


Erection Concept and Access Requirements for Operation and Maintenance

CO₂ Capture Facility

Kårstø, Norway

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0	5 JAN 09	Issued for Approval	SRN	JED	PIR	WBS	
Rev.	Date	Reason for Revision	By	Check	App	App	
 Bechtel Power Corporation			Job No. 25474				
Document No.						Rev.	
25474 - 000 -4CY - T01G - 00002						0	
PAGE 1 of 5							
GASSNOVA			Project No. - Originator - Disc Code - Doc Type - Serial No.				
			10112936 -PB-O-TDO-0001				

Contents

<u>Section</u>	<u>Page</u>
1.0 PURPOSE	3
2.0 DESCRIPTION	3
3.0 SCOPE.....	3
4.0 DEFINITIONS	3
5.0 RESPONSIBILITIES	3
6.0 ERECTION CONCEPT, AND ACCESS REQUIREMENTS FOR OPEATIONS AND MAINTENANCE	4

Erection Concept and Access Requirements for Operations and Maintenance

1.0 PURPOSE

The purpose of this document is to provide details on the transportation, unloading, storage and access requirements for permanent plant equipment.

2.0 DESCRIPTION

The Karsto CCC Project is located adjacent to the Karsto gas terminal and the combined cycle power plant (CCPP) owned and operated by Naturkraft AS. The CCC plant is owned by Gassnova SF. The CCC project's technology is based on the use of amine for the bulk removal of CO₂ from a flue gas stream by liquid chemical absorbents. The amine plant mainly consists of flue gas ducting and blowers, direct contact coolers, absorption columns, a stripper column, reboilers, reclaimers, and CO₂ compression and drying, along with other equipment such as pumps, filters, and heat exchangers.

3.0 SCOPE

This document addresses the delivery, unloading, erection concept, storage and access for operations and maintenance of permanent plant equipment for the CCC processing facilities.

4.0 DEFINITIONS

4.1 SPMT (Self Propelled Motorized Transporter) – A heavy haul vehicle used to transport large heavy loads.

4.2 FRP (Fiberglass Reinforced Pipe) – Pipe material specified for the sea water cooling piping.

4.3 FREP (Forming, Rebar, Embeds, and Placement) – The sequence of operation for constructing concrete structures. The installation of concrete forms, rebar, embeds and the placement of concrete.

5.0 RESPONSIBILITIES

5.1 Construction Organization.

5.1.1 The Contractor's construction organization has the responsibility for the project management of the construction site.

5.2 Owner's Organization

5.2.1 The Owner's organization has the responsibility to oversee the Contractor's construction operations.

6.0 ERECTION CONCEPT AND ACCESS REQUIREMENTS FOR OPERATIONS AND MAINTENANCE

6.1 Zone 1 - Stack Tie-in

The Zone 1 stack tie-in scope consist of existing plant modifications and new construction work within the Naturcraft Power Plant. Zone 1, also, also encompasses the ductwork system routed over to the two (2) absorber towers. Working, within Zone 1, will entail performing construction operations within the operating Naturcraft Power Plant, and, constructing adjacent to the existing plant.

The erection concept within the vicinity of the Naturcraft's flue gas stack can be characterized as stick-built with some pre-assembly. This approach is driven by the fact that the majority of the construction work will need to be accomplished prior to the plants scheduled outage. This pre-outage work may need to be accomplished while the power plant is in full operations. The objective is to ensure that no operations disruptions occurred during pre-outage construction.

The scope of work in Zone 1 includes erection of structural steel, duct work, dampers and flue gas blowers. All structural steel will be coated/painted at the steel manufacture's facilities to protect the steel from the corrosive sea environment. The steel members will be stored in sea vans during shipping. The structural steel will be delivered to a fabrication facility for assembly. Since the stack tie-in will be stick-built, delivery will be made directly to the Anleggskai Jetty. Once at the site, the steel will be inspected for shipping damage, as well as, any coating/painting damage that requires repair. After steel erection is completed, a stair tower will provide operations access to the new stack support structure as well as the CEMS related equipment.

The guillotine dampers will be delivered by shipping vessel and transported to the site via a heavy haul vehicle such as a self propelled motorized transporter (SPMT). Storage requirements will include protection from shipping damage, and corrosion protection from the ocean environment. Corrosion protection will be monitored and maintained during storage on site. Periodic preventive maintenance will be performed as specified by the equipment supplier while in

storage. Once the equipment is installed, operations will have access to inspect and maintain the equipment via ladders and platforms.

All structural steel bridge supports and modularized duct sections will arrive by barge to the Anleggskai Jetty. These heavy haul deliveries will be performed using the self propelled motorized transporter (SPMT). The duct sections will be pre-insulated in the shop and exposed sections will be protected from the environment. Access hatches will be installed along the duct to permit operations access for inspection. This includes a hatch adjacent to the flue gas fogging equipment for maintenance.

Two flue gas blowers will arrive by ocean freight to the module Anleggskai Jetty. The crated fans and motors will be transported to the site via a heavy haul vehicle for setting. The motors will be packaged to ensure protection from the weather. Once at the site, the motors will be stored indoors, and heat applied for protection. Each fan enclosure will be sufficiently erected to install the equipment through a roof opening. This will permit completing the roof immediately after setting the equipment. Subsequent to site delivery, maintenance will be performed as specified by the equipment supplier's preventative maintenance program. After setting each fan and motor, building access will be available for inspection and continued preventative maintenance.

6.1.2 Zone 2 – Amine Plant

The boundaries of Zone 2 begins at the absorber towers and includes all permanent plant equipment excluding the Compressor Building area.

After all underground rock blasting has been completed, installation of sea water piping will commence. The sea water pipe will be installed starting from the absorber towers and finishing at the sea water cooling pumps. Due to the corrosiveness of sea water, fiberglass reinforced pipe (FRP) will be specified for this application.

As the sea water pipe is backfilled then FREP (Forming, Rebar, Embeds, and Placement) activities for the Absorbers and Stripper foundations will begin. Delivery of the absorber and stripper towers will be on the critical path. Therefore, the preparation of the foundations will be key milestone activities.

Delivery of the absorber and stripper towers will be by ocean freight below deck. The towers will be unloaded using heavy lift shipping vessel cranes onto self propelled motorized transporters (SPMT). The towers will be transported along the jetty module transport road to the construction site. Each tower will be staged in preparation for setting. During staging, portions of the ladders and platforms will be assembled onto the towers. Each tower will be set using a heavy lift crane with a tailing crane. After setting each tower, all remaining sections of ladders and platforms will be erected.

All piping and valves for the towers and pipe racks will be coated/painted at the pipe manufactures facilities prior to shipping. The exposed pipe and valve ends will be plugged and sealed during shipping, and delivered to site in sea vans.

Piping sections around the towers will be assembled on the ground, and lifted into position for weld out. The bulk of pipe is large bore pipe, and a dedicated crane will be required for installation. The tower internals will be installed in parallel. Access for operator inspections and maintenance will be via the man-ways located on the various platforms elevations.

The pipe racks will be assembled in an off-site fabrication yard. All piping and valves will be shipped to the fabrication yard, and quality surveillances will be performed to ensure conformance with all storage requirements. Each modularized pipe rack section will be barge delivered to the Anleggskai Jetty. The sections will be transferred using the SPMT, and transported to the site in the scheduled erection sequence. The racks will be transferred onto its foundation anchor bolts, at which time all temporary bracing will be removed. Temporary bracing for the modularized rack will be designed to permit unrestricted removal of the SPMT after setting each section. All interconnecting piping between rack sections will then be welded. Permanent ladders and platforms provide access to piping and valves for maintenance during operation of the plant.

One exception to the module approach will be the platform frame surrounding the stripper. These platforms will require stick building. The platforms will support the reboilers, reclaimers, overhead condenser, and reflux drum. This equipment will be inserted onto the platform frame during steel erection. Following steel erection the installation of large bore piping and electrical will start. Once the equipment is installed, preventative maintenance will be performed in accordance with supplier requirements. Construction and operations will have stair access to the equipment located on the platforms.

The electrical building will be a two story design/build structure. As the electrical equipment is delivered, the equipment will be maintained in a controlled warehouse. The equipment will be set into the building only after weather protection can be ensured. Building access restrictions will be implemented once testing and energization commence.

The Control Building will be erected in parallel with the amine area facilities. A portion of the building will be designed as a concrete bunker structure. After the electrical trenching tie-ins have been completed, the cable pulling for electrical and distributed control systems (DCS) activities will commence. System testing will be performed in a scheduled sequence.

The amine truck unloading area consists of a field erected tank and a fabricated storage tank. All pumps associated with this area will be protected, and periodic preventative maintenance performed.

6.1.3 Zone 3 - Compressor Building

Work within the Zone 3 compressor building will be sequenced to allow for the compressors long lead time. The building structure will be erected prior to equipment delivery. All auxiliary equipment and the majority of piping and electrical work will progress until delivery of the compressors and motors.

The compressors will be skid mounted into sections that will be delivered by shipping vessel. Each skid will be packaged to withstand the corrosive sea environment. Motors will be packaged to ensure protection from the weather. Inspections will be performed immediately upon arrival. The skids will be transported to the site and moved into the building via a maintenance access way. All leave-out piping will be completed once the compressors are placed onto their foundations. After initial installation, the motors will be protected from the damp sea environment using heaters. The compressors and motors will be monitored and preventative maintenance performed.