,-2,-3,-4	C
10112936-S-FIPB-O-0293	25474-000-G27-GZC-00336	Owner's Engineer Document Review Form - Operation and Maintenance philosophy	Code 1	No action required	12/23/2008 9:50	10112936-PB-O-DOC-0003	C
10112936-S-FIPB-O-0294	25474-000-G27-GZC-00337	Owner's Engineer Document Review Form - Operating staff concept	Code 1	No action required	12/23/2008 9:50	10112936-PB-O-DOC-0004	C
10112936-S-FIPB-O-0258	25474-000-G27-GZC-00335	Owner's Engineer Document Review Form - List of consumables	Code 1	No action required	12/23/2008 9:50	10112936-PB-O-DOC-0001	C

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10112936-S-FIPB-P-0126	25474-000-G27-GZC-00211	Owner's Engineer Document Review Form - Amine Emissions Abatement	Code 1	No action required	12/2/2008 12:56	10112936-PB-P-TDO-011	C
10112936-S-FIPB-P-0055	25474-000-G27-GZC-00090	Owner's Engineer Document Review Form - FEED Contractor Technologies & References	Code 1	No action required	11/6/2008 14:07	10112936-PB-P-TED-0001	C
10112936-S-FIPB-R-0061	25474-000-G27-GZC-00094	Owner's Engineer Document Review Form - Driver Selection Study	Code 1	No action required	11/12/2008 10:35	10112936-PB-R-TDO-0001	C
10112936-S-FIPB-S-0018	25474-000-G27-GZC-00068	Owner's Engineering Document Review Form - Material Safety Data Sheets for main chemicals	Code 1	No action required	10/24/2008 13:28	10112936-PB-S-HSE-0002	C
10112936-S-FIPB-S-0122	25474-000-G27-GZC-00234	Owner's Engineer Document Review Form - Discharge and Emissions Data Forms	Code 1	No action required	12/2/2008 17:07	10112936-PB-S-HSE-0004	C
10112936-S-FIPB-S-0289	25474-000-G27-GZC-00313	Owner's Engineer Document Review Form - Occupational Health Area Charts	Code 1	No action required	12/18/2008 15:28	10112936-PB-S-HSE-0007	C
10112936-S-FIPB-S-0290	25474-000-G27-GZC-00314	Owner's Engineer Document Review Form - Layout Safety Review Report	Code 1	No action required	12/18/2008 15:28	10112936-PB-S-HSE-0009	C
10112936-S-FIPB-E-0242	25474-000-G27-GZC-00308	Owner's Engineer Document Review Form - Earthing and lightning protection plans	Code 1	No action required	12/18/2008 15:28	10112936-PB-E-TDO-0011	I
10112936-S-FIPB-P-0295	25474-000-G27-GZC-00339	Owner's Engineer Document Review Form -Process Calculations (HX Fouling Factors)	Code 1	No action required	12/23/2008 9:50	10112936-PB-P-TDO-0009	I
10112936-S-FIPB-P-0147	25474-000-G27-GZC-00110	Owner's Engineer Document Review - Cooling Philosophy Study	Code 2		11/19/2008 14:59	10112936-PB-B-TDO-0008	A
10112936-S-FIPB-C-0201	25474-000-G27-GZC-00266	Owner's Engineer Document Review Form - Conceptual Plan CO2 Compressor Builiding	Code 2		12/9/2008 11:29	10112936-PB-C-PLN-0003	A
10112936-S-FIPB-C-0202	25474-000-G27-GZC-00267	Owner's Engineer Document Review Form - Conceptual Plan Electrical Switchgear Building	Code 2		12/9/2008 11:29	10112936-PB-C-PLN-0004	A
10112936-S-FIPB-C-0292	25474-000-G27-GZC-00322	Owner's Engineer Document Review Form - Conceptual Plan Control Workshop Store Building	Code 2		12/23/2008 9:50	10112936-PB-C-PLN-0005	A
10112936-S-FIPB-E-0067	25474-000-G27-GZC-00104	Owner's Engineer Document Review Form - DC and UPS Single Line Diagram	Code 2		11/14/2008 14:01	10112936-PB-E-DGM-0002	A
10112936-S-FIPB-E-0216	25474-000-G27-GZC-00226	Owner's Engineer Document Review Form - Electrical Power System Design Philosophy	Code 2		12/2/2008 16:15	10112936-PB-E-TED-0001	A
10112936-S-FIPB-E-0223	25474-000-G27-GZC-00241	Owner's Engineer Document Review Form - Electrical Power System Design Philosophy	Code 2		12/4/2008 9:58	10112936-PB-E-TED-0001	A
10112936-S-FIPB-P-0148	25474-000-G27-GZC-00231	Owner's Engineer Document Review Form - Process Description	Code 2		12/2/2008 16:38	10112936-PB-E-TED-0002	A
10112936-S-FIPB-L-0250	25474-000-G27-GZC-00328	Owner's Engineer Document Review Form -Selection And Application of Valves	Code 2		12/23/2008 9:50	10112936-PB-L-TED-0002	A
10112936-S-FIPB-O-0253	25474-000-G27-GZC-00330	Owner's Engineer Document Review Form - Mechanical testing and completion schedule	Code 2		12/23/2008 9:50	10112936-PB-O-DOC-0005	A
10112936-S-FIPB-O-0254	25474-000-G27-GZC-00331	Owner's Engineer Document Review Form - Cold commissioning schedule	Code 2		12/23/2008 9:50	10112936-PB-O-DOC-0006	A
10112936-S-FIPB-O-0255	25474-000-G27-GZC-00332	Owner's Engineer Document Review Form -Hot commissioning schedule	Code 2		12/23/2008 9:50	10112936-PB-O-DOC-0007	A
10112936-S-FIPB-O-0256	25474-000-G27-GZC-00333	Owner's Engineer Document Review Form - Performance Guarantee Test procedure	Code 2		12/23/2008 9:50	10112936-PB-O-DOC-0008	A
10112936-S-FIPB-P-0104	25474-000-G27-GZC-00157	Owner's Engineer Document Review - P&ID Flue Gas System	Code 2		11/21/2008 12:30	10112936-PB-P-DGM-0001	A

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10112936-S-FIPB-P-0108	25474-000-G27-GZC-00161	Owner's Engineer Document Review - P&ID Flue Gas System	Code 2		11/21/2008 12:30	10112936-PB-P-DGM-0002	A
10112936-S-FIPB-P-0149	25474-000-G27-GZC-00180	Owner's Engineer Document Review - PFD Blower & Quench Section	Code 2		11/21/2008 12:30	10112936-PB-P-FLD-0003	A
10112936-S-FIPB-P-0153	25474-000-G27-GZC-00183	Owner's Engineer Document Review - PFD Lean Amine Cooling 1/2	Code 2		11/21/2008 12:30	10112936-PB-P-FLD-0006	A
10112936-S-FIPB-P-0172	25474-000-G27-GZC-00189	Owner's Engineer Document Review - Common to all P&IDs	Code 2		11/21/2008 12:30	10112936-PB-P-PID	A
10112936-S-FIPB-P-0062	25474-000-G27-GZC-00122	Owner's Engineer Document Review - P&ID CO2 Absorber T-101 and T-102 Amine Section	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0006 and 0011	A
10112936-S-FIPB-P-0063	25474-000-G27-GZC-00123	Owner's Engineer Document Review - P&ID Wash_Water_Cooling_Section Absorbers T-101 and T-102	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0007 and 0012	A
10112936-S-FIPB-P-0064	25474-000-G27-GZC-00124	Owner's Engineer Document Review - P&ID Absorber_1_Wash_Water	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0008 and 0013	A
10112936-S-FIPB-P-0065	25474-000-G27-GZC-00125	Owner's Engineer Document Review - P&ID Absorber 1 Rich Amine Pumps	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0009	A
10112936-S-FIPB-P-0071	25474-000-G27-GZC-00126	Owner's Engineer Document Review - P&ID Lean Amine Cooling System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0014	A
10112936-S-FIPB-P-0075	25474-000-G27-GZC-00130	Owner's Engineer Document Review - P&ID Amine Stripper Packed Section	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0023	A
10112936-S-FIPB-P-0076	25474-000-G27-GZC-00131	Owner's Engineer Document Review - P&ID Amine Stripper Trayed Section	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0024	A
10112936-S-FIPB-P-0082	25474-000-G27-GZC-00136	Owner's Engineer Document Review - P&ID Stripper Reflux Section	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0025	A
10112936-S-FIPB-P-0085	25474-000-G27-GZC-00139	Owner's Engineer Document Review - P&ID Amine Reclaimer	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0029	A
10112936-S-FIPB-P-0088	25474-000-G27-GZC-00141	Owner's Engineer Document Review - P&ID Chemical Feed Package	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0030	A
10112936-S-FIPB-P-0077	25474-000-G27-GZC-00132	Owner's Engineer Document Review - P&ID Fresh & Lean Amine Storage	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0031	A
10112936-S-FIPB-P-0133	25474-000-G27-GZC-00169	Owner's Engineer Document Review - P&ID CO2 Compress Suction Drum	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0032	A
10112936-S-FIPB-P-0134	25474-000-G27-GZC-00170	Owner's Engineer Document Review - P&ID CO2 Compressor-1st Stage	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0033	A
10112936-S-FIPB-P-0135	25474-000-G27-GZC-00171	Owner's Engineer Document Review - P&ID CO2 Compressor 1st Stage-Steam Generator and Intercooler	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0034	A
10112936-S-FIPB-P-0137	25474-000-G27-GZC-00173	Owner's Engineer Document Review - P&ID CO2 Compressor 2nd Stage	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0036	A
10112936-S-FIPB-P-0138	25474-000-G27-GZC-00174	Owner's Engineer Document Review - P&ID CO2 Compressor 2nd Stage-Steam Generator and Intercooler	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0037	A
10112936-S-FIPB-P-0140	25474-000-G27-GZC-00176	Owner's Engineer Document Review - P&ID CO2 Drying Package	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0039	A
10112936-S-FIPB-P-0141	25474-000-G27-GZC-00177	Owner's Engineer Document Review - P&ID CO2 Compressor 3rd Stage	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0040	A

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10112936-S-FIPB-P-0142	25474-000-G27-GZC-00178	Owner's Engineer Document Review - P&ID CO2 Compressor 3rd stage Generator and Inter Cooler	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0041	A
10112936-S-FIPB-P-0143	25474-000-G27-GZC-00179	Owner's Engineer Document Review - P&ID Send Out Pump	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0042	A
10112936-S-FIPB-P-0106	25474-000-G27-GZC-00159	Owner's Engineer Document Review - P&ID LP Steam System 1	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0044	A
10112936-S-FIPB-P-0113	25474-000-G27-GZC-00166	Owner's Engineer Document Review - P&ID HP Steam System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0046	A
10112936-S-FIPB-P-0095	25474-000-G27-GZC-00148	Owner's Engineer Document Review - P&ID Compressed Air System 2	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0048	A
10112936-S-FIPB-P-0090	25474-000-G27-GZC-00143	Owner's Engineer Document Review - P&ID Nitrogen Gas System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0050	A
10112936-S-FIPB-P-0101	25474-000-G27-GZC-00154	Owner's Engineer Document Review - P&ID Potable Water System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0051	A
10112936-S-FIPB-P-0094	25474-000-G27-GZC-00147	Owner's Engineer Document Review - P&ID LP Condensate Return	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0052	A
10112936-S-FIPB-P-0099	25474-000-G27-GZC-00152	Owner's Engineer Document Review - P&ID Raw Water System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0053	A
10112936-S-FIPB-P-0091	25474-000-G27-GZC-00144	Owner's Engineer Document Review - P&ID Sea Water Cooling System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0054	A
10112936-S-FIPB-P-0096	25474-000-G27-GZC-00149	Owner's Engineer Document Review - P&ID Sea Water Cooling System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0055	A
10112936-S-FIPB-P-0092	25474-000-G27-GZC-00145	Owner's Engineer Document Review - P&ID Sea Water Cooling System 3	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0056	A
10112936-S-FIPB-P-0097	25474-000-G27-GZC-00150	Owner's Engineer Document Review - P&ID Amine Waste System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0057	A
10112936-S-FIPB-P-0089	25474-000-G27-GZC-00142	Owner's Engineer Document Review - P&ID Waste Water System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0058	A
10112936-S-FIPB-P-0100	25474-000-G27-GZC-00153	Owner's Engineer Document Review - P&ID Demineralized Water System	Code 2		11/21/2008 12:30	10112936-PB-P-PID-0059	A
10112936-S-FIPB-S-0058	25474-000-G27-GZC-00093	Owner's Engineer Document Review Form - HAZID Report	Code 2		11/7/2008 9:39	10112936-PB-S-HSE-0003	A
10112936-S-FIPB-P-0121	25474-000-G27-GZC-00215	Owner's Engineer Document Review Form - Heat and Mass Balance Diagrams	Code 2		12/2/2008 14:05	10112936-PB-P-HMB-0001-0002	C
10112936-S-FIPB-P-0218	25474-000-G27-GZC-00214	Owner's Engineer Document Review Form - Storage Units and Transfer Systems	Code 2		12/2/2008 12:56	10112936-PB-P-LST-0002	C
10112936-S-FIPB-E-0023	25474-000-G27-GZC-00073	Owner's Engineer Document Review Form - Effluent Production	Code 2		10/27/2008 17:14	10112936-PB-P-TDO-0007	C
10112936-S-FIPB-C-0236	25474-000-G27-GZC-00302	Owner's Engineer Document Review Form - Plant area drawing including surrounding infrastructure and security fencing	Code 2		12/16/2008 9:15	10112936-PB-C-DRW-0001	C
10112936-S-FIPB-C-0237	25474-000-G27-GZC-00303	Owner's Engineer Document Review Form - Site preparation and leveling drawings	Code 2		12/16/2008 9:15	10112936-PB-C-DRW-0002	C
10112936-S-FIPB-C-0238	25474-000-G27-GZC-00304	Owner's Engineer Document Review Form - Layout drawings fro construction areas	Code 2		12/16/2008 9:15	10112936-PB-C-DRW-0003	C
10112936-S-FIPB-C-0224	25474-000-G27-GZC-00299	Owner's Engineer Document Review Form - Preliminary list of equipment and piping	Code 2		12/16/2008 9:15	10112936-PB-C-PAL-0001	C

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-C-0144	25474-000-G27-GZC-00197	Owner's Engineer Document Review Form - Landscape Plan	Code 2		11/24/2008 14:39	10112936-PB-C-PLN-0001	C
10112936-S-FIPB-C-0239	25474-000-G27-GZC-00305	Owner's Engineer Document Review Form - Landscape plan	Code 2		12/16/2008 9:15	10112936-PB-C-PLN-0001	C
10112936-S-FIPB-C-0234	25474-000-G27-GZC-00301	Owner's Engineer Document Review Form - Description and drawings of road,paving and terrain surface requirements and design	Code 2		12/16/2008 9:15	10112936-PB-C-TED-0005	C
10112936-S-FIPB-C-0180	25474-000-G27-GZC-00247	Owner's Engineer Document Review Form - Description and Drawings of foundation design - Site_Subsurface_Plan	Code 2		12/5/2008 9:55	10112936-PB-C-TED-0013	C
10112936-S-FIPB-E-0241	25474-000-G27-GZC-00307	Owner's Engineer Document Review Form - Electrical data sheets for equipment	Code 2		12/18/2008 15:28	10112936-PB-E-DAS-0001	C
10112936-S-FIPB-E-0176	25474-000-G27-GZC-00219	Owner's Engineer Document Review Form - Electrical Arrangement Drawings	Code 2		12/2/2008 15:50	10112936-PB-E-DRW-0001	C
10112936-S-FIPB-E-0194	25474-000-G27-GZC-00236	Owner's Engineer Document Review Form - Load flow calculations (EDSA)	Code 2		12/3/2008 11:19	10112936-PB-E-TDO-0001	C
10112936-S-FIPB-E-0195	25474-000-G27-GZC-00237	Owner's Engineer Document Review Form - Short-circuit calculations (EDSA)	Code 2		12/3/2008 11:19	10112936-PB-E-TDO-0002	C
10112936-S-FIPB-E-0196	25474-000-G27-GZC-00238	Owner's Engineer Document Review Form - Transient stability calculations (EDSA)	Code 2		12/3/2008 11:19	10112936-PB-E-TDO-0003	C
10112936-S-FIPB-E-0197	25474-000-G27-GZC-00239	Owner's Engineer Document Review Form - Harmonic distortion study	Code 2		12/3/2008 11:19	10112936-PB-E-TDO-0004	C
10112936-S-FIPB-E-0198	25474-000-G27-GZC-00223	Owner's Engineer Document Review Form - Electrical load study (all voltage levels)	Code 2		12/2/2008 16:15	10112936-PB-E-TDO-0005	C
10112936-S-FIPB-E-0177	25474-000-G27-GZC-00220	Owner's Engineer Document Review Form - Electrical Routing Plan Cable Ladder CCC Facilty	Code 2		12/2/2008 15:50	10112936-PB-E-TDO-0007-8 -9 -10	C
10112936-S-FIPB-E-0178	25474-000-G27-GZC-00221	Owner's Engineer Document Review Form - Operating Philosophy and sizing of emergency diesel generator	Code 2		12/2/2008 15:50	10112936-PB-E-TED-0004	C
10112936-S-FIPB-E-0179	25474-000-G27-GZC-00222	Owner's Engineer Document Review Form - Sizing reports and main design data for all electrical facilities within the CCC plant electrical systems	Code 2		12/2/2008 15:50	10112936-PB-E-TED-0005	C
10112936-S-FIPB-E-0227	25474-000-G27-GZC-00293	Owner's Engineer Document Review Form - Specification of main electrical equipment	Code 2		12/12/2008 11:39	10112936-PB-E-TSP-0001	C
10112936-S-FIPB-G-0243	25474-000-G27-GZC-00343	Owner's Engineer Document Review Form -Material Take off (MTO) main components	Code 2		12/23/2008 14:39	10112936-PB-G-DOC-0002	C
10112936-S-FIPB-G-0244	25474-000-G27-GZC-00323	Owner's Engineer Document Review Form - 3D Model Composite Extraction End View and Elevation	Code 2		12/23/2008 9:50	10112936-PB-G-DRW-0005,6	C
10112936-S-FIPB-H-0192	25474-000-G27-GZC-00273	Owner's Engineer Document Review Form - HVAC System Design and Description	Code 2		12/9/2008 14:46	10112936-PB-H-TED-0002	C
10112936-S-FIPB-I-0210	25474-000-G27-GZC-00259	Owner's Engineer Document Review Form - Telephone System Conceptual Block Diagram	Code 2		12/5/2008 14:31	10112936-PB-I-DRW-0007-8-9	C
10112936-S-FIPB-I-0235	25474-000-G27-GZC-00315	Owner's Engineer Document Review Form - Location plan of gas analysing and monitoring equipment	Code 2		12/19/2008 10:05	10112936-PB-I-PLN-0001	C

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-M-0263	25474-000-G27-GZC-00275	Owner's Engineer Document Review Form - Corrosion Evaluation For Main Systems	Code 2		12/9/2008 14:46	10112936-PB-M-TDO-0001	C
10112936-S-FIPB-M-0262	25474-000-G27-GZC-00274	Owner's Engineer Document Review Form - Durability Report	Code 2		12/9/2008 14:46	10112936-PB-M-TDO-0002	C
10112936-S-FIPB-N-0223	25474-000-G27-GZC-00263	Owner's Engineer Document Review Form - Identification and defination of foundation loads	Code 2		12/8/2008 9:05	10112936-PB-N-TDO-0002	C
10112936-S-FIPB-N-0233	25474-000-G27-GZC-00276	Owner's Engineer Document Review Form - Idtentification and defination of foundation loads	Code 2		12/9/2008 14:46	10112936-PB-N-TDO-0002	C
10112936-S-FIPB-O-0120	25474-000-G27-GZC-00228	Owner's Engineer Document Review Form - Constructibility Report	Code 2		12/2/2008 16:38	10112936-PB-O-DOC-0001	C
10112936-S-FIPB-O-0191	25474-000-G27-GZC-00232	Owner's Engineer Document Review Form - Material Preservation and Storage Philosophy	Code 2		12/2/2008 16:38	10112936-PB-O-DOC-0002	C
10112936-S-FIPB-O-0257	25474-000-G27-GZC-00334	Owner's Engineer Document Review Form - Recommended Spare and wear Parts	Code 2		12/23/2008 9:50	10112936-PB-O-DOC-0009	C
10112936-S-FIPB-P-0124	25474-000-G27-GZC-00229	Owner's Engineer Document Review Form - Line List	Code 2		12/2/2008 16:38	10112936-PB-P-LCL-0001	C
10112936-S-FIPB-P-0125	25474-000-G27-GZC-00216	Owner's Engineer Document Review Form - Utility Consumption List	Code 2		12/2/2008 14:05	10112936-PB-P-LST-0001	C
10112936-S-FIPB-P-0127	25474-000-G27-GZC-00212	Owner's Engineer Document Review Form - Hydraulic and Mechanical Study on CCC plant Column Design	Code 2		12/2/2008 12:56	10112936-PB-P-TDO-0012	C
10112936-S-FIPB-P-0129	25474-000-G27-GZC-00230	Owner's Engineer Document Review Form - Energy Consumption Optimization Study	Code 2		12/2/2008 16:38	10112936-PB-P-TDO-0014	C
10112936-S-FIPB-P-0130	25474-000-G27-GZC-00213	Owner's Engineer Document Review Form - Depressurization and Draining Philosophy	Code 2		12/2/2008 13:05	10112936-PB-P-TDO-013	C
10112936-S-FIPB-P-0128	25474-000-G27-GZC-00217	Owner's Engineer Document Review Form - Utility Unit Descriptions	Code 2		12/2/2008 14:05	10112936-PB-P-TED-0003	C
10112936-S-FIPB-R-0259	25474-000-G27-GZC-00340	Owner's Engineer Document Review Form - Equipment mechanical data sheets Auxiliary Boiler	Code 2		12/23/2008 9:50	10112936-PB-R-DAS-0001-2-3-4-5-6	C
10112936-S-FIPB-R-0265	25474-000-G27-GZC-00278	Owner's Engineer Document Review Form - Main Equipment And Main Equipment Package List	Code 2		12/9/2008 14:46	10112936-PB-R-PAL-0001	C
10112936-S-FIPB-R-0269	25474-000-G27-GZC-00341	Owner's Engineer Document Review Form - Main Equipment And Main Equipment Package List	Code 2		12/23/2008 9:50	10112936-PB-R-PAL-0001	C
10112936-S-FIPB-S-0260	25474-000-G27-GZC-00309	Owner's Engineer Document Review Form - Contractor's Fire and Explosion Strategy (FES)	Code 2		12/18/2008 15:28	10112936-PB-S-HSE-0006	C
10112936-S-FIPB-S-0181	25474-000-G27-GZC-00290	Owner's Engineer Document Review Form -Concept Occupational Health Impact Assessment	Code 2		12/11/2008 10:48	10112936-PB-S-HSE-0008	C
10112936-S-FIPB-S-0261	25474-000-G27-GZC-00310	Owner's Engineer Document Review Form - Hazardous Area Classification drawings	Code 2		12/18/2008 15:28	10112936-PB-S-HSE-0010	C
10112936-S-FIPB-S-0268	25474-000-G27-GZC-00312	Owner's Engineer Document Review Form - Contractor's Escape Evacuation and Rescue Strategy (EERS)	Code 2		12/18/2008 15:28	10112936-PB-S-HSE-0011-0015 -0019	C
10112936-S-FIPB-S-0267	25474-000-G27-GZC-00311	Owner's Engineer Document Review Form - Contribution to Quantitative Risk Analysis (QRA)	Code 2		12/18/2008 15:28	10112936-PB-S-HSE-0014	C

Client Document Number	Bechtel Document Number	Title	Client Status Code	Response Status Open/ Closed	Creation Date	Associated Client Document Number	Document Submitted for I-Information C - Comment A - Approval
10112936-S-FIPB-C-0240	25474-000-G27-GZC-00306	Owner's Engineer Document Review Form - Description of required infrastructure improvements outside plant battery limits	Code 2		12/16/2008 9:15	10112936-PB-C-TED-0017	I
10112936-S-FIPB-E-0060	25474-000-G27-GZC-00105	Owner's Engineer Document Review Form -Electrical Consumer List	Code 2		11/14/2008 14:01	10112936-PB-E-PAL-0001	I
10112936-S-FIPB-E-0187	25474-000-G27-GZC-00240	Owner's Engineer Document Review Form - Electrical Consumers List	Code 2		12/4/2008 9:58	10112936-PB-E-PAL-0001	I
10112936-S-FIPB-E-0226	25474-000-G27-GZC-00292	Owner's Engineer Document Review Form - Electrical Consumers List	Code 2		12/12/2008 11:39	10112936-PB-E-PAL-0001	I
10112936-S-FIPB-E-0199	25474-000-G27-GZC-00224	Owner's Engineer Document Review Form - Electrical Location Plan Electrical Switchgear Building	Code 2		12/2/2008 16:15	10112936-PB-E-TDO-0006	I
10112936-S-FIPB-G-0054	25474-000-G27-GZC-00088	Owner's Engineer Document Review Form - Current CDR List	Code 2		11/5/2008 10:20	10112936-PB-G-DAL-0001	I
10112936-S-FIPB-P-0291	25474-000-G27-GZC-00338	Owner's Engineer Document Review Form - Utility Data Sheet	Code 2		12/23/2008 9:50	10112936-PB-P-DAS-0013	I
10112936-S-FIPB-R-0264	25474-000-G27-GZC-00277	Owner's Engineer Document Review Form - Main Equpment Outlines And Weights	Code 2		12/9/2008 14:46	10112936-PB-R-TDO-0003	I

Notes:
Code 1 - Approved (no action required)
Code 2 - Approved with comment
Code 3 - not Approved

Total 9 Code 3 Reviews
Total 160 Code 2 Reviews
Total 74 Code 1 Reviews
Total 243 Review Sheets

Total Code 2 in-progress = 107

Appendix A – CAPEX Cost Estimate

CAPEX Cost Estimate

CO_2 Capture Facility

Kårstø, Norway

Bechtel Proprietary and Confidential

0	12JAN 09	Issued for approval					
Rev.	Date	Reason for Revision	By	Check	App	App	Client

Bechtel
Power
Corporation

Job No. 25474	
Document No. 25474 – 000- G38-GAB-00001	Rev. 0
PAGE 1 of 5	

GASSNOVA

Project No. - Originator - Disc Code - Doc Type - Serial No.

10112936 – PB –G– CRE – 0001

Contents

Attachments

1) Capital Cost Estimate Summary Sheets

2) Summary of Contingency and Risk Analysis

1.0 General

The estimate was prepared in accordance with the requirements of the following Contract Documents:

- Exhibit E1.1: Requirements for Cost Estimates and Capture Cost Calculation
- Exhibit E1.2: Cost Breakdown Structure

The Capital Cost Estimates (CAPEX) has been prepared to an accuracy of +/- 20% as required in the Contract documents. The Cost Breakdown Structure (CBS) described in document E1.2 was used.

A cost risk analysis was performed and details are provided in this documents.

The following sections provide additional information on the CAPEX and risk analysis

2.0 CAPEX Estimate

2.1 General

The Capital cost estimate (CAPEX) is provided in attachment number 1.

2.2 Pricing basis

The estimate costs are based on 4th Quarter 2008 prices. Escalation through commercial operation is not included.

2.3 Exchange rate

The currency exchange rate used for the estimate is 1 USD = 5.3 NOK, which is in accordance with the requirements of Exhibits E1.1 and E1.2

2.4 Contingency

Contingency is not included in the Contractors Cost in attachment number 1. The Contingency analysis was undertaken as part of the risk analysis (see section 3.0).

2.5 Qualifications and Assumptions

The following qualifications and assumptions apply to the CAPEX estimate:

- The site is clean, free of hazardous materials, level, and free of any obstructions above or below grade.
- The estimate is only for material within the plant B/L shown on the general arrangement drawing, except for the flue gas duct, electrical power tie-ins, seawater cooling pumps, and cooling water pipe.

- Since the site is an existing operating plant with a wharf, it is possible to receive shop-fabricated, large-diameter tanks and vessels. Access to the project site is possible without any modifications to the route.
- The existing stack can accept the modifications to support the CCC Plant flue duct and stack damper.
- The seawater pump structure accommodates the selected pumps, and the cooling water pipe connection design and routing can be accommodated.
- Construction power and water are to be provided by the Owner.
- Soils conditions allow for spread footing design.
- Adequate construction access is available on all sides of the proposed site except the west side.
- CCC Plant lighting and small power distribution are limited to the B/L.
- All pre-existing hazardous materials are to Owner's account.

2.6 Exclusions

The following items are excluded from this cost estimate:

- Contingency (see section 3.0)
- Escalation
- Liquidated damages (LD) insurance
- Builders risk and marine cargo insurance
- Required payment securities
- Environmental wetland and endangered species protection is excluded.
- All construction and environmental permits (to be obtained by Owner)
- Camp costs
- Value-added taxes (VATs) and import duties, where applicable, which are a pass through
- Licensing or royalty fees associated with proprietary processes/ equipment/chemicals (none identified for base case)
- Capital spare parts
- Work associated with demolition at the site
- Furniture or laboratory equipment
- Duties, permits, and taxes
- Modifications to existing utilities, equipment, and facilities
- Onsite accommodations for craft housing are excluded

3.0 CAPEX Cost Contingency and Risk Analysis

3.1 General

The Bechtel Risk Analysis Contingency (BecRAC) software was used for the contingency and risk analysis. The summary sheet of the results from the analysis IS provided in attachment 2.

The Contingency derived from the analysis was not included in the overall CAPEX estimate for the project.

ATTACHMENT # 1
SHT 1 OF 3

CO$_2$ KARSTO

Estimate Summary Sheet

		TOTAL NOK
0 - A	Complete Project Cost	
1	Owner's Costs	by Gassnova
0 - B	Contractor's Costs	2,235,711,000
2	General (Indirect) Costs	438,227,000
2.1	Project Engineering (including Project Management, Documentation, other)	62,526,000
2.2	Construction Preliminaries	307,792,000
2.3	Mechanical Completion; Commissioning and Testing	62,609,000
2.4	Training	5,300,000
2.5	Guarantee tests	Included in 2.3
2.6	Spare Parts	Included in 2.3
3	Stack connection / modification incl. Engineering , Procurement, Construction and all ducting within the Naturkraft property	81,965,000
3.1	Flue gas plenum including support structure and foundation, reinforcement where necessary	13,716,000
3.2	Stack modifications including silencers, damper, measurement devices	3,395,000
3.3	Flue gas transfer duct including insulation, measurement devices and support structure and foundation works	49,790,000
3.4	Other	10,836,000
3.5	400 V power interface for new flue gas dampers including LV power cabeling with cable trays from outgoing terminal of existing 400 V CCPP switchgear and all required electrical systems to feed the required consumers	4,228,000
4	Flue gas conditioning incl. Engineering, Procurement, Construction from Naturkraft fence to Absorber inlet flange	135,061,000
4.1	Flue gas cooler including all utilities	2,905,000
4.2	Flue gas fan including drives, all utilities	34,849,000
4.3	Piping and Vessels comprising: all process piping incl. valves and fittings all process vessels incl. the expansion joints	7,070,000
4.4	Pumps comprising: associated drives and utilities (e.g. lubrication system)	Included in 4.1
4.5	Heat and sound insulation	5,989,000
4.6	Other (Ductwork)	84,248,000
5	CO2 Absorption incl. Engineering, Procurement, Construction from flange in flue gas condtioning & utility systems to flange towards Solvent Regeneration system	352,461,000
5.1	Absorber Tower	
5.1.1	Absorber tower	89,962,000
5.1.2	Internal packing incl. distributon, collectors and associated equipment	60,866,000
5.1.3	Piping, fittings	83,731,000
5.1.4	Other	10,154,000
5.2	All Utilities i.e heat exchanger , pumps incl. drives	106,975,000
5.3	Insulation and cladding	773,000
5.4	Other (License Fee)	0
6	Solvent Regeneration incl. Engineering, Procurement, Construction	177,280,000
6.1	Tanks and storage vessels comprising all utilities	4,169,000
6.2	Stripper, comprising all utilities	33,813,000
6.3	Reboiler, comprising all utilities	14,052,000
6.4	Overhead condenser, comprising all utilities	13,481,000

SHT 2 of 3

CO_2 KARSTO

Estimate Summary Sheet

BECHTEL

GASSNOVA

		TOTAL NOK
6.5	Heat exchanger incl. all utilities	25,954,000
6.6	Pumps and blowers incl. all utilities	31,994,000
6.7	All internal piping including valve and fittings	53,559,000
6.8	Heat and sound insulation where applicable	258,000
6.9	Other	0
7	**CO2 Compressor and Conditioning incl. Engineering, Procurement,Construction from flange Solvent Regeneration system & utility system to flange of the CO2 pipeline to Transport Project**	**200,177,000**
7.1	Multistage compression and conditioning package comprising all internal piping, valves and fittings	197,265,000
7.2	Metering package	1,696,000
7.3	All utility equipment	Included in 8.0
7.4	Heat and sound insulation	1,216,000
7.5	Other	0
8	**General utility system incl. Engineering, Procurement, Construction**	**171,240,000**
8.1	Cooling water system	51,789,000
8.2	Process steam system	38,147,000
8.3	Condensate system	6,264,000
8.4	Sewage and waste water system	28,340,000
8.5	Compressed air and instrument air system	6,351,000
8.6	Reclaimer	7,973,000
8.7	Hazardous waste system	2,621,000
8.8	Fire fighting system	6,767,000
8.9	Other	22,988,000
9	**Automation incl. Engineering, Procurement Documentation, Construction**	**98,005,000**
9.1	Supply of Field Equipment in Flue Gas Conditioning Area	9,494,000
9.2	Supply of Field Equipment in CO2 Absorption Area	18,988,000
9.3	Supply of Field Equipment in Solvent Regeneration Area	9,494,000
9.4	Supply of Field Equipment in Compress. & Conditioning Area	9,494,000
9.5	Supply of Safety and Automation System (SAS)	9,284,000
9.6	Services for Field Equipment and SAS	26,643,000
9.7	Supply and Services of Plant Communication Systems	4,822,000
9.8	Supply and Services of Fire and Gas Monitoring and Alarm System	9,786,000
10	**Civil structural work incl. Engineering, Procurement, Construction**	**222,804,000**
10.1	Site preparation comprising: Levelling works, roads, parking areas, pavements, preparational works for cranes and tools, all installations for prefabrication and erection, utilities supply and installation, fencing and gates.	12,500,000
10.2	Foundations comprising Formworks, concrete works, piling if applicable and all internals	119,983,000
10.3	Supporting Steel Construction comprising all hangers and suspensions, all platforms and gratings	26,840,000
10.4	Trenches for cables and piping	7,170,000
10.5	Buildings (except control room building) comprising HVAC, sanitary installation and cladding	36,998,000
10.5.1	Control room building	19,313,000
10.5.2	Social rooms and offices	Included in 10.5

SHT 3 of 3

CO_2 KARSTO

Estimate Summary Sheet

		TOTAL NOK
10.5.3	Workshops and storage rooms	Included in 10.5
10.5.4	Laboratory building	Included in 10.5
10.6	Other	0
11	**Main power supply, all distribution system and auxiliary system incl. Engineering, Procurement; Construction**	**358,492,000**
11.01	Power Transformers including tap changer, secondary cabling, protection, control, etc.	44,820,000
11.02	Medium Voltage Switchgears: including the complete secondary cabling, electrical protection and control, etc.	10,672,000
11.03	Low Voltage Switchgears: including the complete cabling, for protection, control, etc	4,109,000
11.04	DC equipment	6,023,000
11.05	Safe AC Equipment	0
11.06	Emergency Diesel Generator Set: including prime mover and all necessary auxiliary equipment like e.g. AVR, generator protection, etc	2,209,000
11.07	Cabling: including cable connecting, cable terminations, cable joints, etc	132,726,000
11.08	Earthing and Lightning Protection, EMC Requirements: Includes the earthing of the complete electrical equipment, all non electric metal structures, etc.; also includes the inner and outer lightning protection of the whole CCC Plant and all EMC requirements. Note: Earthing laid in concrete shall be included in the civil construction costs of the CCC Plant.	8,600,000
11.09	Lighting and small power installations: the prices for lights, power sockets and domestic sockets shall include the respective portion of the lighting distributions and all necessary cabling, cable ducts, junction boxes, fixing materials, etc. necessary for their installation and connection to the related lighting distributions	26,712,000
11.10	Power factor compensation system: includes MV and / or LV compensation equipment, e. g. reactors, capacitors, electronic control, secondary cabling, electrical protection, etc. (refer to Exhibit E5.1, Section 1.6.1)	112,141,000
11.11	Accessories for Electrical Rooms: Includes all accessories as per Exhibit E5.1, Section 1.13.	6,018,000
11.12	Other	4,462,000

Notes:

A) Above given list shall be adapted and/or extended by the Contractor if necessary.

B) Bidder shall explain main cable types and quantities used in No. 11.7

C) Bidder shall explain power and domestic socket types given in No. 11.9.

ATTACHMENT 2
SHT 1 of 1

1. Contingency and Risk

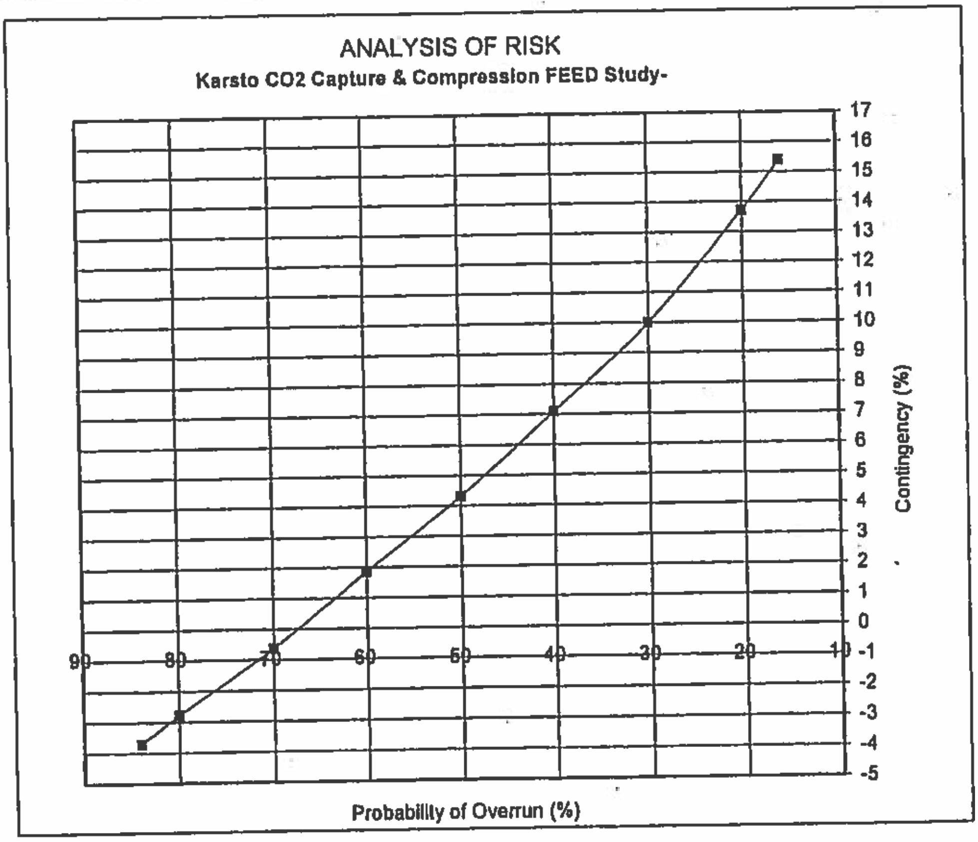
BECHTEL POWER CORPORATION
Frederick, Maryland

GASSNOVA
Karsto CO2 Capture & Compression FEED Study-UNIQUE
Norway
25474-UNI

ESTIMATED COST:				
Est.Cost Excl.Contingency	$	422.000.000		
Accuracy Excl.Contingency *	+	15.4	-	3.724
Most Probable Cost	$	439.957.000		

MANAGEMENT DECISION:				
Probability of Overrun		50.0%		
Contingency in %		4.3%		
Contingency in $	$	18.168.000		
Estimate Accuracy Incl.Contingency *	+	11.1%	-	8.0%

* Based on standard deviation



Appendix B – OPEX Cost Estimate

OPEX Cost Estimate

CO_2 Capture Facility

Kårstø, Norway

0	12JAN09	Issued for approval					
Rev.	**Date**	**Reason for Revision**	**By**	**Check**	**App**	**App**	**Client**

Bechtel
Power
Corporation

Job No. 25474

Document No.	Rev.
25474 – 000- G38-GAB-00002	0

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GASSNOVA

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10112936 – PB –G– CRE – 0002

Contents

Attachments

1) Operating Cost (OPEX) estimate

1.0 General

The estimate was prepared in accordance with the requirements of the following Contract Documents:

- Exhibit E1.1: Requirements for Cost Estimates and Capture Cost Calculation
- Exhibit E1.2: Cost Breakdown Structure

The Operating Expenditure (OPEX) Cost Estimates has been prepared to an accuracy of +/- 20% as required in the Contract documents.

2.0 OPEX Estimate

2.1 General

The OPEX estimate is provided in attachment number 1.

2.2 Data used in developing OPEX

The following is a summary of the basis of the data used in the OPEX estimate:

- The average use time for utility consumption was estimated at 8105 hours per year. This includes allowances for CCPP outages and the 97% capacity factor for the CCC plant.
- 1: Utility Consumption:
    - Usage rates are based on the base case open-art design
    - Unit prices were provided from Gassnova except for price of condensate which was estimated based on our past experience
- 2: Consumables
    - Usage rates are based on the base case open-art design
    - Unt prices were obtained from Bechtel pricing database
- 3: Staff
    - Staffing levels are as outlined in the Bechtel [redacted] document submittal 10112936-PB-O-DOC-0004 (Operating Staff Concept)
- 4: Maintenance cost
    - This was estimated as a percentage of capital costs as is typical for a FEED estimate.

- 5: Spare and Wear Parts
    - This was estimated as a percentage of equipment costs, except for Absorber packing which was estimated separately based on input from packing suppliers.
- 6: Service cost to Gassco
    - A cost of 8000,000 NOK/y was input per section 2.0 of Exhibit E1.1
- 7: Special Waste
    - Usage for activated carbon and reclaimer sludge is based on the base case open-art design. Unit price was based on vendor pricing data.
- 8: Service Agreement with Naturkraft
    - Cost to be determined by Gassnova per clause E2.2 of Exhibit E1.2
- 9: Taxes
    - Cost to be determined by Gassnova per clause E2.2 of Exhibit E1.2
- 10: Land leasing cost
    - Cost to be determined by Gassnova per clause E2.2 of Exhibit E1.2
- 11: Other costs
    - Administartion cost of 10,000,000 NOK/y was input per section 2.0 of Exhibit E1.1

3.0 OPEX Sensitivity/Risk Analysis

The data on the OPEX Sensitivity/risk analysis is included in the CO2 Capture Cost Calculation (document number: 10112936-PB-G-CRE-0003)

ATTACHMENT 1

Base Case: Open Art

	Usage Rate	Average Usage Time	Unit Price	Annual Cost (NOK 000s)
1 Utility consumption				
Electricity	32.0 MW	8,105 h	450 NOK/MWh	116,714
LP Steam	165 t/h	8,105 h	96 NOK/t	128,185
HP Steam	12 t/h	486 h	340 NOK/t	1,984
Natural Gas	708 kg/h	8,105 h	2.06 NOK/kg	11,814
Cooling Water Consumption	17,340 m³/h	8,105 h	0.10 NOK/m³	14,054
Condensate Consumption	12.0 t/h	8,105 h	15.00 NOK/t	1,459
Utility Consumption				**274,211**
2 Consumables				
MEA consumption				2,656
MEA lost through absorber	15.6 kg/h	8,105 h	14,310 NOK/t	1,807
MEA consumption from reclaimer	122.0 kg/h	486 h	14,310 NOK/t	849
Soda Ash Cost Consumption	35.0 kg/h	486 h	1,590 NOK/t	27
Nitrogen Gas Cost Consumption	4.45 m³/h	8,105 h	5.30 NOK/m³	191
Consumables Cost				**2,874**
3 Staff				
Spec Workers	15 people	1 year	775 kNOK/y	11,625
Shift Leaders	5 people	1 year	950 kNOK/y	4,750
Secretaries	1 people	1 year	500 kNOK/y	500
Accounting	9 people	1 year	560 kNOK/y	5,040
Heads of CCC	1 people	1 year	1,200 kNOK/y	1,200
Staff Cost				**23,115**
4 Maintenance cost				
Maintenance Cost	**n/a**	**1 year**	**55,893 kNOK/y**	**55,893**
5 Spare and wear parts				
Average Absorber Packing*	n/a	1 year	1,749 kNOK/y	1,749
Spare Parts	n/a	1 year	11,925 kNOK/y	11,925
Spare and wear parts				**13,674**
The absorber packing costs will not be the same every year. See the financial model for the estimated repacking schedule				
6 Service cost to GASSCO				
Services from GASSCO	**n/a**	**1 year**	**8,000 kNOK/y**	**8,000**
7 Special waste				
Activated Carbon	29.8 kg/h	8,105 h	3,000 NOK/t	724
Reclaimer Sludge	171.0 kg/h	486 h	3,000 NOK/t	249
Waste Disposal				**973**
8 Service Agreement with Naturkraft				
To be determined by Gassnova				**0**
9 Taxes				
by Gassnova				**0**
10 Land Leasing cost				
by Gassnova				**0**
11 Other costs				
Administration	**n/a**	**1 year**	**10,000 kNOK/y**	**10,000**
12 Total Operating Costs				
Total				**388,741**

Appendix C – Capture Cost Calculation

CO_2 Capture Cost Calculation

CO_2 Capture Facility

Kårstø, Norway

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0	13JAN09	Issued for information					
Rev.	Date	Reason for Revision	By	Check	App	App	Client

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GASSNOVA

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10112936 - PB -G-CRE - 0003

Contents

Attachments

1) CO_2 Capture Cost Calculation

1.0 General

The Capture Cost Calculation was not a required deliverable in the Exhibit A1 contract documents. However, we believe it would be useful to Gassnova and have therefore prepared the calculation and attached it to this document.

2.0 CO_2 Capture Cost Calculation

2.1 General

The CO2 Capture Cost Calculation was undertaken using our own financial model. It uses a similar approach to the provisional calculation model provided by Gassnova as an attachment to Exhibit E1.1.

The calculation is undertaken for the base case open-art MEA design.

The output is provided in attachment 1.

2.2 Information included and excluded from the model

The model calculates the CO2 capture cost (NOK/tCO2) based on data from the following cost estimates for the CO2 Capture Plant

- Capital cost (CAPEX). See document number 10112936-PB-G-CRE-0001
- Operating costs (OPEX). See document number 10112936-PB-G-CRE-0002

The following information is not included in the calculation:

- Gassnova's OPEX costs which were defined as 'By Gassnova' in Exhibit E1.2
- Capital cost contingency and all other items excluded from the CAPEX estimate
- Insurance
- Capital or operating costs for any work to be performed outside of the battery limit by Gassnova.

2.3 Assumptions used in model

The following assumptions were used in creating the model

- Project Life time: 25 years
- We used the data provided in Exhibit E1.1 to determine the level of planned and unplanned outages for the Naturkraft CCPP. These vary year by year and this is reflected in the model. (for information the availability averages 95.4% over the 25 year period)

- We used a Capture plant on stream factor is 97% for the design case (100% load of power plant) relative to the CCPP availability
- One production year is equal to 8760 hours. Actual operation hours are then calculated using CCPP availability and CCC on stream factor for each year.
- Exchange rate used was NOK/USD: 5.3 (per Exhibit E1.1)
- Discount rate (NPV) is 8%
- For simplicity, the construction schedule was done on an annual basis. Because the NPV calculation is done on an annual basis, little is gained by splitting construction numbers in to a monthly level of detail.
- Changes in working capital are added to operating expenses to get a more accurate representation of cash flows. Working capital includes changes in operating cash and changes in accounts payable.

2.4 Sensitivity Analysis

Sensitivity analysis were performed for the NPV unit cost (NOK/t) and the NPV of total cost.

The output is presented in terms of a 'tornado' chart with the higher impacts shown at the top of the chart.

The parameters listed in section 6 of Exhibit E1.1 were assessed along with other parameters identified by the Contractor.

2.5 Description of model output sheets

The model output in contained in attachment number 1. The following data is contained in the output:

- Key Data and Results: These sheets show all model inputs and results. The inputs on the first page are all constant over time. The inputs on the second page are time-varying
- Project Financial Statement: These sheets show annual cash flows for each year
- OPEX summary. This shows the operating cost breakdowns for an average year. This information was also provided in the OPEX Cost Estimate document number: 10112936-PB-G-CRE-0002
- Technical Data Summary. These sheets show the non-financial model outputs
- Sensitivity Analysis. Sensitivity analysis in terms of unit cost and total cost

ATTACHMENT 1

Karsto CO2 Capture Cost Calculation

Description of Model Outputs

- The Key Data & Results sheets show all of the model inputs and key financial metrics. The inputs on the first page are constant over time and the inputs on the second page are time-varying.
- The Technical Data Summary sheet shows the non-financial model outputs.
- The OPEX Summary sheet shows operating cost breakdown for an average year.
- The Project Financial Statement sheets show annual cash flows for each year.
- The Sensitivity Charts show the economic effect for changes in input variables.

Model Assumptions

- The model is done using real NOK and uses an 8% real discount rate (re exhibit E1.1).
- For simplicity, the construction schedule was done on an annual basis. Because the NPV calculation is done on an annual basis, little is gained by splitting construction numbers into a monthly level of detail before recombining them to annual numbers
- The model is based on both cost estimates provided by Bechtel and costs provided by Gassnova.
- Changes in working capital are added to operating expenses to get a more accurate representation of cash flows. Working capital includes changes in operating cash and changes in accounts payable.

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This report is integral and must be read in its entirety. This notice must accompany every copy of this report.

Base C . Open Art

Karsto
Key Data & Results

INPUTS

Capital Costs		
General Indirect	438,227	NOK 000s
Stack Connection	81,965	NOK 000s
Flue Gas Condition	135,061	NOK 000s
CO2 Absorption	352,461	NOK 000s
Solvent Regeneration	177,280	NOK 000s
CO2 Compression & Conditioning	200,177	NOK 000s
General Utility Systems	171,240	NOK 000s
Automation	98,005	NOK 000s
Civil Work	222,804	NOK 000s
Main Power Supply	358,492	NOK 000s
Total Capital Cost	2,235,712	NOK 000s

Engineering Data		
NGCC		
CO2 emissions from flue gas	149.53	tonne/hr
Average NGCC Availability	95.4%	%
Average NGCC Capacity Factor	95.4%	%
CO2 Capture		
CO2 Capture %	85.3%	%
CC Capacity Factor	97.0%	%
-Direct Electricity Consumption	32.00	MW
LP Steam Consumption	165.0	t/h
LP Steam Power Reduction Factor	0.213	MWh/t
Hot water Consumption	-	t/h
Cooling Water Consumption	17,340	m³/h
MEA loss through absorber	15.58	kg/hr
Nitrogen Gas Consumption	39,000	m³/yr
Condensate Consumption	12	t/h
Activated Carbon Disposal	5	t/week
Aux Boiler		
Additional Fuel Consumption	708	kg/hr
Natural Gas Density	0.8500	kg/m³
Natural Gas Heating Value (LHV)	46.60	MJ/kg
Reclaimer		
HP Steam Consumption	12.00	tonne/h
MEA Consumption	122.00	kg/h
Soda Ash Consumption	35.00	kg/h
Sludge Disposal	171.00	kg/h
Reclaimer run frequency (rel to CCC)	6.00%	%

INPUTS

Consumable Price & Disposal Cost		
Electricity	450.00	NOK/MWh
HP Steam	340.00	NOK/t
LP Steam	95.85	NOK/t
Natural Gas	1.75	NOK/m³
Hot water	-	NOK/ton
Cooling Water	0.10	NOK/m³
Hazardous Waste Disposal	3,000	NOK/t
MEA	14,310	NOK/t
Soda Ash	1,590	NOK/t
Nitrogen Gas	5.30	NOK/m³
Condensate	15.00	NOK/m³

Personnel Cost	Number of People	Salary NOK 000s
Spec Workers	15	775
Shift Leaders	5	950
Secretaries	1	500
Accounting	9	560
Head of CCC	1	1,200

O&M Cost		
Services from GASSCO	8,000	NOK 000s
Annual Spare Parts Usage	11,925	NOK 000s
Absorber & Stripper Packing Cost	39,750	NOK 000s
Maintenance	55,893	NOK 000s

Administration Cost		
Administration Cost	10,000	NOK 000s
Insurance (percent of EPC)	-	%

Working Capital		
Accounts Receivable	45	days
Accounts Payable	30	days
Operating Cash	3	days

Other		
Exchange Rate (NOK/USD)	5.30	NOK/USD
Exchange Rate (NOK/EUR)	8.00	NOK/Eur

RESULTS

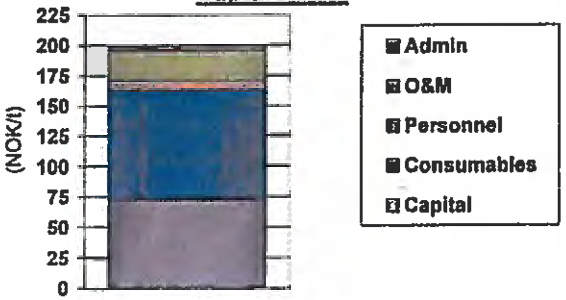
CO2 Captured		
CO2 captured over 25 years	25,845,091	tonne
NPV of CO2 Captured	8,766,039	tonne

NPV of Capture Cost		
Capital	1,868,773	NOK 000s
Consumables & Disposal Cost	2,345,033	NOK 000s
Personnel Costs	194,818	NOK 000s
Operation Maintenance & Repair	650,138	NOK 000s
Administration and Insurance	84,282	NOK 000s
Total	5,143,044	NOK 000s

NPV of Cost per tonne of CO2 capture		
Capital	72.31	NOK/t
Consumables & Disposal Cost	90.73	NOK/t
Personnel Costs	7.54	NOK/t
Operation Maintenance & Repair	25.16	NOK/t
Administration and Insurance	3.26	NOK/t
Total	199.00	NOK/t

NPV Cost / NPV CO2 Captured		
Capital	213.18	NOK/t
Consumables & Disposal Cost	267.51	NOK/t
Personnel Costs	22.22	NOK/t
Operation Maintenance & Repair	74.17	NOK/t
Administration and Insurance	9.61	NOK/t
Total	586.70	NOK/t

Capture Cost



Karsto
Key Data & Results

Time Series Inputs

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Construction Draw Schedule																
EPC Draw Schedule	-	15%	35%	50%	-	-	-	-	-	-	-	-	-	-	-	-
Other Data																
NGCC Days of planned shutdown	-	-	-	-	7	7	21	7	7	37	7	7	7	21	7	7
NGCC Days of Unplanned shutdown	-	-	-	-	4	4	4	4	4	4	4	4	4	4	4	4
Repacking Cost (% of full replacement)	-	-	-	-	-	-	-	-	2.5%	-	-	-	-	2.5%	-	-

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Construction Draw Schedule													
EPC Draw Schedule	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Data													
NGCC Days of planned shutdown	37	7	7	7	21	7	7	37	7	7	7	21	7
NGCC Days of Unplanned shutdown	4	4	4	4	4	4	4	4	4	4	4	4	4
Repacking Cost (% of full replacement)	-	-	100.0%	-	-	2.5%	-	-	-	2.5%	-	-	-

Base Ca... Open Art

Technical Data Summary

	Constant	Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020
NGCC											
NGCC Operating Hours		hours	8,496	8,496	8,160	8,496	8,496	7,776	8,496	8,496	8,496
NGCC Shutdown hours (planned + unplanned)		hours	264	264	600	264	264	984	264	264	264
NGCC other non-operating hours		hours	-	-	-	-	-	-	-	-	-
CO2 Emissions from NGCC		tonne	1,270,403	1,270,403	1,220,162	1,270,403	1,270,403	1,162,742	1,270,403	1,270,403	1,270,403
Capture											
Capture Plant Operating Hours		hours	8,241	8,241	7,915	8,241	8,241	7,543	8,241	8,241	8,241
CO2 Captured		tonne	1,051,145	1,051,145	1,009,574	1,051,145	1,051,145	962,064	1,051,145	1,051,145	1,051,145
Direct Electricity Consumption		MWh	263,716	263,716	253,286	263,716	263,716	241,367	263,716	263,716	263,716
HP Steam Consumption		tonne	5,934	5,934	5,699	5,934	5,934	5,431	5,934	5,934	5,934
LP Steam Consumption		tonne	1,359,785	1,359,785	1,306,008	1,359,785	1,359,785	1,244,549	1,359,785	1,359,785	1,359,785
Power Reduction from LP Steam Consumption		MWh	289,634	289,634	278,180	289,634	289,634	265,089	289,634	289,634	289,634
Hot Water Consumption		tonne	-	-	-	-	-	-	-	-	-
Cooling Water Consumption		m³ MM	142.90	142.90	137.25	142.90	142.90	130.79	142.90	142.90	142.90
Activated Carbon Disposal		tonne	245.27	245.27	235.57	245.27	245.27	224.49	245.27	245.27	245.27
MEA loss through absorber		tonne	128.40	128.40	123.32	128.40	128.40	117.52	128.40	128.40	128.40
Nitrogen Gas Consumption		m³	36,690	36,690	35,239	36,690	36,690	33,581	36,690	36,690	36,690
Aux Boiler											
Aux Boiler Operating Hours		hours	8,241	8,241	7,915	8,241	8,241	7,543	8,241	8,241	8,241
Additional Fuel Consumption		tonne	5,835	5,835	5,604	5,835	5,835	5,340	5,835	5,835	5,835
Additional Fuel Consumption		m³	6,864,368	6,864,368	6,592,896	6,864,368	6,864,368	6,282,642	6,864,368	6,864,368	6,864,368
Additional Fuel Consumption		MMBTU	257,709	257,709	247,517	257,709	257,709	235,869	257,709	257,709	257,709
Reclaimer											
Reclaimer run frequency (rel to CCC)	6.0%	%									
Reclaimer Operating Hours		hours	494	494	475	494	494	453	494	494	494
Reclaimer MEA Consumption		tonne	60	60	58	60	60	55	60	60	60
Soda Ash Consumption		tonne	17	17	17	17	17	16	17	17	17
Reclaimer Sludge Disposal		tonne	85	85	81	85	85	77	85	85	85

Base Cas.. Open Art

Technical Data Summary

	Constant	Unit	2021	2022	2023	2024	2025	2026	2027	2028	2029
NGCC											
NGCC Operating Hours		hours	8,160	8,496	8,496	7,776	8,496	8,496	8,496	8,160	8,496
NGCC Shutdown hours (planned + unplanned)		hours	600	264	264	984	264	264	264	600	264
NGCC other non-operating hours		hours	-	-	-	-	-	-	-	-	-
CO2 Emissions from NGCC		tonne	1,220,162	1,270,403	1,270,403	1,162,742	1,270,403	1,270,403	1,270,403	1,220,162	1,270,403
Capture											
Capture Plant Operating Hours		hours	7,915	8,241	8,241	7,543	8,241	8,241	8,241	7,915	8,241
CO2 Captured		tonne	1,009,574	1,051,145	1,051,145	962,064	1,051,145	1,051,145	1,051,145	1,009,574	1,051,145
Direct Electricity Consumption		MWh	253,286	263,716	263,716	241,367	263,716	263,716	263,716	253,286	263,716
HP Steam Consumption		tonne	5,699	5,934	5,934	5,431	5,934	5,934	5,934	5,699	5,934
LP Steam Consumption		tonne	1,306,008	1,359,785	1,359,785	1,244,549	1,359,785	1,359,785	1,359,785	1,306,008	1,359,785
Power Reduction from LP Steam Consumption		MWh	278,180	289,634	289,634	265,089	289,634	289,634	289,634	278,180	289,634
Hot Water Consumption		tonne	-	-	-	-	-	-	-	-	-
Cooling Water Consumption		m³ MM	137.25	142.90	142.90	130.79	142.90	142.90	142.90	137.25	142.90
Activated Carbon Disposal		tonne	235.57	245.27	245.27	224.49	245.27	245.27	245.27	235.57	245.27
MEA loss through absorber		tonne	123.32	128.40	128.40	117.52	128.40	128.40	128.40	123.32	128.40
Nitrogen Gas Consumption		m³	35,239	36,690	36,690	33,581	36,690	36,690	36,690	35,239	36,690
Aux Boiler											
Aux Boiler Operating Hours		hours	7,915	8,241	8,241	7,543	8,241	8,241	8,241	7,915	8,241
Additional Fuel Consumption		tonne	5,604	5,835	5,835	5,340	5,835	5,835	5,835	5,604	5,835
Additional Fuel Consumption		m³	6,592,896	6,864,368	6,864,368	6,282,642	6,864,368	6,864,368	6,864,368	6,592,896	6,864,368
Additional Fuel Consumption		MMBTU	247,517	257,709	257,709	235,869	257,709	257,709	257,709	247,517	257,709
Reclaimer											
Reclaimer run frequency (rel to CCC)	6.0%	%									
Reclaimer Operating Hours		hours	475	494	494	453	494	494	494	475	494
Reclaimer MEA Consumption		tonne	58	60	60	55	60	60	60	58	60
Soda Ash Consumption		tonne	17	17	17	16	17	17	17	17	17
Reclaimer Sludge Disposal		tonne	81	85	85	77	85	85	85	81	85

Technical Data Summary

	Constant	Unit	2030	2031	2032	2033	2034	2035	2036
NGCC									
NGCC Operating Hours		hours	8,496	7,776	8,496	8,496	8,496	8,160	8,496
NGCC Shutdown hours (planned + unplanned)		hours	264	984	264	264	264	600	264
NGCC other non-operating hours		hours	-	-	-	-	-	-	-
CO2 Emissions from NGCC		tonne	1,270,403	1,162,742	1,270,403	1,270,403	1,270,403	1,220,162	1,270,403
Capture									
Capture Plant Operating Hours		hours	8,241	7,543	8,241	8,241	8,241	7,915	8,241
CO2 Captured		tonne	1,051,145	962,064	1,051,145	1,051,145	1,051,145	1,009,574	1,051,145
Direct Electricity Consumption		MWh	263,716	241,367	263,716	263,716	263,716	253,286	263,716
HP Steam Consumption		tonne	5,934	5,431	5,934	5,934	5,934	5,699	5,934
LP Steam Consumption		tonne	1,359,785	1,244,549	1,359,785	1,359,785	1,359,785	1,306,008	1,359,785
Power Reduction from LP Steam Consumption		MWh	289,634	265,089	289,634	289,634	289,634	278,180	289,634
Hot Water Consumption		tonne	-	-	-	-	-	-	-
Cooling Water Consumption		m³ MM	142.90	130.79	142.90	142.90	142.90	137.25	142.90
Activated Carbon Disposal		tonne	245.27	224.49	245.27	245.27	245.27	235.57	245.27
MEA loss through absorber		tonne	128.40	117.52	128.40	128.40	128.40	123.32	128.40
Nitrogen Gas Consumption		m³	36,690	33,581	36,690	36,690	36,690	35,239	36,690
Aux Boiler									
Aux Boiler Operating Hours		hours	8,241	7,543	8,241	8,241	8,241	7,915	8,241
Additional Fuel Consumption		tonne	5,835	5,340	5,835	5,835	5,835	5,604	5,835
Additional Fuel Consumption		m³	6,864,368	6,282,642	6,864,368	6,864,368	6,864,368	6,592,896	6,864,368
Additional Fuel Consumption		MMBTU	257,709	235,869	257,709	257,709	257,709	247,517	257,709
Reclaimer									
Reclaimer run frequency (rel to CCC)	6.0%	%							
Reclaimer Operating Hours		hours	494	453	494	494	494	475	494
Reclaimer MEA Consumption		tonne	60	55	60	60	60	58	60
Soda Ash Consumption		tonne	17	16	17	17	17	17	17
Reclaimer Sludge Disposal		tonne	85	77	85	85	85	81	85

Base Case: Open Art

Karsto
OPEX Summary

	Usage Rate	Average Usage Time	Unit Price	Annual Cost (NOK 000s)
1 Utility consumption				
Electricity	32.0 MW	8,105 h	450 NOK/MWh	116,714
LP Steam	165 t/h	8,105 h	96 NOK/t	128,185
HP Steam	12 t/h	486 h	340 NOK/t	1,984
Natural Gas	708 kg/h	8,105 h	2.06 NOK/kg	11,814
Cooling Water Consumption	17,340 m³/h	8,105 h	0.10 NOK/m³	14,054
Condensate Consumption	12.0 t/h	8,105 h	15.00 NOK/t	1,459
Utility Consumption				274,211
2 Consumables				
MEA consumption				2,656
MEA lost through absorber	15.6 kg/h	8,105 h	14,310 NOK/t	1,807
MEA consumption from reclaimer	122.0 kg/h	486 h	14,310 NOK/t	840
Soda Ash Cost Consumption	35.0 kg/h	486 h	1,590 NOK/t	27
Nitrogen Gas Cost Consumption	4.45 m³/h	8,105 h	5.30 NOK/m³	191
Consumables Cost				2,874
3 Staff				
Spec Workers	15 people	1 year	775 kNOK/y	11,625
Shift Leaders	5 people	1 year	950 kNOK/y	4,750
Secretaries	1 people	1 year	500 kNOK/y	500
Accounting	9 people	1 year	560 kNOK/y	5,040
Heads of CCC	1 people	1 year	1,200 kNOK/y	1,200
Staff Cost				23,115
4 Maintenance cost				
Maintenance Cost	n/a	1 year	55,893 kNOK/y	55,893
5 Spare and wear parts				
Average Absorber Packing*	n/a	1 year	1,749 kNOK/y	1,749
Spare Parts	n/a	1 year	11,925 kNOK/y	11,925
Spare and wear parts				13,674
6 Service cost to GASSCO				
Services from GASSCO	n/a	1 year	8,000 kNOK/y	8,000
7 Special waste				
Activated Carbon	29.8 kg/h	8,105 h	3,000 NOK/t	724
Reclaimer Sludge	171.0 kg/h	486 h	3,000 NOK/t	249
Waste Disposal				973
8 Service Agreement with Naturkraft				
To be determined by Gassnova				0
9 Taxes				
by Gassnova				0
10 Land Leasing cost				
by Gassnova				0
11 Other costs				
Administration	n/a	1 year	10,000 kNOK/y	10,000
12 Total Operating Costs				
Total				388,741

*The absorber packing costs will not be the same every year. See the financial model for the estimated repacking schedule

Base Case: Open Art

All Values in NOK 000s

Karsto Carbon Capture

Project Financial Statements

	Total	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
CAPITAL COST												
General Indirect	438,227	-	65,734	153,379	219,114	-	-	-	-	-	-	-
Stack Connection	81,965	-	12,295	28,688	40,983	-	-	-	-	-	-	-
Flue Gas Condition	135,061	-	20,259	47,271	67,531	-	-	-	-	-	-	-
CO2 Absorption	352,461	-	52,869	123,361	176,231	-	-	-	-	-	-	-
Solvent Regeneration	177,280	-	26,592	62,048	88,640	-	-	-	-	-	-	-
CO2 Compression & Conditioning	200,177	-	30,027	70,062	100,089	-	-	-	-	-	-	-
General Utility Systems	171,240	-	25,686	59,934	85,620	-	-	-	-	-	-	-
Automation	98,005	-	14,701	34,302	49,003	-	-	-	-	-	-	-
Civil Work	222,804	-	33,421	77,981	111,402	-	-	-	-	-	-	-
Main Power Supply	358,492	-	53,774	125,472	179,246	-	-	-	-	-	-	-
Capital Costs	**2,235,712**	**-**	**335,357**	**782,499**	**1,117,856**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
OPERATING COST												
Consumables & Disposal Cost												
Direct Electricity Consumption	2,917,859	-	-	-	-	118,672	118,672	113,979	118,672	118,672	108,615	118,672
HP Steam Consumption	49,604	-	-	-	-	2,017	2,017	1,938	2,017	2,017	1,846	2,017
LP Steam Consumption	3,204,630	-	-	-	-	130,335	130,335	125,181	130,335	130,335	119,290	130,335
Additional Fuel Consumption Cost	295,362	-	-	-	-	12,013	12,013	11,538	12,013	12,013	10,995	12,013
Hot Water Consumption	-	-	-	-	-	-	-	-	-	-	-	-
Cooling Water Consumption	351,359	-	-	-	-	14,290	14,290	13,725	14,290	14,290	13,079	14,290
Hazardous Waste Disposal	24,329	-	-	-	-	989	989	950	989	989	906	989
MEA Cost Consumption	66,401	-	-	-	-	2,701	2,701	2,594	2,701	2,701	2,472	2,701
Soda Ash Cost Consumption	677	-	-	-	-	28	28	26	28	28	25	28
Nitrogen Gas Cost Consumption	4,781	-	-	-	-	194	194	187	194	194	178	194
Condensate Consumption	36,473	-	-	-	-	1,483	1,483	1,425	1,483	1,483	1,358	1,483
Total Consumables & Disposal	**6,951,475**	**-**	**-**	**-**	**-**	**282,723**	**282,723**	**271,542**	**282,723**	**282,723**	**258,764**	**282,723**
Personnel												
Spec Workers	290,625	-	-	-	-	11,625	11,625	11,625	11,625	11,625	11,625	11,625
Shift Leaders	118,750	-	-	-	-	4,750	4,750	4,750	4,750	4,750	4,750	4,750
Secretaries	12,500	-	-	-	-	500	500	500	500	500	500	500
Accounting	126,000	-	-	-	-	5,040	5,040	5,040	5,040	5,040	5,040	5,040
Heads of CCC	30,000	-	-	-	-	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Personnel	**577,875**	**-**	**-**	**-**	**-**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**
O&M												
Services from GASSCO	200,000	-	-	-	-	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Spare Parts Usage	298,125	-	-	-	-	11,925	11,925	11,925	11,925	11,925	11,925	11,925
Absorber Packing	43,725	-	-	-	-	-	-	-	-	994	-	-
Maintenance	1,397,320	-	-	-	-	55,893	55,893	55,893	55,893	55,893	55,893	55,893
Operation Maintenance and Repair	**1,939,170**	**-**	**-**	**-**	**-**	**75,818**	**75,818**	**75,818**	**75,818**	**76,812**	**75,818**	**75,818**
Administration & Insurance												
Administration	250,000	-	-	-	-	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Insurance	-	-	-	-	-	-	-	-	-	-	-	-
Administration and Insurance	**250,000**	**-**	**-**	**-**	**-**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**
Total Operating Cost	**9,718,520**	**-**	**-**	**-**	**-**	**391,656**	**391,656**	**380,475**	**391,656**	**392,650**	**367,696**	**391,656**

Base C e: Open Art

All Values in NOK 000s

Karsto C bon Capture
Project Financial Statements

	Total	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
NET CASH FLOW												
Increase in Net Working Capital	-	-	-	-	-	(28,972)	-	827	(827)	(74)	1,846	(1,772)
Net Cash Flow	11,954,232	-	335,357	782,499	1,117,856	362,684	391,656	381,302	390,829	392,576	369,542	389,884
NPV of Net Cash Flow	5,143,044	-	-	-	-	-	-	-	-	-	-	-

Base Case: Open Art

All Values in NOK 000s

Karsto Carbon Capture

Project Financial Statements

	Total	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
CAPITAL COST												
General Indirect	438,227	-	-	-	-	-	-	-	-	-	-	-
Stack Connection	81,965	-	-	-	-	-	-	-	-	-	-	-
Flue Gas Condition	135,061	-	-	-	-	-	-	-	-	-	-	-
CO2 Absorption	352,461	-	-	-	-	-	-	-	-	-	-	-
Solvent Regeneration	177,280	-	-	-	-	-	-	-	-	-	-	-
CO2 Compression & Conditioning	200,177	-	-	-	-	-	-	-	-	-	-	-
General Utility Systems	171,240	-	-	-	-	-	-	-	-	-	-	-
Automation	98,005	-	-	-	-	-	-	-	-	-	-	-
Civil Work	222,804	-	-	-	-	-	-	-	-	-	-	-
Main Power Supply	358,492	-	-	-	-	-	-	-	-	-	-	-
Capital Costs	**2,235,712**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
OPERATING COST												
Consumables & Disposal Cost												
Direct Electricity Consumption	2,917,859	118,672	118,672	113,979	118,672	118,672	108,615	118,672	118,672	118,672	113,979	118,672
HP Steam Consumption	49,604	2,017	2,017	1,938	2,017	2,017	1,846	2,017	2,017	2,017	1,938	2,017
LP Steam Consumption	3,204,630	130,335	130,335	125,181	130,335	130,335	119,290	130,335	130,335	130,335	125,181	130,335
Additional Fuel Consumption Cost	295,362	12,013	12,013	11,538	12,013	12,013	10,995	12,013	12,013	12,013	11,538	12,013
Hot Water Consumption	-	-	-	-	-	-	-	-	-	-	-	-
Cooling Water Consumption	351,359	14,290	14,290	13,725	14,290	14,290	13,079	14,290	14,290	14,290	13,725	14,290
Hazardous Waste Disposal	24,329	989	989	950	989	989	906	989	989	989	950	989
MEA Cost Consumption	66,401	2,701	2,701	2,594	2,701	2,701	2,472	2,701	2,701	2,701	2,594	2,701
Soda Ash Cost Consumption	677	28	28	26	28	28	25	28	28	28	26	28
Nitrogen Gas Cost Consumption	4,781	194	194	187	194	194	178	194	194	194	187	194
Condensate Consumption	36,473	1,483	1,483	1,425	1,483	1,483	1,358	1,483	1,483	1,483	1,425	1,483
Total Consumables & Disposal	**6,951,475**	**282,723**	**282,723**	**271,542**	**282,723**	**282,723**	**258,764**	**282,723**	**282,723**	**282,723**	**271,542**	**282,723**
Personnel												
Spec Workers	290,625	11,625	11,625	11,625	11,625	11,625	11,625	11,625	11,625	11,625	11,625	11,625
Shift Leaders	118,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750
Secretaries	12,500	500	500	500	500	500	500	500	500	500	500	500
Accounting	126,000	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040	5,040
Heads of CCC	30,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Personnel	**577,875**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**
O&M												
Services from GASSCO	200,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Spare Parts Usage	298,125	11,925	11,925	11,925	11,925	11,925	11,925	11,925	11,925	11,925	11,925	11,925
Absorber Packing	43,725	-	-	994	-	-	-	-	39,750	-	-	994
Maintenance	1,397,320	55,893	55,893	55,893	55,893	55,893	55,893	55,893	55,893	55,893	55,893	55,893
Operation Maintenance and Repair	**1,939,170**	**75,818**	**75,818**	**76,812**	**75,818**	**75,818**	**75,818**	**75,818**	**115,568**	**75,818**	**75,818**	**76,812**
Administration & Insurance												
Administration	250,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Insurance	-	-	-	-	-	-	-	-	-	-	-	-
Administration and Insurance	**250,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**
Total Operating Cost	**9,718,520**	**391,656**	**391,656**	**381,469**	**391,656**	**391,656**	**367,696**	**391,656**	**431,406**	**391,656**	**380,475**	**392,650**

Base C e: Open Art

All Values in NOK 000s

Karsto C bon Capture

Project Financial Statements

	Total	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
NET CASH FLOW												
Increase in Net Working Capital	-	-	-	754	(754)	-	1,772	(1,772)	(2,940)	2,940	827	(901)
Net Cash Flow	11,954,232	391,656	391,656	382,222	390,902	391,656	369,469	389,884	428,466	394,596	381,302	391,749
NPV of Net Cash Flow	5,143,044	-	-	-	-	-	-	-	-	-	-	-

BECHTEL

Base Case: Open Art

All Values in NOK 000s

Karsto Carbon Capture

Project Financial Statements

	Total	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
CAPITAL COST											
General Indirect	438,227	-	-	-	-	-	-	-	-	-	-
Stack Connection	81,965	-	-	-	-	-	-	-	-	-	-
Flue Gas Condition	135,061	-	-	-	-	-	-	-	-	-	-
CO2 Absorption	352,461	-	-	-	-	-	-	-	-	-	-
Solvent Regeneration	177,280	-	-	-	-	-	-	-	-	-	-
CO2 Compression & Conditioning	200,177	-	-	-	-	-	-	-	-	-	-
General Utility Systems	171,240	-	-	-	-	-	-	-	-	-	-
Automation	98,005	-	-	-	-	-	-	-	-	-	-
Civil Work	222,804	-	-	-	-	-	-	-	-	-	-
Main Power Supply	358,492	-	-	-	-	-	-	-	-	-	-
Capital Costs	**2,235,712**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
OPERATING COST											
Consumables & Disposal Cost											
Direct Electricity Consumption	2,917,859	118,672	108,615	118,672	118,672	118,672	113,979	118,672	-	-	-
HP Steam Consumption	49,604	2,017	1,846	2,017	2,017	2,017	1,938	2,017	-	-	-
LP Steam Consumption	3,204,630	130,335	119,290	130,335	130,335	130,335	125,181	130,335	-	-	-
Additional Fuel Consumption Cost	295,362	12,013	10,995	12,013	12,013	12,013	11,538	12,013	-	-	-
Hot Water Consumption	-	-	-	-	-	-	-	-	-	-	-
Cooling Water Consumption	351,359	14,290	13,079	14,290	14,290	14,290	13,725	14,290	-	-	-
Hazardous Waste Disposal	24,329	989	906	989	989	989	950	989	-	-	-
MEA Cost Consumption	66,401	2,701	2,472	2,701	2,701	2,701	2,594	2,701	-	-	-
Soda Ash Cost Consumption	677	28	25	28	28	28	26	28	-	-	-
Nitrogen Gas Cost Consumption	4,781	194	178	194	194	194	187	194	-	-	-
Condensate Consumption	36,473	1,483	1,358	1,483	1,483	1,483	1,425	1,483	-	-	-
Total Consumables & Disposal	**6,951,475**	**282,723**	**258,764**	**282,723**	**282,723**	**282,723**	**271,542**	**282,723**	**-**	**-**	**-**
Personnel											
Spec Workers	290,625	11,625	11,625	11,625	11,625	11,625	11,625	11,625	-	-	-
Shift Leaders	118,750	4,750	4,750	4,750	4,750	4,750	4,750	4,750	-	-	-
Secretaries	12,500	500	500	500	500	500	500	500	-	-	-
Accounting	126,000	5,040	5,040	5,040	5,040	5,040	5,040	5,040	-	-	-
Heads of CCC	30,000	1,200	1,200	1,200	1,200	1,200	1,200	1,200	-	-	-
Personnel	**577,875**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**23,115**	**-**	**-**	**-**
O&M											
Services from GASSCO	200,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	-	-	-
Spare Parts Usage	298,125	11,925	11,925	11,925	11,925	11,925	11,925	11,925	-	-	-
Absorber Packing	43,725	-	-	-	994	-	-	-	-	-	-
Maintenance	1,397,320	55,893	55,893	55,893	55,893	55,893	55,893	55,893	-	-	-
Operation Maintenance and Repair	**1,939,170**	**75,818**	**75,818**	**75,818**	**76,812**	**75,818**	**75,818**	**75,818**	**-**	**-**	**-**
Administration & Insurance											
Administration	250,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	-	-	-
Insurance	-	-	-	-	-	-	-	-	-	-	-
Administration and Insurance	**250,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**10,000**	**-**	**-**	**-**
Total Operating Cost	**9,718,520**	**391,656**	**367,696**	**391,656**	**392,650**	**391,656**	**380,475**	**391,656**	**-**	**-**	**-**

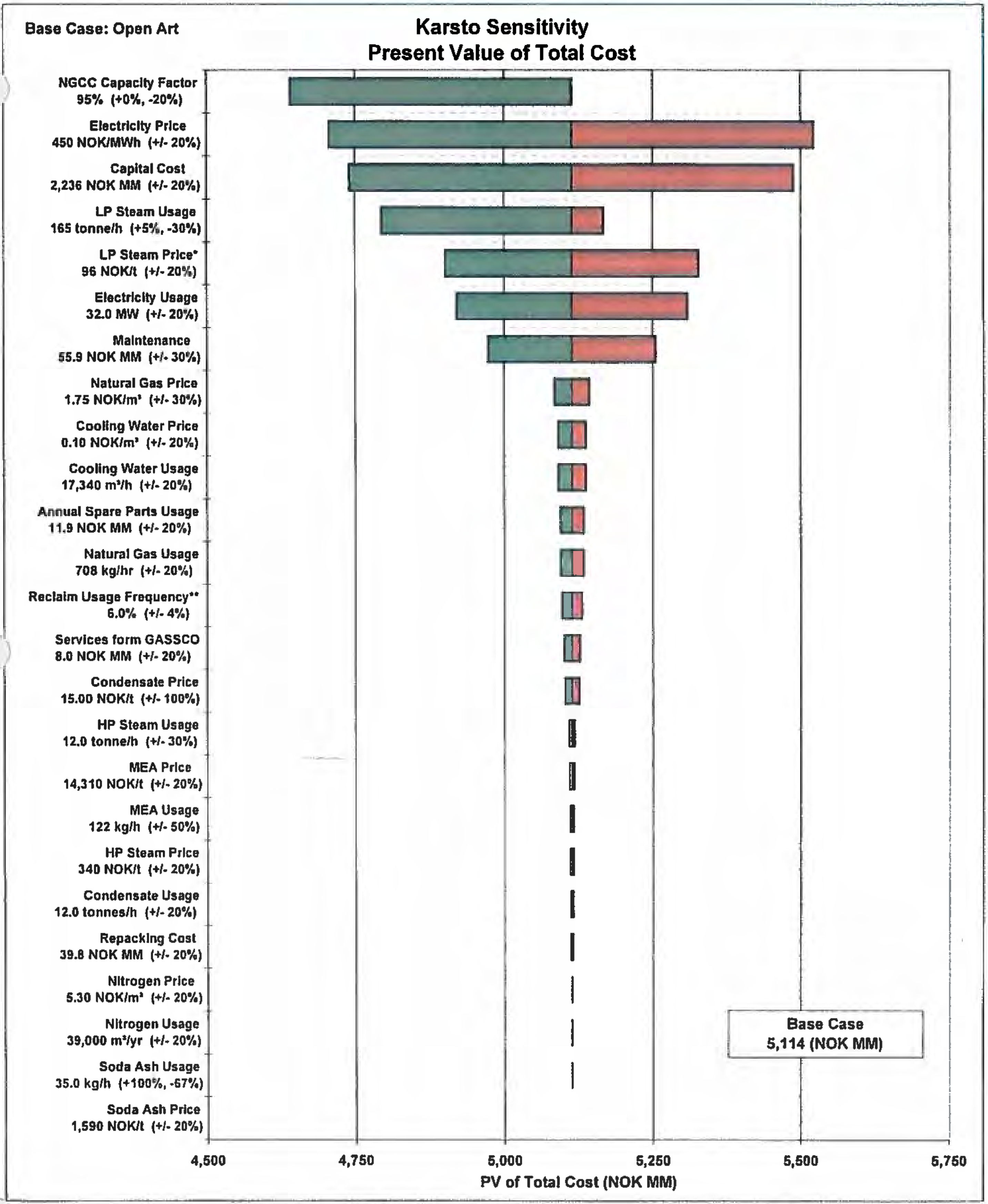
Base C[illegible]: Open Art

All Values in NOK 000s

Karsto C[illegible]bon Capture

Project Financial Statements

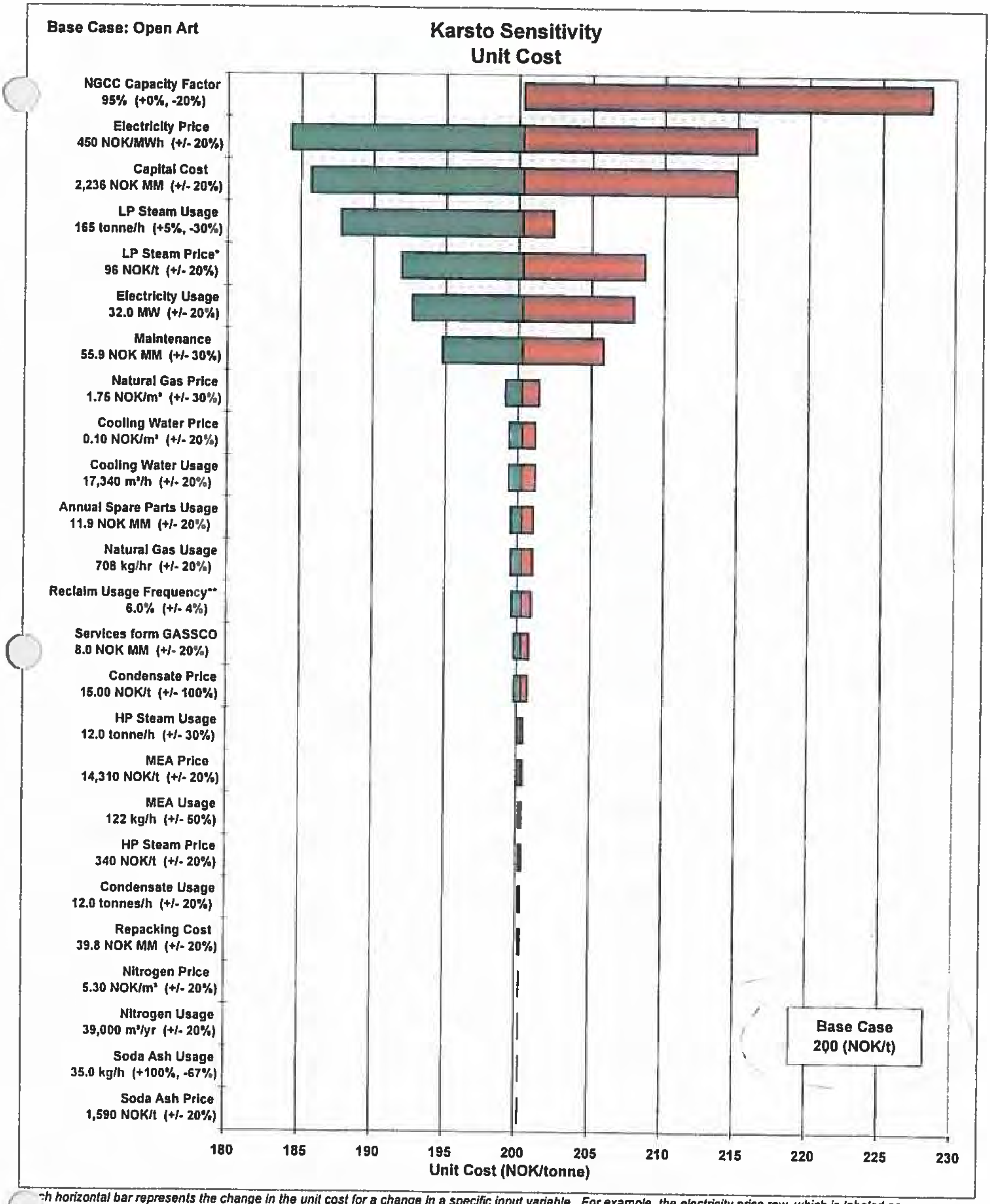
	Total	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
NET CASH FLOW											
Increase in Net Working Capital	-	74	1,772	(1,772)	(74)	74	827	28,145	-	-	-
Net Cash Flow	11,954,232	391,729	369,469	389,884	392,576	391,729	381,302	419,801	-	-	-
NPV of Net Cash Flow	5,143,044	-	-	-	-	-	-	-	-	-	-



Each horizontal bar represents the change in the total cost for a change in a specific input variable. For example, the electricity price row, which is labeled as 450 NOK/MWh (+/- 20%), shows the total cost when the electricity price is set to $360, 450, and 540 NOK. Each bar is independent of other bars, therefore the base case total cost is the same for every variable. Because Capacity Factor and Reclaimer Use Frequency are already in units of percent, they are treated slightly differently. For example a 60% +/- 20% range would be treated as 40% to 80% instead of 48% to 72%.

**LP steam price is based on the power reduction factor and the electricity price.*

*** Reclaimer Usage Frequency refers how often the reclaimer must be run, and affect the use of HP steam, MEA, and soda ash.*



ch horizontal bar represents the change in the unit cost for a change in a specific input variable. For example, the electricity price row, which is labeled as NOK/MWh (+/- 20%), shows the unit cost when the electricity price is set to 360, 450, and 540 NOK. Each bar is independent of other bars, therefore the base case unit cost is the same for every variable. Because Capacity Factor and Reclaimer Use Frequency are already in units of percent, they are treated slightly differently For example a 60% +/- 20% range would be treated as 40% to 80% instead of 48% to 72%

**LP steam price is based on the power reduction factor and the electricity price*

*** Reclaimer Usage Frequency refers how often the reclaimer must be run, and affect the use of HP steam, MEA, and soda ash.*