

# PUERTO BOLIVAR PORT EXPANSION – EPC



## CONTAINER TERMINAL DEVELOPMENT – PHASE 1



## GENERAL ASPECTS

### 4.2.1 – I) Arrangements and Construction Methods Statements



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A handwritten signature in black ink, appearing to read "GOBERT Jean-Luc", written over a horizontal line.

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## TABLE OF CONTENTS

1	INTRODUCTION.....	6
1.1	LOCATION .....	6
1.2	EXISTING LAYOUT AND SITUATION .....	6
1.3	NEW LAYOUT AND INTEGRATION IN EXISTING SITUATION.....	7
1.4	PROJECT'S SCOPE .....	8
2	METHOD STATEMENT'S SCOPE.....	9
3	WORKING AREAS.....	10
3.1	TOPOGRAPHICAL SURVEY.....	11
3.2	LOCATION OF SITE AND SERVICES .....	11
3.3	WORKERS ACCOMODATION .....	14
3.4	PRECAST AND STEEL YARD (CASINGS AND REBAR).....	14
3.4.1.	Steel Casings Yard .....	15
3.4.2.	Precast Yard .....	16
3.5	CONCRETE SUPPLY (BATCHING PLANT) .....	17
3.6	TEMPORARY JETTY .....	18
4	SEQUENCE OF ACTIVITIES .....	19
4.1	DREDGING .....	19
4.1.1.	Mobilization & Installation .....	19
4.1.2.	Procedure .....	19
4.2	DEMOLITIONS .....	21
4.2.1.	Diamond Thread Cutting System .....	22
4.2.2.	Pecker Equipped Excavator and Demolition Hammers .....	25
4.3	DECK ON PILES .....	27
4.3.1.	Safety & Environmental Requirements .....	27
4.3.2.	Piling Methodology .....	28
4.3.3.	Scour Protection Installation.....	31
4.3.4.	Quay Deck Construction.....	33

4.3.5.	STS Rails Installation .....	35
4.3.6.	Quay Furniture .....	37
4.3.7.	Site Clearance and Preliminary Earthworks .....	37
4.4	SOIL IMPROVEMENT .....	38
4.4.1.	On Shore Soil Improvement (Terminal Areas) .....	38
4.4.2.	Off Shore Soil Improvement: Q1/T1 & Q2 (Slope Stability) .....	44
4.5	HYDRAULIC SYSTEMS .....	56
4.5.1.	Water Supply .....	56
4.5.2.	Storm Water Drainage .....	56
4.5.3.	Waste Water System & Sewerage System .....	56
4.5.4.	General Procedure .....	57
4.5.5.	Specific Procedures .....	61
4.6	ELECTRICAL .....	66
4.6.1.	Scope Of Work .....	66
4.6.2.	Assumptions .....	67
4.6.3.	Technical Deviations .....	68
4.6.4.	Equipment .....	68
4.6.5.	69 KV Switchyard Equipment .....	68
4.6.6.	MV Switchgear .....	77
4.6.7.	Diesel Generator System .....	80
4.6.8.	LV Switchgear and LV Panels AC/DC .....	85
4.6.9.	Power and Distribution Transformers .....	88
4.6.10.	AC/DC Panel - Rectifier - Batteries .....	96
4.6.11.	High Mast Installation .....	99
4.6.12.	MV and LV Cables and Terminations .....	103
4.6.13.	Reefer Sockets .....	109
4.6.14.	Cable Trays and Accessories for Earthing Lightning .....	113
4.7	PAVEMENTS .....	122

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4.7.1.	Definitions .....	122
4.7.2.	Resources .....	125
4.7.3.	Procedure .....	126
4.8	ROADMARKING .....	134
4.8.1.	Resources .....	134
4.8.2.	Procedure .....	135
4.9	BUILDINGS .....	136
4.9.1.	Main Buildings - Definitions .....	136
4.9.2.	Common Procedures .....	142
APPENDIX – TESTING AND MONITORING PLAN .....		162

## 1 INTRODUCTION

### 1.1 LOCATION

Puerto Bolívar is part of the municipality of Machala, El Oro Province, Ecuador. Puerto Bolívar is one of the world's largest shipment points for bananas. A large part of Ecuador's banana export is shipped through the port of Puerto Bolívar.

The location of Puerto Bolívar is shown in Figure 1 below. The location of the port is sheltered from direct ocean waves by Jambelí Island.

In August 2016, the Turkish port operator 'Yilport Holding' (Client) signed a 50-year concession for operating the terminal. Part of the concession contract is the obligation to modernize the port, mainly consisting of container handling and storage facilities.

The development is planned in 3 phases. **Only Phase 1 will be constructed in the short term.**



### 1.2 EXISTING LAYOUT AND SITUATION

The existing Port can handle various cargo, such as containers, general cargo, refrigerated cargo, dry and liquid bulk. The port has a total area of 70 ha, with 2.61 ha of covered storage and 49.63 ha of open storage. It has an administrative area next to Av. Bolívar Madero Vargas and the main entrance to the port and the CAE (Ecuadorian Customs Corporation).



## GENERAL ASPECTS

### 4.2.1 I) Arrangements and Construction Methods Statements – rev A



There are five berths within the Yilport concession area at Puerto Bolívar. There is a concrete finger pier with two berths (Berths 1 and 2) of 140m length each, connected to the shore by a trestle of about 120m length. Based on local information, this berth can service vessels with maximum draught of 9.7m.

There is a marginal jetty of 372m length (Berth 3 and 4) of piled suspended deck construction, connected to the shore by three short viaducts. Based on local information, this berth can service vessels with a maximum draught of up to 10.6m and a displacement of up to 20,000 tonnes.

Berth 5 has a length of approximately 300m and a mooring dolphin with catwalk to the north, the structure is a concrete deck supported by raking and vertical concrete piles, with a gentle slope of about 1 in 6 underneath, resulting in a total deck width of about 98m. The catwalk between Berth 5 and the dolphin is supported by an intermediate pile. Berth 5 is fitted out with double cone fenders.

To the North of the existing port facilities, there is an existing jetty and helicopter platform belonging to the naval base, as per the picture below.



### 1.3 NEW LAYOUT AND INTEGRATION IN EXISTING SITUATION

The port expansion as covered in this document will be developed in 3 phases. The existing layout and the layout for the 3 phases are shown in the following drawings:

- Existing situation: BF1842-100-1002
- Phase 1: BF1842-200-2001
- Phase 2: BF1842-200-2002
- Phase 3: BF1842-200-2003

As indicated in the drawings, the quay will be developed in the 1st phase, while the 2nd and 3rd phase include reclamation behind the quay structure bund wall.

Main buildings will be developed in line with what has been indicated on the drawings and as per below:

- Phase 1:
  - ✓ Construction of Cold Storage Warehouse (first part), for storage of bananas and shrimps.
- Phase 2 and 3:
  - ✓ Expansion of Cold Storage Warehouse, for storage of bananas and shrimps;
  - ✓ Construction of new Administration Building, Workshop and Container Freight Station.

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## 1.4 PROJECT'S SCOPE

The Main Scope for the project includes, but shall not be limited to:

- Demolition works of a mooring dolphin with catwalk, the navy jetty in north side of site, revetments and various smaller demolition works to existing structures and facilities as required under the scope.
- Dredging works for the berth pocket
- Soil improvement offshore and onshore;
- New 450m long quay structure for berth 6, connecting to the existing berth 5, including all furniture, services and provisions
- Scour protection and slope protection at berth 6
- Structural modifications to the quay structure of Berth 5, the pavement behind Berth 5 and other
- existing structures as required
- Terminal, E-RTG and road pavement behind part of berth 6 and over the complete terminal,
- connecting to existing Berth 5 terminal and connecting to the public road via the gate complex
- Electrical works and data works
- Connection to the power grid and data grid
- Main substation and general power supply
- Complete reefer power supply with substations, cables, ducts, pits, etcetera
- Complete E-RTG power supply with substations, cables, ducts, pits, etcetera
- Complete STS crane power supply with substations, cables, ducts, pits, etcetera



## 2 METHOD STATEMENT'S SCOPE

This document aims to define the general method statements for the construction activities of the execution of Container Terminal Development of Puerto Bolivar Expansion.

Throughout the document, specific method statement for each type of work and specific details required are mentioned.

The document does not intend to go into detail of the activities, therefore, Safety, Environmental and Quality issues will not be addressed either.

In the event of being awarded, all the detailed methodologies will be delivered for each of the activities mentioned in this document.

The activities described in this document must comply as following list:

- The Technical Specifications delivered by the Engineer and the designer;
- The American and British Standards ASTM, AWS, API or others if specified in the final design;
- Drawings delivered by the Consortium's Designer.

### 3 WORKING AREAS

This document sets forth contractor's working areas of our Joint Venture to be set up for the execution of Container Terminal Development of Puerto Bolivar Expansion.

In general, social and support facilities need to be installed on site with strategic positioning. This layout will minimize the impact since the preliminary works will allow the position of our temporary area and at the end proceed with landscaping the to finish the scope.

As pavements and hydraulic networks are not foreseen to be installed in the below surface in yellow, the same will be used for the installation of the support facilities. This location will avoid facility future relocation to give way to other activities, and in addition its central position allows for shorter distances to the quay.



**Photo 1 - Working Areas Location**

This area will allow the installation of various set ups that will enable the correct operations and logistics necessary to the works. The different set ups are as follows:

- Offices for operational staff, employer and the engineer;
- Dining room for workers;
- Bathrooms and dressing rooms;
- Warehouses;
- Temporary storage of piles and precast concrete elements;
- Dangerous waste warehouse with its respective dykes and roofs;
- Storage areas;
- Fuel and light plants;
- Concrete plant for cast-in-place elements;
- Laboratory for the sampling of concrete and aggregates.

### 3.1 TOPOGRAPHICAL SURVEY

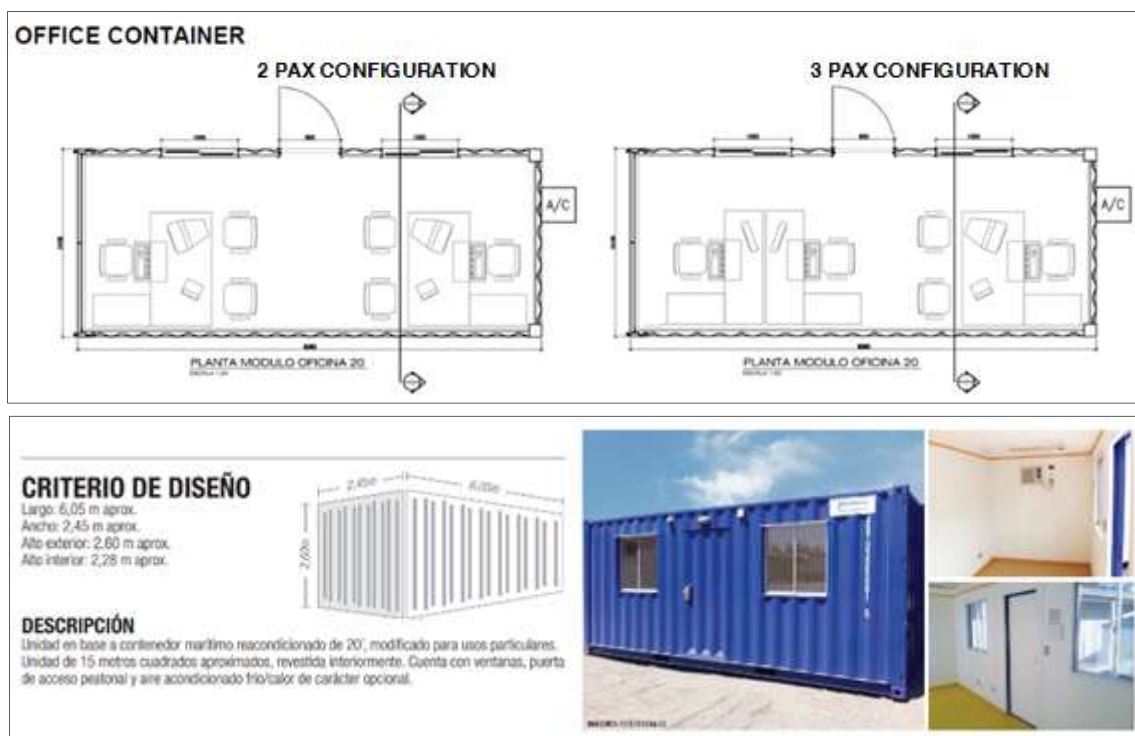
Before starting the works, a general topographical survey of the Project Works will be carried out, based on the planimetry and dimensions indicated in the engineering drawings. Together with the setting out, all the topographic works necessary to have a representation of the terrain relief will be carried out.

The topographic works will be carried out using precision instruments and topographic implements, with current certification of a seniority not exceeding 1 year.

### 3.2 LOCATION OF SITE AND SERVICES

Offices will be built for the Consortium, with all its facilities, including all its services such as electricity, telephone, internet, heating, hygiene services, etc., in addition to the furniture that must be of quality per the duration of the Project.

Preliminary, the 20' Modular container has been proposed as a solution for the offices, can be two option for the internal distribution at the offices containers:



**Photo 2 - Office Containers Configuration**

General Specifications:

- Walls & Ceiling wood framed R-13 fiberglass insulation and lined w/ 5/16" Hardie Paneling™;
- 10,000 BTU A/C window unit;
- 100 AMP Electrical panel;
- (5) 110V (2-PLUG) Outlets (one dedicated for A/C unit);
- (2) 4ft overhead florescent lights & (1) switch;
- (2) 2ft x 3ft Windows w/ steel security bars;
- 3ft side entrance steel personnel door w/ deadbolt, handle lock & drip edge;
- Paint interior (solid color, flat finish).

### GENERAL ASPECTS

#### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

It's foreseen to build the employer and engineer in the same area of the contractor's offices, to comply the requirement requested in §10.2 and 10.3 – Volume IV Part 1.

Both (Employer and Engineer) facilities will have the follow aspects:

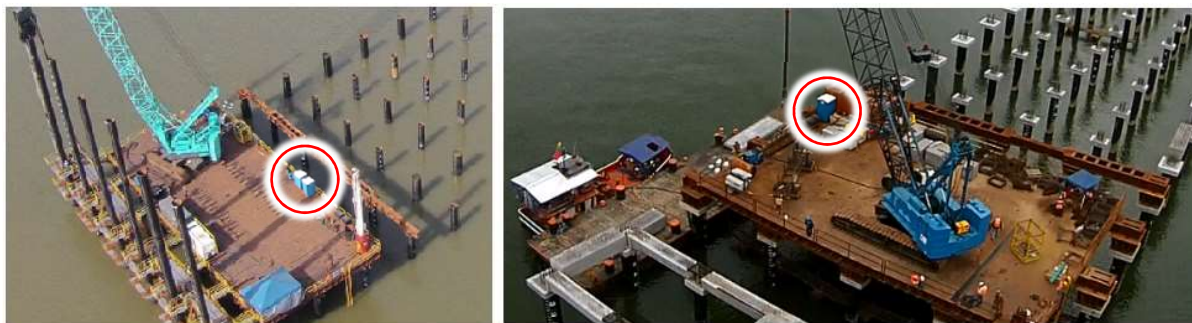
Room No:	Description	Approximate Size
1	Project Manager's office	6m x 3m
2	RE (Marine Works) office	6m x 3m
3	RE (M&E Works) office	6m x 3m
4	Office for Senior Engineer	6m x 3m
5	Office for 2 No. Inspectors	6m x 3m
7	Office for Secretary	6m x 3m
9	Spare Office	6m x 3m
10	Conference Room	12m x 4m
11	Stores	3m x 3m
12	Toilets, male and female	
13	Kitchen	
14	Shower and Changing Room	2m x 2m

**Table 1 - Office Containers Estimated Needs**

As a complement for the Offices there will be sanitary facilities:

The Contractor's, Employer's, Engineer's and Subcontractors' areas shall also be equipped with bathrooms and showers for administrative personal. As well all operational support areas shall be equipped with sanitary facilities.

All working areas shall have chemical bathrooms, bearing in mind that there is a considerable distance from those points to the main facilities, this includes the maritime working areas (platform and barges).



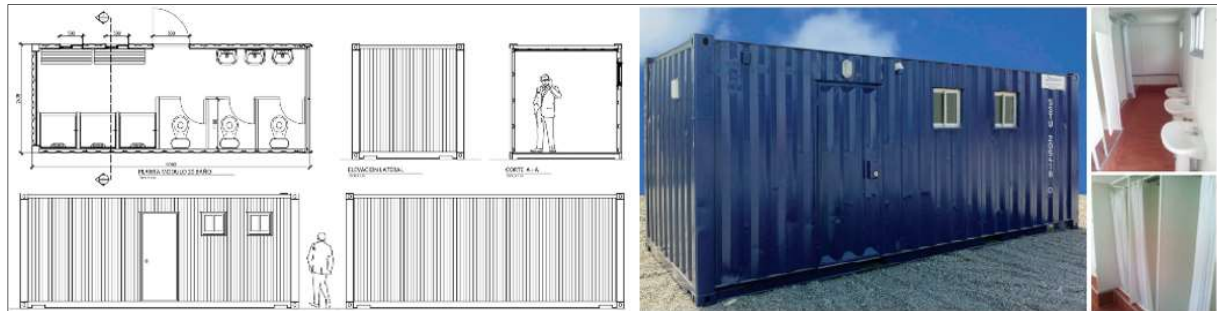
**Photo 3 - Chemical Wc's on Pontoons**

Note that the number of bathrooms and facilities have been calculated considering local regulations as per the envisaged manpower.

The specifications for all sanitary and clothe changing facilities are foreseen as follows:

#### **Shower and Bathroom Containers**

- Principal area: 7 units (Males) + 1 Units (Female)
- Precast Yard: 1 unit
- Steel Yard: 1 unit
- Laboratories area: 1 unit



**Photo 4 - Shower & Bathroom Containers Configuration**

### **Bathroom Containers (female and male)**

- Contractor's area: 2 units;
- Employer's area: 1 unit;
- Engineer's area: 1 unit;
- Subcontractor's area: 1 unit.



**Photo 5 - Bathroom Containers Configuration**

### **Showers**

- Contractor's area: 1 unit;
- Employer's area: 1 unit;
- Engineer's area: 1 unit;
- Subcontractor's area: 1 unit.

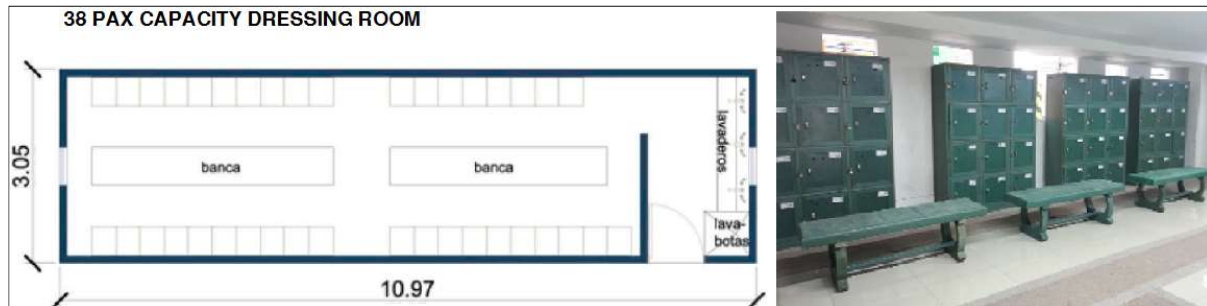


**Photo 6 - Showers Containers Configuration**



### Dressing Room Facilities

- Principal area: 1 unit (female) and 6 units (male)



**Photo 7 - Dressing Room Configuration**

### **3.3 WORKERS ACCOMODATION**

Accommodation for both administrative staff and operating personal has been planned in the city of Machala near to the project area, having in mind the hotel infrastructure and possible houses that will serve for the accommodation of the foreign personal.

### **3.4 PRECAST AND STEEL YARD (CASINGS AND REBAR)**

The below mentioned possibilities shall remain valid for the precast and steel yard and the selection between them will be done depending on the safe implementation of each option and supplier's local availability and capacity;

At this stage, the JV foresees to acquire already assembled steel casings and to stock them on site. Steel Casing shall then be labeled and stocked accordingly before installation. However, the JV can also elect assemble the steel casings on site, for this purpose a full stocking/assembly operation will be foreseen to be installed. Steel plates/coil will be imported, and casings will be rolled, welded, tested and painted on site (the full operation will be executed by a specialized supplier).

With regards to the rebar Steel Yard, the JV intends to assemble a stocking yard where the cut and bent rebar will be stocked before assembly. Nonetheless, the JV also envisages the possibility of acquiring full length steel rebar and executing in situ cut and bend operations followed by stocking before installation.

It is foreseen that the precast elements shall be built off-site by a specialized supplier and brought on site to be stocked. As an alternative, the JV can opt to assemble a full prefabrication yard and manage the prefabrication operation on site.

The following working areas shall be put in place in addition to the steel casing and precast yards:

- In-situ Concrete and Aggregates Laboratory;
- Storage House;
- Mechanical workshop.



### 3.4.1. Steel Casings Yard

Steel casings are planned to arrive directly to Puerto Bolivar Port, once the casings are off-loaded, they shall be taken to the steel stocking yard to be labeled and stocked.

A wooden beam cradle type structure will be laid along the foreseen steel casing stocking areas, the wooden beams being at least 10 cm thick. The wooden beams shall be evenly distributed (every 4-6 m) and be in sufficient number and to avoid deformations. Given the inertia of each pilot (diameter and thickness), the casings shall be superimposed up to 5 layers and wooden beams will be placed between each layer to prevent any damage.



**Photo 8 - Steel Casing Cradle/Rack Configuration**

Wooden wedges shall also be placed between each casing to prevent them from sliding/rolling while stocked and/or when being stacked and or removed from the stack. When lifting a casing, only the corresponding shall be removed so that the adjacent casings remain stable.



**Photo 9 - Steel Casing Stack & Wedges**

The casings shall be stored per length and in accordance with the pile manufacturing program, so that the first casings that will be required are accessible thus avoiding or minimizing the number of handlings and reduce the risk of damage.

Full length steel casings shall be transported by a set made of two dolly and a tractor and delivered to the loading area (temporary jetty or similar facility), this shall be done as per the daily/weekly installation needs. While performing this operation identical precautions as per before described shall be taken to avoid possible damages.



**Photo 10 - Steel Casing Transport and Off-load**

A crawler crane shall load the casings from the loading facility onto transport pontoons (two pontoons are foreseen to be used with a minimum capacity of 400-ton each) to be taken to the piling zone. The pontoons shall be equipped with racks to secure the casings in place during transport. The racks shall be made of wood or steel lined with rubber to avoid damage. The casings shall not be overlaid during transportation.

All casings will be placed in the same direction on the pontoon (part painted on one side only) to facilitate the lifting process on the working front.



**Photo 11 - Steel Casings on Transport Pontoon**

### 3.4.2. Precast Yard

As per what is mentioned in the chapter “Precast and Steel Yards” (§3.4.) above, the precast elements are planned to be built off-site. Once delivered, the precast elements shall be checked for quality issues and labelling accuracy upon arrival and subsequently taken to the precast yard to be stocked.



**Photo 12 - Precast Stock Yard View**

Strict construction and delivery schedules shall be put in place to ensure the necessary rhythm of delivery and guarantee the necessary foreseen stock.

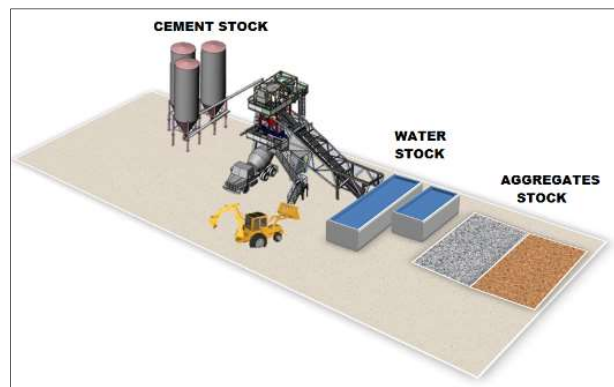
When needed for deck assembly the precast elements will be loaded and transported from the yard to the working areas by trucks per the installation requirements.



**Photo 13 - Precast Beam Transport by Truck**

### 3.5 CONCRETE SUPPLY (BATCHING PLANT)

It is foreseen that concrete supply shall be supplied from off-site batching plants and by one or two different local ready-mix certified concrete suppliers. Nonetheless the JV also envisages the possibility of operating a small on-site batching plant depending on the cement and aggregates availability.



**Photo 14 - On-site Batching Plant Simplified Scheme**

### 3.6 TEMPORARY JETTY

At an early construction stage, the casings will be loaded onto the pontoons from the 30 meters made available by the Employer at the end of Berth 5.



**Photo 15 - Loading Area from Berth 5**

After the casings are installed a temporary loading facility shall be built on top of the already installed piles, estimated from row A to row D, along the first 40 meters Q1. This facility will allow delivery and loading of casings onto the transport pontoons at an early stage of the Quay construction.

This loading facility, 60-meter long stretch, will move North along Berth 6, following the assembly of the permanent deck thus allowing the delivery and loading of casings and all precast parts onto the transport pontoons as well as all other marine works required materials.

## 4 SEQUENCE OF ACTIVITIES

### 4.1 DREDGING

#### 4.1.1. Mobilization & Installation

The vessels will be mobilized from their last location. All can sail on own keel with the exception of the backhoe dredger which will be transported on a semi-submersible transport vessel. The supporting vessels are likely to be chartered locally. The spare parts and all other supporting tools are typically transported containerized. Upon arrival, if required, final arrangements with Local Authorities are made for clearance. Sea fastening will be removed, and the vessels will be prepared for operations.

#### 4.1.2. Procedure

##### In-survey

Prior to the execution of the works, a bathymetric pre-dredge survey will be carried out at the Dredging Area, the Disposal Areas and covering any potential sailing routes, to verify actual (sea)bed levels and volumes.



Photo 16 - Multibeam (left) and typical Survey set-up on board Survey Vessel (right)

The pre-dredge survey will be undertaken, using a survey vessel equipped with DGPS positioning system, multibeam echo sounder, heave compensator and tide gauge. In dry areas, a topographic survey will be carried out using a back-pack DGPS-RTK system. Processed data will be plotted in plan-view drawings as well as cross-sectional drawings.

The in-survey volumes are used to determine the total scope of works, update the planning if necessary and used to determine the monthly progress.

##### Dredging Operations

Join Venture PBO proposes the execution of the dredging works using a trailing suction hopper dredger, as well as a backhoe dredger.

A trailer suction hopper dredger pumps the material from the seabed through its suction pipes and pumps and discharges the materials in its holds. Once the hold is loaded at its maximum level, the suction pipes are brought back onboard, and the dredger will sail to the discharging area. Once at the



discharge area, the bottom doors are opened, and dredged material is released. The material will then settle to the sea bottom.



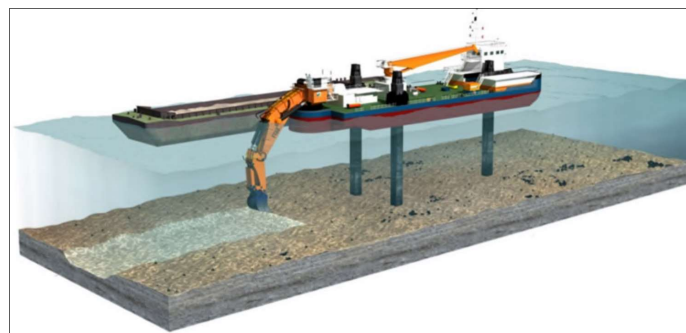
**Photo 17 - Schematic view of a Trailing Suction Hopper Dredger during dredging operations**



**Photo 18 - Medium Sized Trailing Suction Hopper Dredger Lelystad**

A Backhoe dredger is a barge with an excavator mounted on the deck. It is positioned using 4 spuds. The excavated material is dumped into split hopper barges which are moored alongside. Once these barges are filled, they will be towed to the dumping area. At the dumping area, material will be discharged through bottom doors, just as for the Trailing Suction Hopper Dredger.

This dredger will be used for the areas near to land, as well as at greater depths where firm clay is located.



**Photo 19 - Schematic view of a Backhoe dredger during dredging operations**



### Out-survey

After completion of the Works an out-survey, witnessed by the Employer or it's representative is conducted to verify and prove that design levels have been achieved. The data is converted into as-built drawings and submitted for approval, to the Employer or either the dedicated Engineer. Once the out-survey is approved, equipment is demobilized.

### General Measures

The deposit of sediments in the ready Zone must be controlled and the following measures must be complied with:

- The mechanical condition of the dredge must be verified, and no excess flue gas is emitted;
- The deposit will not be made in the high seas area in the months of June to October due to these months, the son of humpback whale transit (*Megaptera novaeangliae*) for its reproduction process;
- No discharge of waste and / or discharges of hydrocarbons from the washing of tanks, bilge water, and in general any other action capable of having polluting effects is required;
- The discharges must be homogeneous at different points within the disposal zone, avoiding the formation of a background threshold that can alter the currents;
- Signal the sediment disposal area at sea;
- Keep track of the volume deposited in the high seas area.

## 4.2 DEMOLITIONS

Several structures will be demolished and removed from the site for the construction of the Expansion of the port of Puerto Bolívar, namely:

- The catwalk and the dolphin north of Berth 5;
- The naval base jetty and related structures, north of Berth 5;
- And Other smalls structures onshore.



**Photo 20 - Structures to be Demolished**

Two types of demolition procedures shall be adopted, namely:

- For items i. and ii. above, demolition shall be done by cutting with diamond thread;

- For items iii. and iv. above, demolition shall be done by using a pecker equipped excavator.



**Photo 21 - Demotion Type Location**

The following demolition procedures explain both methods:

#### 4.2.1. Diamond Thread Cutting System

The system consists of a hydraulic equipment that entails a set of devices (hydraulic unit, head, pulleys, rail and accessories) that guide a 10.5 mm diameter steel cable and has alternating discs with diamond inlays (sintered pearls). Due to the driving force of the equipment, tension, translation and speed are applied to the cable in friction with reinforced concrete elements, in such a way that it can cut them.



**Photo 22 - Pulley system and accessories**

##### 4.2.1.1 Resources

###### **Personnel:**

- Site engineer;
- Health& safety manager;
- Worker;
- Equipment operator.

###### **Equipment:**

###### **Drilling System and breakers**

- Hammer combined;
- Combined rotary hammer.

###### **Diamond Perforation System**

- Water tank;
- Diamond.

#### **Cutting System with Diamond Thread**

- Thread cutting system;
- Tool Set;
- Cutting saw with thread;
- double pole with stand.

#### **4.2.1.2 Procedure**

I. The Labor Supervisor will verify that the water intakes and distribution hoses are in good condition.

II. The Work Supervisor will instruct the equipment operator and his assistant to open the valves of the cooling water verifying that at the cooling points the water flow is suitable.

III. The hand tools must be tied with ropes to the wrists of the operators and in addition, it must be verified that the scaffolds have skirting boards throughout the perimeter of the work platform.

IV. The installation of the DS WS15 equipment includes the anchoring of directional pulleys. For this end perforations with TE-30 rotary hammer and carbureted drill bits will be made; the rotary hammer must have dielectric insulation, sockets and sockets must be inspected cables and personnel must be trained in the use of rotary hammer and must have particle protection mask and hearing protectors.

V. The installation of the diamond wire in the equipment will be carried out by the operator and his assistant wearing leather gloves. The equipment operator must verify that the length of the thread diamond is adequate to cover the entire length of cut. Verified thread length diamond the operator will place the connectors using a manual press.

VI. The team operator and his assistant will enter the work area with his team personal protection to make a final verification of the feeding location of the equipment, cooling water hoses, directional pulleys, wire position diamond and head are appropriate. This verification will be done with the equipment disconnected from the power source (440 V generator set), it must also be verified that all equipment start switches are turned off.

VII. The Labor Supervisor must verify that there is no person at a distance less than 3 m. of the cutting equipment. The entire perimeter of the scaffolding around the concrete wall with safety tapes to prevent the transit of people below the cutting area (surrounded by scaffolding).

VIII. The Work Supervisor will instruct the operator to activate the cutting equipment by means of the control remote in order to perform a test of the equipment in progress for 3 minutes, verifying that the equipment components work smoothly (pulleys, diamond wire, head).

IX. The Labor Supervisor will make the final verification that there are no people close to the area of work and then give the indication to the operator of the equipment to start the cutting of the block of reinforced concrete.

X. During the team's cutting work, the entry of people outside the task will be restricted within the work area. Additionally, the access of any person will be restricted (including Supervisors, Work Supervisor, Operator and Operator Assistant) to 3 m. around the team.

XI. The only persons authorized to intervene in the work area of the cutting team are: Work Supervisor, Equipment Operator and Operator Assistant prior authorization of the Work Supervisor.



**Photo 23 - Operator Assistant in the work area**

XII. When necessary to enter the work area, less than 3 m from the cutting equipment, with in order to relocate the cooling hoses, accommodate the position of the pulleys, place steel wedges and / or any type of intervention less than 3 m. of the cutting equipment, the person responsible for the intervention will minimize the revolutions in the cut and communicate to the task staff so that it performs the work with caution and constantly coordination.

XIII. Concluded the intervention of authorized personnel in the work area less than 3 m. of the team, the staff will proceed to remove their tools, equipment or materials used and communicate to the Labor Supervisor the end of his activities.

XIV. The Work Supervisor will inform the area staff about the end of the intervention and this will carry out a final inspection and verification that everything is risk free and the person who intervened in the work area has not left tools and / or equipment that can represent dangers when re-energizing the cutting equipment.

XV. If the work remains unfinished during the day, the teams will be left with a card “Out of Service” in the boot system, indicating on the reverse the risk at which exposes when activating the equipment. if, on the other hand, the work has already been completed, the cut element will be removed by lifting operation.



**Photo 24 - Lifting maneuvers.**



#### 4.2.2. Pecker Equipped Excavator and Demolition Hammers

The system consists of a hydraulic excavator equipped with a hammer tool and some compressor equipped with pneumatic hammers, to dismantle or eliminate structures which have already fulfilled their useful life or need to take advantage of the space where it is built for a new project or construction. In this case there is an advantage that is a controlled demolition provided that the relevant care is taken and the appropriate techniques are used knowing the key weaknesses of the structure.



**Photo 25 - Pecker Equipped Excavator and Pneumatic hammer**

##### 4.2.2.1 Resources

###### **Personnel:**

- Site engineer
- Health& safety manager
- Worker
- Equipment operator

###### **Equipment and Tools:**

- Excavator
- Pneumatic hammer for excavator
- Pneumatic hammer
- Compressor
- Shears
- Manual tools

##### 4.2.2.2 Procedure

I. Inspect the work area before starting work, which must be totally free of water-oil, oil and any type of sludge or chemical substance. Otherwise, the executor must immediately inform the issuer, be it the area owner, operations personnel or the technical agency, in order to treat this crude, or chemical substance found in the area. The sludge and sewage that may exist in the septic tanks to be demolished must have been previously cleaned, treated and disposed of as established in the environmental guidelines.

II. Demarcate the work area with danger tape or demarcation of the demolition area.

III. Before, during and after each activity, you must confirm the physical condition of the people to prevent the occurrence of accidents.

IV. Clean the work area to eliminate or control objects on the floor and avoid slipping or tripping. Perform spraying, felling, and removal if necessary.

V. Stop activities when heavy rains and thunderstorms occur.

VI. Replaced the area to start demolition work.

VII. The pre-operational check of all the equipment and / or tools used will be carried out, verify before they start the activity their proper functioning, if at the time of carrying out the work the conditions in the task analysis of the activity, will be disclosed to staff.

VIII. Identification of the type of equipment to be used to demolish.

IX. The demolition may be executed using the following equipment; compressor with pneumatic hammer and / or excavator with demolition hammer, polisher, hand tools, power tools, etc. The demolition of concrete structures through the use of the compressor, pneumatic hammers, excavator with demolition hammer, will be carried out like this, once the pre-operational of the equipment and tools is carried out and if the electrical certificate issued by the electrical specialist with card is required current professional.

X. The pneumatic compressor, excavator with demolition hammer are switched on. It should be noted that the operator of the equipment and the guide must have ear and cup protection, mask for articulated material, helmet, boots, glasses and safety clothing.

XI. If the compressor is used, it must be located on a stable and level surface. The operator will firmly hold the hammer control, which by percussion will penetrate the concrete structure with its tip to the point of completely demolishing it.

XII. If the excavator is used, the area must be cleared for its operation, it is necessary to have a person who serves as an operational watchman who must be in communication with the equipment operator so that in case of emergency the activities are suspended.

XIII. Once the concrete has been demolished, it is necessary to cut the existing rod using a polisher or shear.

XIV. It should be noted that during the development of the activity the workers must have hearing protection of insert and cup if necessary, mask for particulate material, helmet, boots and safety clothing, face shield, gloves and breastplate. Likewise, the operator of the pneumatic hammer must make temporary rest breaks of 10 minutes for each hour worked or according to physical capacity, this rest includes the complete shutdown of the equipment to mitigate the impact of noise exposure.

XV. The operators of these equipment and machinery must be trained, qualified and competent to handle them. The presence and proximity of workers close to the field of action of the equipment and / or machinery will not be allowed on the risk of projection of particles, blows, entrapments, and even death.

XVI. Partially, the material resulting from the demolition (debris) will be located in an area adjacent to the operation. Civil works assistants, by means of minor tools such as shovels and wheelbarrows, will collect the resulting material and deposit them in the area duly indicated as provisional collection of debris.



XVII. The worker, through the minor tools mentioned above, proceeds to the demolition of the concrete; you must wear permanent safety glasses, as well as masks for participating material.

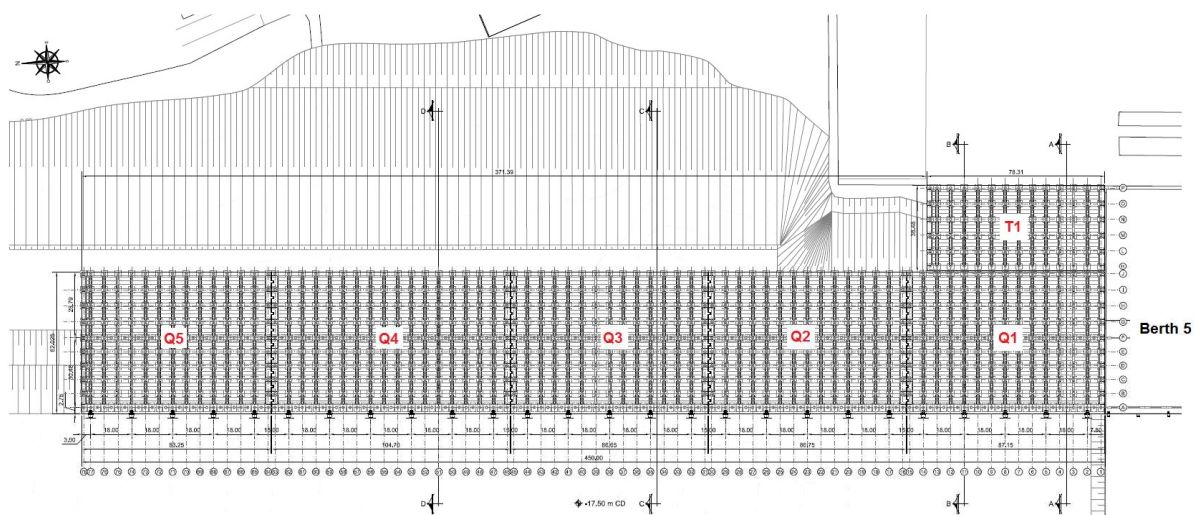
XVIII. Once the demolition work is finished, the area is cleaned.

### 4.3 DECK ON PILES

The deck-on-pile solution consists in the construction of a reinforced concrete deck that will be supported by deep foundation (steel casings) (piles). The deck will be made of:

- Precast pile caps;
- Precast longitudinal and transversal beams;
- Precast slabs (set on the beams);
- A cast-in-situ compression slab.

Provided deep foundation is made of steel driven casings (piles). Casings will be driven to the required depths per the JV's Design.



**Photo 26 - Deck on Pile Layout**

The connection with the deck is ensured by precast concrete pile caps which will be placed on top of the piles. The connection between precast elements shall be done by means of cast-in-place concrete.

#### 4.3.1. Safety & Environmental Requirements

Due to project characteristics and location, special care on safety and environmental issues during design, planning, installation and operations shall be adopted.

Safety and environmental specific requirements are not the object of this documents and shall be developed at a later stage and in depth after award. For this purpose, special dedicated chapters on safety and environmental issues during piling shall be included in the safety manual.

These chapters shall be developed with the participation of all involved individuals from the design stage and planning phases up to the final stages of installation and operation of the system (s).

#### 4.3.1.1 Safety

Platforms and guide frame unit(s) shall be designed to ensure maximum safety to all personnel involved in the operations. Access and egress ways including stairs and handrails shall be included.

The following safety guidelines shall be adopted:

- Detailed safety and evacuation plan to be understood by all authorized personnel working on the piling;
- Only authorized and trained personnel shall access to the platforms and deck;
- Individual safety protection equipment shall be used always by all personnel;
- All accidents and incidents shall generate a revision in the safety plan;
- Pre-job meeting for the involved personnel shall be included at the shift start and for all shifts;
- Organization and order must be predominant in all working areas;
- Periodical inspections on all structures and equipment shall be planned, scheduled and performed timeously, extraordinary inspections shall also be enforced;
- Pre-determined check-lists shall be verified and recorded prior every platform or crane move between spans;
- Pre-determined check-lists shall be verified and recorded prior to the start of any activity on the piling frame.

#### 4.3.1.2 Environmental

All personnel allocated to the project, from design to construction stages, shall be compliant with Environmental Company Policy and Project Plan, namely:

- Pollution Prevention Plan;
- Waste Management Plan;
- Noise Management Procedure;
- Spills Response Procedure;
- Ecological Monitoring Procedure.

Personnel involved in the construction shall be trained to all the above mentioned HSSE matters.

#### 4.3.2. Piling Methodology

The piling broad methodology shall be as per below:

- The quay deck shall be built using movable platforms on top of the previously installed casings (piles) as well as the adequate crawler cranes and piling frames;
- The cranes shall be able to crawl and turn while operating on top of the movable platforms;
- The working loads shall be bear by the platforms/piles.

#### 4.3.2.1 Casing Transportation

Transportation from the stock yard to the loading area shall be done by a set 2 dolly and 1 tractor.



**Photo 27 - Full Length Casing Transport Detail**

The casings shall be delivered directly to the casings loading area initially at Berth 5, to be either installed directly from its deck (in the case of the first casings to be installed) or at a later stage loaded onto service pontoons (while casing is to be installed from moving platforms) to be subsequently delivered directly to the pile driving platforms.



**Photo 28 - Full Length Casing Tandem Lifting Detail**

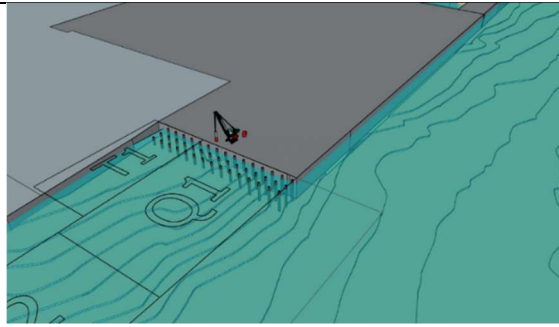
These operations shall be executed in accordance to the schedule and progress of the works.

Allowance for additional length will be made for the first casings to be installed. Welding is foreseen in case casings need to be increased in length.

#### 4.3.2.2 Casing Driving from Berth 5 & Moving Platforms

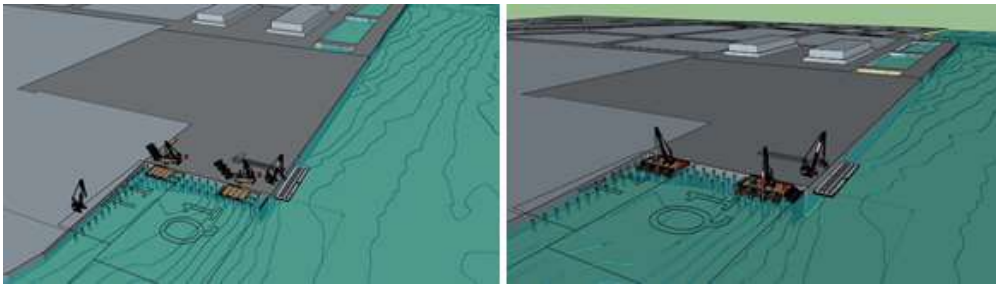
The full number of piles along the Quay and for the Terminal Platform extension are to be installed the following way:

1. Initial piles will be installed from Berth 5 and from land using vibrators for pile pitching and driving down to the casings to a suitable depth. Driving then follows in the more competent soils by using hydraulic hammers;



**Photo 29 - Full Length Casing Tandem Lifting Detail**

2. Movable fixed 4-stage platforms will be assembled on top of the initial piles.



**Photo 30 - General View of Moving Platforms**

These platforms will consist of 4 movable platforms set parallelly side by side with variable single-level driving guides (6 to 8) specially developed to the design/grid layout.

250ton cranes will be placed on the platforms and execute the piles by using vibrators type ICE 12/14 for pile pitching and driving down to the suitable depth followed by pile driving using hydraulic hammers type IHC S-150 to enable reaching both the required depth and the pile bearing capacity;

3. After the piles are driven to refusal and their cut-off to the right level is made, the crane will move and travel between platforms displacing all the guide frames, tools and supporting equipment into their required position as per depicted below;

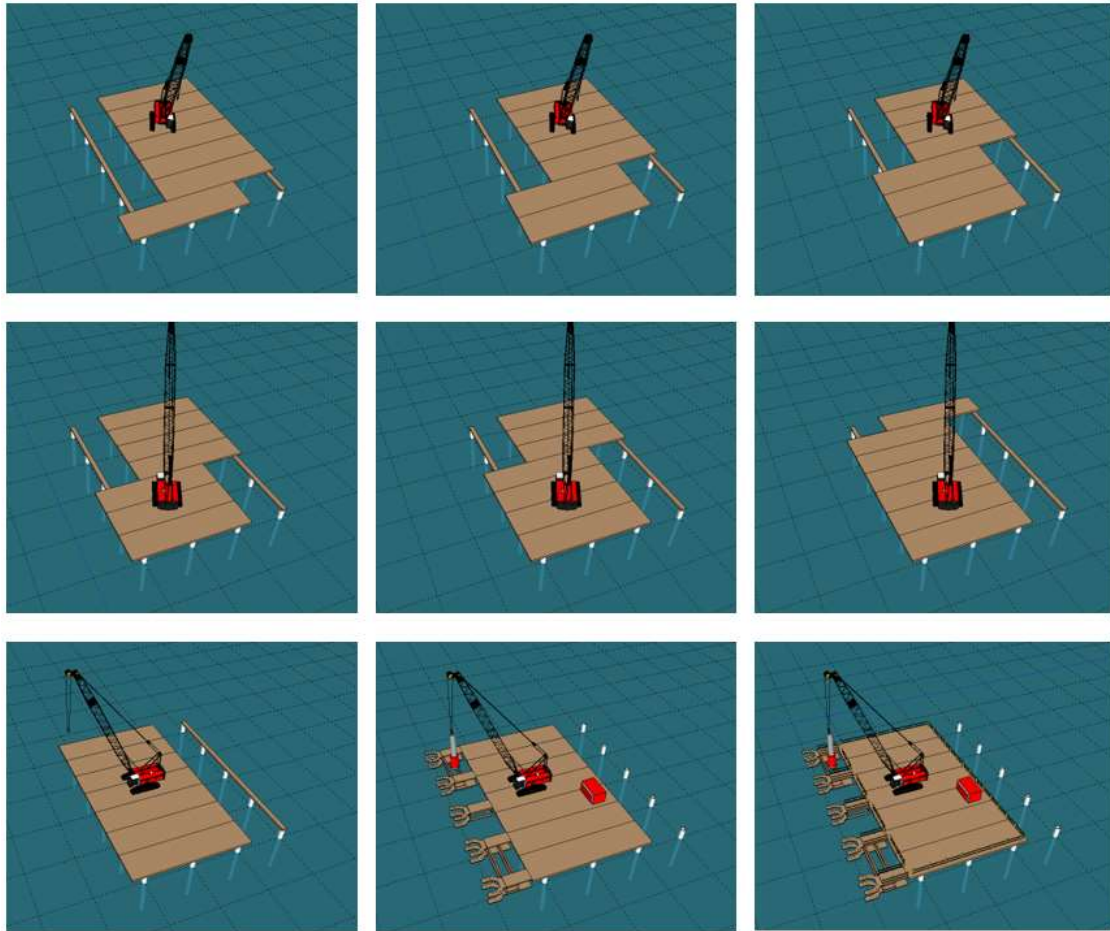


Photo 31 - Moving Platforms Displacement Principles

#### 4.3.2.3 Pile Testing

Dynamic load testing shall be done along casings driving through PDA pile testing. Special attention shall be granted to eave phenomenon and casing re-driving together with testing to ensure pile foreseen bearing capacity and limit settlement.

#### 4.3.3. Scour Protection Installation

As per BF1842-0400-1004 Volume IV, vessel data at Berth 5 and Berth 6 has been established as per the following:

- Berth 5: Maersk Kowloon (50,000 dwt);
- Berth 6: 167,000 dwt (19,224 TEU).

A Concrete Mattress system solution is proposed for the slope and scour protection, the preselected system for the project is defined as follows:

- **CT 220mm** Constant Thickness Mattress (Incomat) under permanently immersed areas in horizontal sea bed. 220 mm average thickness of C24/30 micro concrete. 65 mm Ø Weep holes. Mattress panels fabricated to suit scour protection.



- **CT 150mm** Constant Thickness Mattress (Incomat) under permanently immersed areas in slope protection. 150 mm average thickness of C24/30 micro concrete. 65 mm Ø Weep holes. Mattress panels fabricated full slope length and to suit pile configuration. These areas is subject to propeller action and bow thrusters during berth and unberthing.
- **OH 220** mm in tidal areas. OH220 Constant Thickness Mattress (Incomat) 220 mm average thickness of C24/30 micro concrete. Weep holes 65 mm Ø @ 1 m C/C positions. Panels rolled out and zipped between piles. The upper section, exposed to wave action, is an open-hole mattress (OH220) for increased permeability to allow for effective wave rundown.

Design methods are available supported by case history performance. The combination of in-situ concrete mattress with a rock falling edge apron to the perimeter provides an effective combination for slope protection under piled quay structures. Flex mattress concepts will also be analyzed during the detailed design stage.

The detailed design will provide further details on the use of this solution. Final specification of the concrete mattresses is subject to modification.



Photo 32 - Concrete Mattress OH (LEFT); Pile protection example (RIGHT)

#### 4.3.3.1 Mattress Installation

In-situ concrete mattress for scour protection purpose shall be installed before deck construction, nonetheless concrete mattresses can also be installed after deck installation is concluded, this allows the possibility for damage repairing and/or mattress upgrade during the quay life span, otherwise very difficult or even impossible when other systems are used.

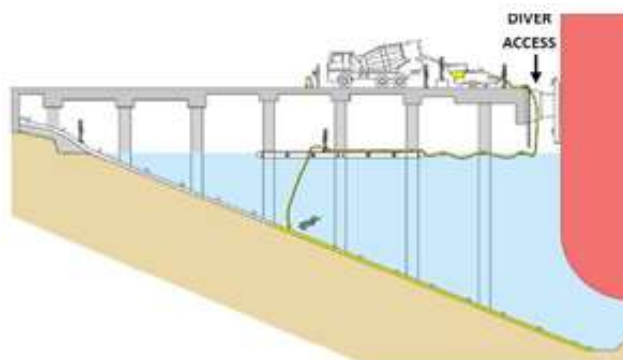


Photo 33 - Mattress filling while Moored Vessel

Panels of mattress fabric are pulled out to each bay, fixed around piles and zipped to neighboring panels. A construction method from the top of the deck is preferred, mainly to reduce the project delivery time, but the concrete mattresses can also be installed even with moored vessels in case of early operational scenarios.

#### 4.3.3.2 Maintenance Dredging Suitability

Maintenance dredging over concrete mattress can be undertaken by controlled suction dredging, jetting or suction dredging without damaging the concrete mattress.

Water injection pumping can readily be used on the in-situ concrete mattress as the system is sealed to resist high velocity jetting. Suction dredging should be controlled to not exceed the deadweight of concrete mattress panels and to not disturb the rock edge.

Dredging by excavator, clamshell or cutter suction dredging are not advisable due to the risk of mattress damage.

- A minimum mattress thickness of 200mm is recommended for the areas where dredging works may be executed;
- A minimum mattress thickness of 150mm is suggested for the areas where maintenance dredging is unlikely.

#### 4.3.4. Quay Deck Construction

##### 4.3.4.1 Precast Elements Construction

Most part of the concrete structure is composed of precast elements. These precast elements (beams, deck slab, pile plugs, etc...) will be manufactured off-site by a specialized supplier, based on drawings and concrete formulation as per design specifications.



**Photo 34 - Precast Construction Details**

##### 4.3.4.2 Precast Elements Installation

The assembly of the precast elements will be carried out by a 250ton crane working from a movable fixed platform (like the pile driving fixed platform) The precast elements will be transported on a barge and placed directly in their correct final position according with a logical assembly sequence.

The crane will start by installing the pile caps from the forward side of the platform (towards the pile driving platform). Grout injection will be carried out from an independent moving grouting plant placed on a small pontoon.



**Photo 35 - Pile Plug Installation Detail**

The installation of the remaining precast elements, transversal and longitudinal beams and pre-slabs will be done from the backward side of the platform (facing opposite side from the piling platform).

The installation sequence will be the following:

1. Beam installation shall be done taking special care of the support points on the pile caps.



**Photo 36 - Beam Installation Detail**

2. After beam installation is concluded, the “pile cap/beams” steel connection and formwork shall be prepared, and inner beams/nodes concreting shall follow.



**Photo 37 - Cast in Place Concrete for Beams/Nodes**

3. Following the conclusion of the “pile cap/beams” connection concreting the deck precast slabs shall be installed on top the beams taking special care to the curing required time.



**Photo 38 – Precast Slabs Placing**

#### 4.3.4.3 Compression Slab

The deck construction shall follow by placing and fixing construction rebar and in parallel all required ducts and niches for electrical network, drainage, crane rails, crane anchoring and end-rail stops and bollards on top of the precast slabs. The assembly of formwork shutters shall follow and concreting will start by use of a crane and a strategically placed stationary concrete pump.

The ready-mix concrete shall be supplied from a local ready-mix plant, based on a previously approved concrete mix, and the concrete will be transported by means of mixers to the stationary pump.

#### 4.3.5. STS Rails Installation

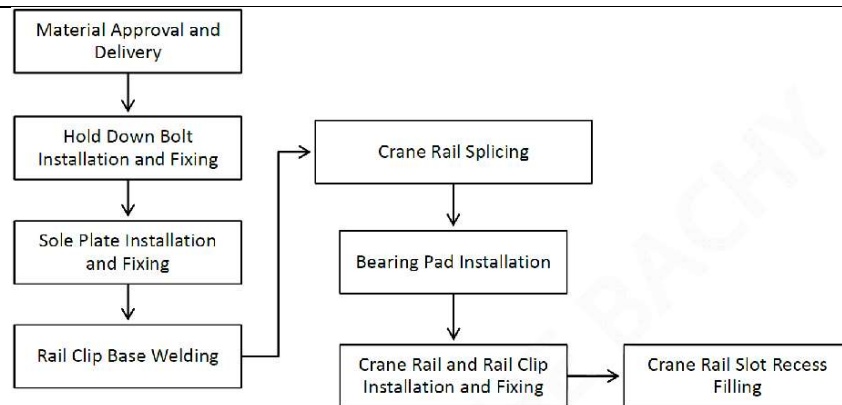
##### 4.3.5.1 General

Crane Rail installation works pertains to the provision and installation of steel rails at constructed crane beam foundation including its necessary accessories and fixtures to its design specifications, alignments and levels.

One (1) pair of 450-meter-long crane rail spaced 30,48m apart for the quayside STS Gantry Crane will be supplied for this Project.

The main works involved in the crane rail installation are as follows;

- Sole plate and anchor bolt installation
- Rail and rail clip installation
- Crane slot recess filling



**Photo 39 - STS Crane Rail Installation Flow Chart**

#### 4.3.5.2 Sole Plate and Anchor Bolt Installation

Prior to the carrying out of concrete casting works for crane beam foundations, the hold down bolts of the crane rail system are embedded. This is done using a temporary template to hold and support the bolts into position. The alignment and level of the bolts and template are properly fixed and stiffened to avoid any movement during concreting. After concrete casting of the crane beam foundation is completed, the template is carefully removed for use at the next foundation. The bolts, as necessary, are barricaded and protected from being damage.

Based on the programmed schedule of works, the installation of the sole plate is carried out; the sole plate has been fabricated with holes the size and spacing of the previously installed hold down bolts and is of discontinuous type. The plates are laid and inserted to the bolts and its level adjusted by means of the hold down bolt screws. After the sole plate alignment and level are fixed, a pre-approved high strength grouting material is injected between the concrete beam foundation and the sole plate for bonding.

#### 4.3.5.3 Rail and Rail Clip Installation

The crane rail installation proceeds after the sole plate installation is completed.

Pre-approved steel rails are delivered to the site and readied for installation. The installation is done by first cleaning the surface of sole plate and making sure that no deleterious materials remains. The bases of the crane rail clips are thereafter fixed to the sole plate by full welds, the upper part which will hold the rail are installed later.

After the welding of the crane rail bases are completed, steel reinforced resilient bearing pads are laid inside the space between the rail clip bases. The pads are properly aligned and leveled prior to the installation of crane rails.

Subsequent to its installation, the crane rails are spliced to cover an entire length of rail installation area currently prepared. It is laid above the bearing pad and fixed into alignment by rail clips inserted through the hold down bolts of the rail.

The process is repeated until all rails and clips are installed in accordance with the construction drawings and design specifications. During the installation work, it is constantly monitored by



instrumented survey to maintain that all required alignment and levels are within the allowable tolerable limits.

#### 4.3.5.4 Crane Rail Slot Recess Filling

After the completion of rail installation, the rail slot recess is filled with pre-approved materials to reduce the recess gap and achieve an acceptable low impact from crossing vehicles.

Accordingly, the crane rail installation works will be in accordance with the construction drawings and design specifications and comply with all the safety, environmental and quality plans being implemented for the Project.



**Photo 40 - STS Crane Rail Slot and End Stop**

#### 4.3.6. Quay Furniture

After the compression slab concreting is concluded, fenders, bollards, ladders, barriers and other elements will be installed or other either from land or from a barge depending on the element by using cranes and/or other suitable resources.



**Photo 41 - Fender and Bollards Installation Details**

#### 4.3.7. Site Clearance and Preliminary Earthworks

Excavation, loading, transportation and dipping on the different areas shall be carried out at several work locations, per the schedule and as per what is described in the technical specifications.

The following construction processes will apply:

- Project zoning and definition of elevations shall be done through topographic measurements, transferring to the ground, through staking, the project alignments and levels.
- Site clearance, if verified necessary, can entail, cleaning and removing all local flora, in such a way that the surface shall be fit for purpose within the whole of the project area.
- Excavation and soil selection: Cutting and excavation shall be done considering the existing ground levels and the final required project levels. The ground that is below the required project levels will be filled in with selected soils and the ground that is above the project levels will be cut and excavated.
- During the cut and excavation, soil selection will be done according with the following:
  - ✓ Soils suitable for filling;
  - ✓ Soils not suitable for fill that will be disposed of to an offsite dumping facility.
- Suitable soils shall be transported by dumper trucks to the designated fill areas, the soil is offloaded, spread using bulldozer and motor grader and finally compacted by layers by compactors/steamroller



**Photo 42 - Cutting, Loading, Extended and Compacting Activities**

#### 4.4 SOIL IMPROVEMENT

According to the foreseen soft soil current and final thickness, our design will require that soil improvement techniques need to be executed to improve the soil-bearing capacity and to account for liquefaction under seismic conditions. According to our preliminary design the soil improvement techniques are the following:

- Onshore: Dynamic Replacement
- Offshore: Cutter Soil Mixing

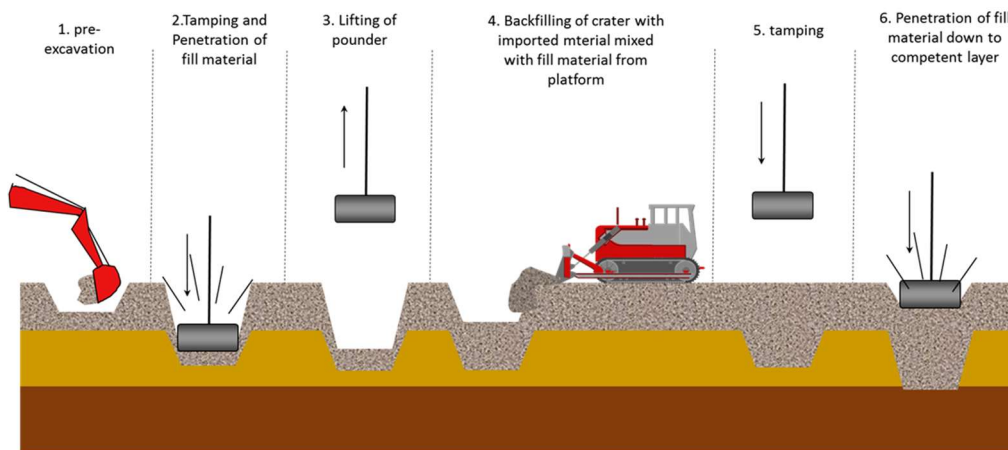
##### 4.4.1. On Shore Soil Improvement (Terminal Areas)



**Photo 43 - Dynamic Replacement Execution**

The Dynamic Replacement (DR) columns are formed by a heavy pounder with a weight ranging from 15 to 30 tons drops from a height ranging from 10 to 30 m on a 0.6 to 1.2 m thick working platform prepared on the construction site using non-cohesive soil. A single column is formed by a few series of pounding. Large diameter (1.6 to 3.0 m) columns are driven to a depth ranging from 4 to 7 m.

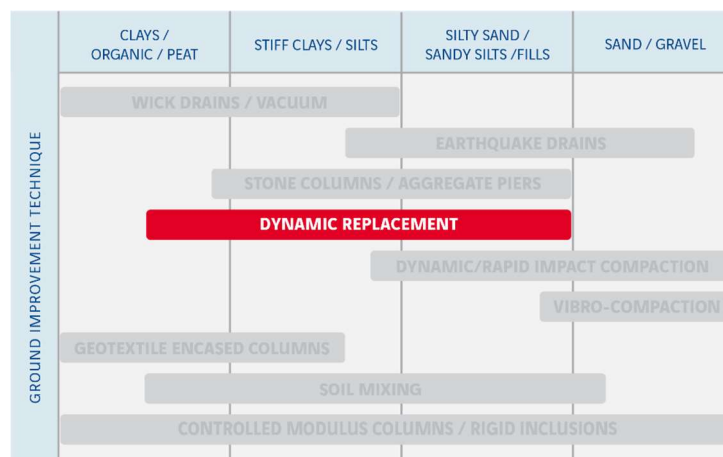
Following the installation of DR columns, the “ironing phase” is executed where the working platform and the top layer of soil is compacted. This process is normally performed by using a flat-shaped pounder with a square base. Single pounds are performed side by side at a distance equal to the external dimension of the pounder base so that the whole improved surface area is covered. Finally, classic compaction with the use of heavy vibratory rollers is conducted to complete the soil treatment.



**Photo 44 - Dynamic Replacement Execution Process**

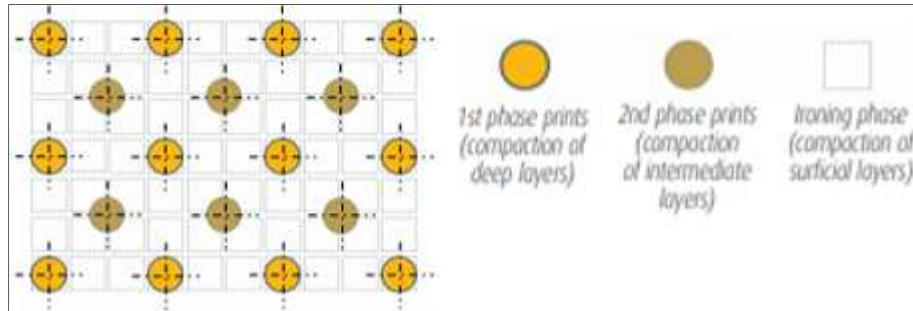
DR columns can act as piles with an extended head for stabilization of road or rail embankments where the columns improve the stability and increase the safety factor of the embankment. These columns are also successfully applied to reduce the foundation settlement of commercial and industrial buildings and to stabilize landfills.

DR columns can be constructed both in loose non-cohesive and firm soils, soft cohesive soils as well as in organic deposits. Natural aggregates, concrete rubble, crushed asphalt and construction rubble can be used to form the DR columns.



**Photo 45 - Dynamic Replacement Technique Suitability**

The parameters of the treatment such as spacing between impacts, number of drops per location, number of compaction phases, are usually confirmed on site during the pilot test area (calibration zone) that can include confirmatory testing such as weight penetration tests, global settlement measurement and in-situ testing. Dynamic Compaction is performed in phases until the achievement of design requirements, usually requiring several compaction phases with a final ironing phase of lower energy high density drops.



**Photo 46 - Dynamic Replacement Typical Phasing**

### **Benefits**

- Enhanced bearing capacity.
- A reduction in the total and differential settlements.
- An increase in the permeability allows acceleration of anticipated settlements.
- Ground bearing foundation solutions can be adopted reducing the need for reinforced foundations.
- The displacement process creates no spoil.

#### **4.4.1.1 Resources**

### **Staff**

- Engineer.
- Foreman work.
- Safetyman.

### **Personnel**

- Operator crane.
- Helpers.
- Operator excavator.
- Welder.
- Mechanical.

### **Equipment**

- Crane 80 ton or similar + Mass \*
- Excavator 20 Ton.
- Bulldozer 20-30 Ton.

(\*) For the construction of the Dynamic Replacement Columns (DR or also called 'plots'), a service crane of between 80 and 150 tons is used, equipped with a hexagonal mass of between 10 and 16

tons, which is exchanged for a light dough for ironing. The construction of the plots requires, as auxiliary equipment, an excavator and a front loader.

The masses, which are commonly used, are made of steel, generally of hexagonal section, and of "punching" geometry to be able to direct the energy directly on the column that is constructed.

### **Material**

The material used for the making of the granular piles be selected every project in function of the local availability. In general, it is of granular type without select (fines percentage < 15%). However, we have made a great number of projects with a lot variety material among which include debris material (dimensions between 400-600mm).

#### **4.4.1.2 Procedure**

##### **i. Preliminary.**

It should have a work platform that must be flat, horizontal, drained and stable so that all the movements of all the machines that will intervene in the dynamic replacement (material gondolas, cranes, front loaders and excavators), are carried out, in any moment, safely and free of all obstacles on the ground. It is advisable to have a geotextile that functions as a separation layer between the materials that make up the natural terrain and the granular filling of the new work platform, this in order to prevent the thickness of the new platform from decreasing due to the penetration of the latter in the natural terrain.

##### **ii. Calibration.**

A calibration will be carried out for the construction of each plot before starting the series work. As a recommendation, it is suggested that the sea calibration zone of 25.0 x 25.0 m, in order to optimize the following parameters, depending on the behavior of the soil:

- Execution logistics.
- Mass drop height.
- Number of strokes per plot.
- Energy.
- Volume of material to be incorporated in each plot.

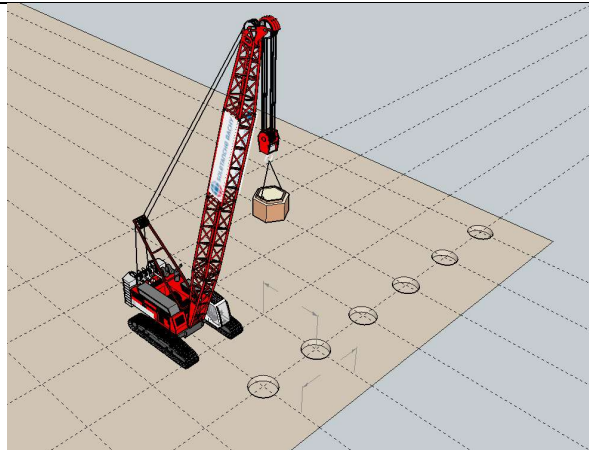
Calibration zone (test zone), the following parameters are taken into account:

- Representative location (suggested area of 25.0 x 25.0 m).
- Free access.
- There should be no vegetation or obstacle.
- Stable work platform at least 1.50 m above the water level.
- The location of the four corners (grid).
- Sufficiently far from a sensitive construction or structure.

Subsequently, during the production process, adjustments to the parameters can also be made depending on the behavior of the filler material and the energy applied.

##### **iii. Location reference plots.**

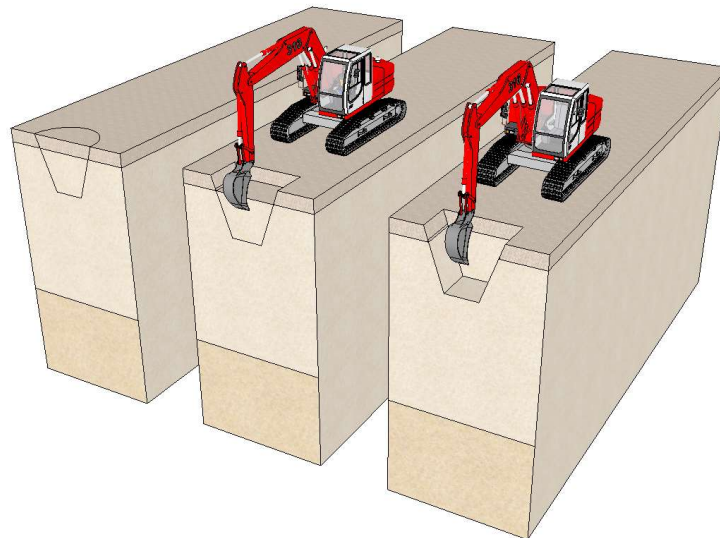




**Photo 47 - Dynamic Replacement Plots Referencing**

The Project Manager / Team Leader will instruct the surveyor to location reference within the area where he is going to work. The surveyor then draws sections within the work area by locating reference points in a given area; subsequently, the location of the plots that are within the area delimited by the references is plotted with the help of a tape measure.

**iv. Pre-excavation.**



**Photo 48 - Dynamic Replacement Pre-excavation**

Depending on the behavior of the soil it will be necessary or not to carry out a pre-excavation, up to the depth of the project or as far as the soil allows. Once the pre-excavation is done, some granular material is added in order to start the construction of the plot.

## v. Plot Construction

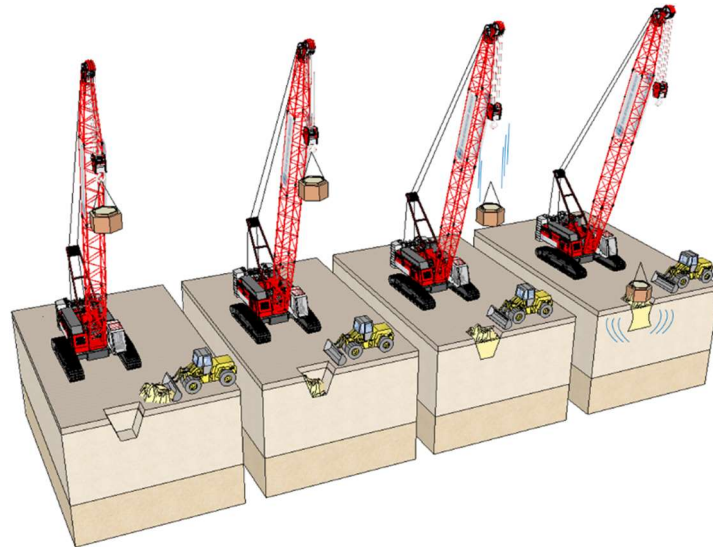


Photo 49 - Dynamic Replacement Construction Sequence, #1

The operator positions the mass on the point of the element to be built, and then proceeds to plot from the work platform level.

The operator lifts the mass to the defined height and drops it to the center of the plot. This is repeated several times in order to insert the granular material into the soil to the desired depth and compact it. As the granular material is compacted, and it penetrates the ground, more material is added, in order to complete the column up to the work platform level. Occasionally, if the walls of the excavation are unstable, the necessary material may be added to fill the pre-excavation and achieve containment, and then compact the latter with sufficient blows given by the mass. The input material is transported with the help of a front loader.

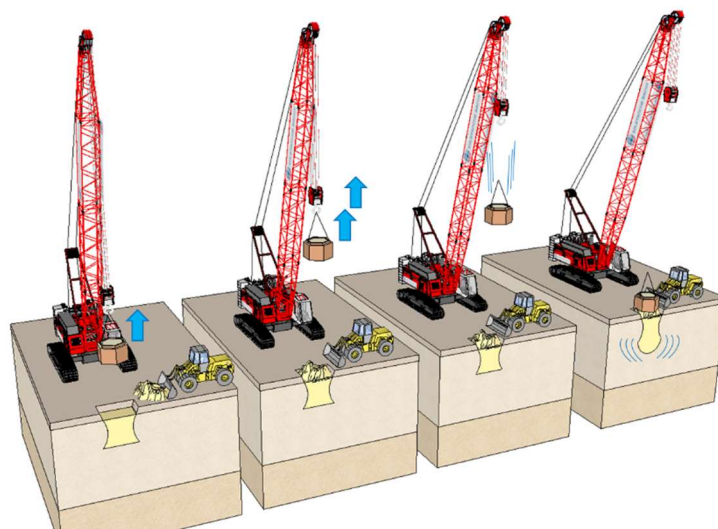


Photo 50 - Dynamic Replacement Construction Sequence, #2



**Photo 51 - Dynamic Replacement Ironing Stage**

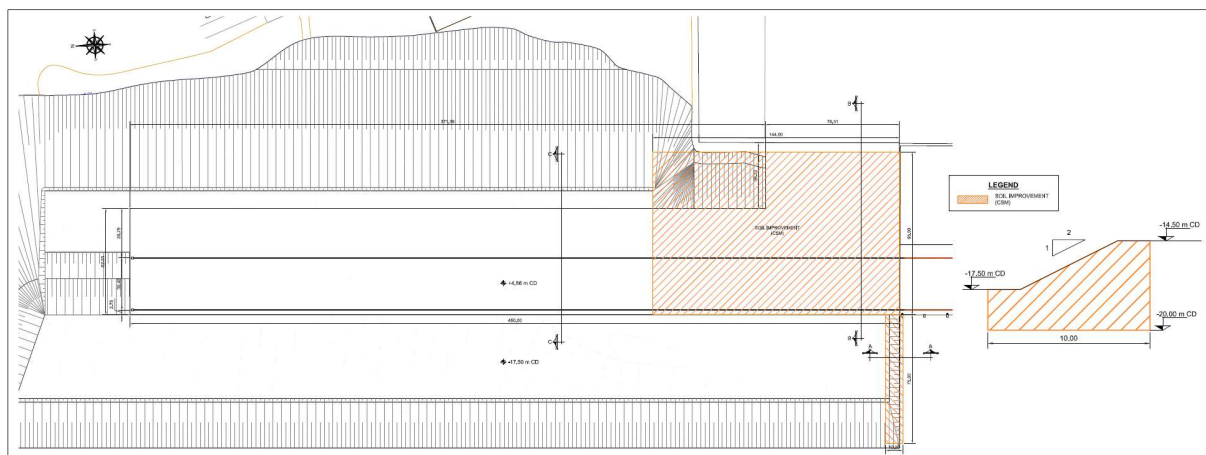
At the end of the dynamic substitution, you should hit on the area that has already been treated, which consists of hitting the entire surface with a light mass (hit mass) and thus terminating the treatment.

#### 4.4.2. Off Shore Soil Improvement: Q1/T1 & Q2 (Slope Stability)

Cutter Soil Mixing Technology (“CSM”) was developed by the SOLETANCE BACHY GROUP and other partners in 2004. The CSM soil improvement technique has now been in operation for 15 years with excellent results both technically and economically.

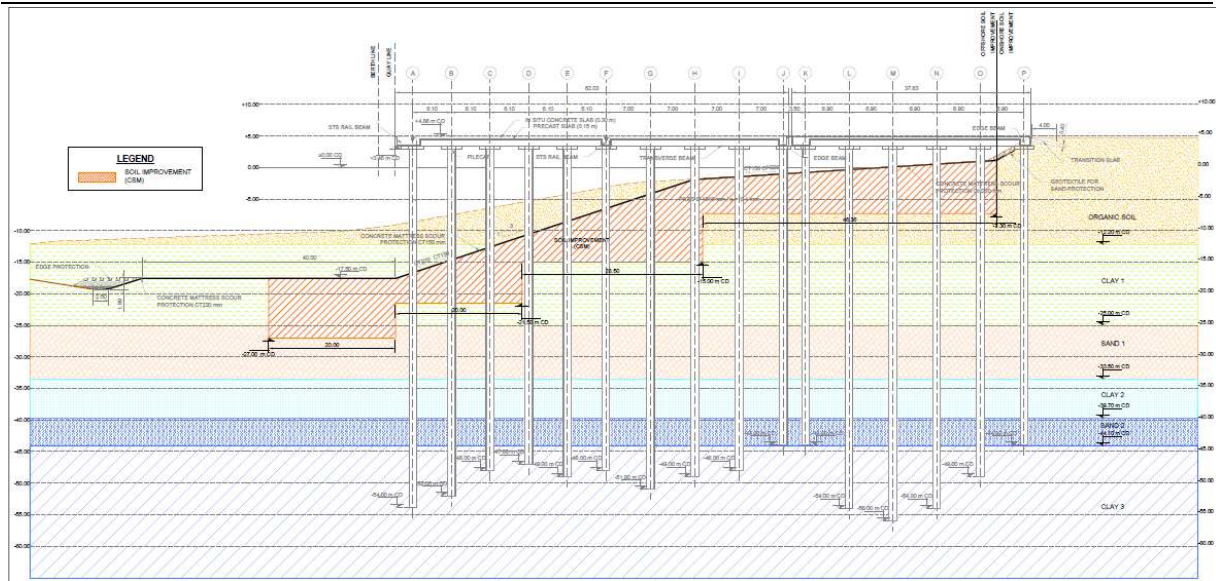
The JV’s alternative solution entails soil improvement that is envisaged as depicted below and a footprint as per the following:

- Starting at the edge of Berth 5 and extending North for approximately for 144 meters along the future Berth 6, with average width of 95 meters and average depth of 9,50 meters;
- At the transition slope from Berth 5 to Berth 6, a 75-meter long and 10-meter wide stretch, with 4,00 meters’ average depth.



**Photo 52 - CSM Soil Improvement Footprint**

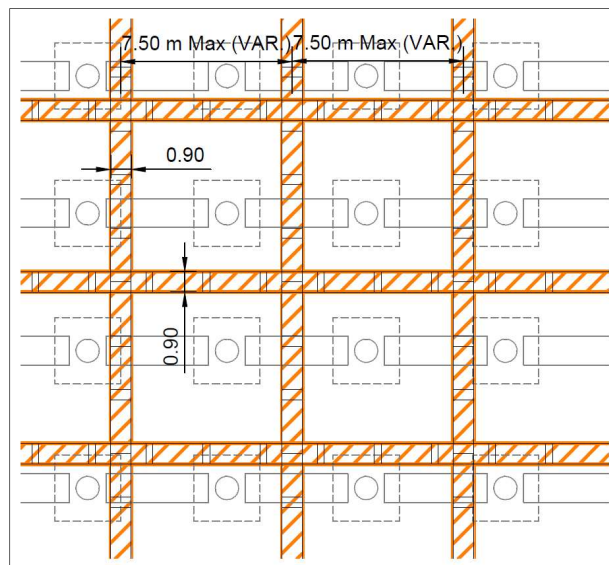




**Photo 53 - CSM Soil Improvement Transverse Section at Q1/T1 & Q2**

The total volume of soil to be improved shall be around 132 885 m<sup>3</sup> with a substitution ratio of 23%, thus the effective CSM treatment shall be around 30 560 m<sup>3</sup>. The CSM treatment shall be done executed as per the following geometrical parameters, as depicted in the picture below:

- Panel width: 0,90 meters;
- Panel length: 2,80 meters;
- Max square grid dimensions: 7,50m x 7,50m



**Photo 54 - CSM treatment Panel Grid**

As per what is shown above, the geometry of the exiting slope under Bert 6 at Q1 and Q2 together with the fact that T1 is around the same level as Berth Terminal platform and that the stretch of slope from the back of Q2 to shore is a natural under water slope, demands that CSM soil improvement be executed by two separate workshops in parallel, using two IKIA LHDCM Rigs together with complementary land-based and marine-based support resources.

#### 4.4.2.1 Resources

##### 4.4.2.1.1 COMMON RESOURCES

##### Mixing Tool



Photo 55 - CSM Mixing Tool

##### IKIA LHDCM Rig



**THE HC05 – A STRONG BASE FOR THIS NEW CABLE MOUNTED CSM**

The HC05 is the most compact cutter in the world. Designed and fabricated by the SOLETANCHE BACHY, it can be shipped anywhere in the world in three 40-foot and three 20-foot containers. It can be also rapidly assembled and disassembled (three days). This machine was used on various job sites in South East Asia and has proved its effectiveness. This machine is specially designed for low-headroom works.

**CUTTER SOIL MIXING**

The Geomix wall consists of producing rectangular elements made of a mixture of soil in situ with a hydraulic binder. The CSM (Cutter Soil Mixing) incorporates Hydrofraise technology. The cutter drums are designed to optimize the mixing of ground in place with grout injected to obtain a very homogeneous material simultaneously. The tool is mounted on a cable. Its center of gravity ensures very low deviation. The CSM allows for rectangular panels, section from 2400 mm x 500 mm to 2800 mm x 1200 mm and up to 35 meters deep. The GEOMIX wall is an alternative to supporting construction and sealing of screens: circular wells, temporary walls, donuts, waterproof screens.

**SUPERVISION**

This CSM tool includes 2 axis inclinometers for real time monitoring by the operator through a dedicated software.



**MAIN FEATURES**

Diesel Engine CATERPILLAR C18-type diesel	
Power	522 kW (700 HP) at 1850 rev/min
Fuel tank capacity	1800 l
Service hydraulic pressure	320 bars
Machine total weight	110 tons
Tool weight	15 tons
Tool section	2800mm (L) x 500mm to 1200mm (T)
Maximum mixing depth	35m
CSM motors Type HT 7500 (7500 daN.m), 25 RPM	

Photo 56 - IKIA Rig Datasheet, #1

#### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A



IKIA CSM Compact is the last generation of compact Soil mixing, designed and manufactured by Soletanche Bachy, following requirements for a compact low headroom. CSM is a 40-m deep excavating machine and its hydraulic power comes from an external power pack that can be mounted on a carriage platform (tracks).

The CSM will be associated with the cement plant and Injection cement pump.

In addition to the usual cutter facilities, CSM is equipped with a translation (800 mm), a parallelogram boom, a 360° turning table and the Kelly will be equipped with a turning head to allow the cutter to be correctly positioned.

### **Base Carrier Dimensions**

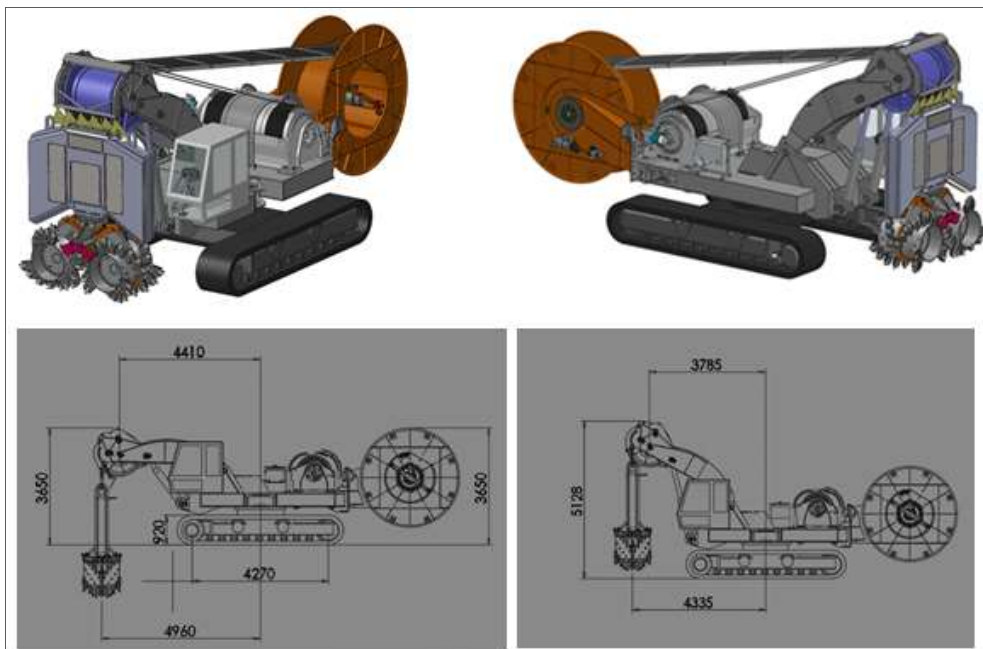
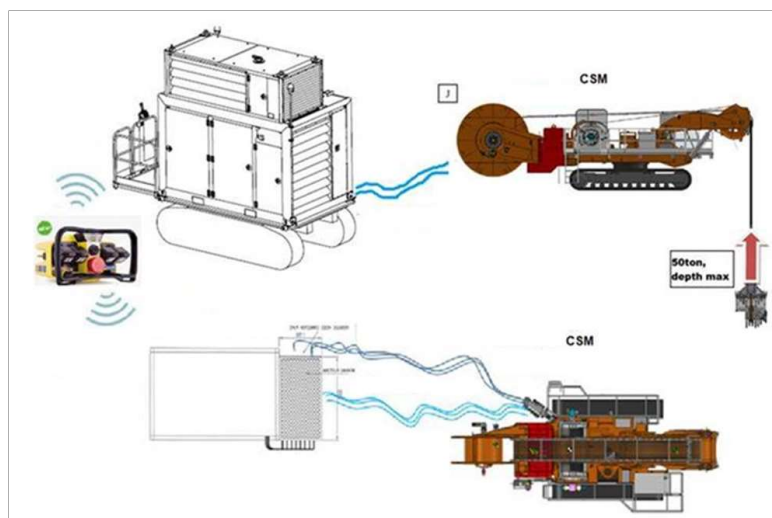


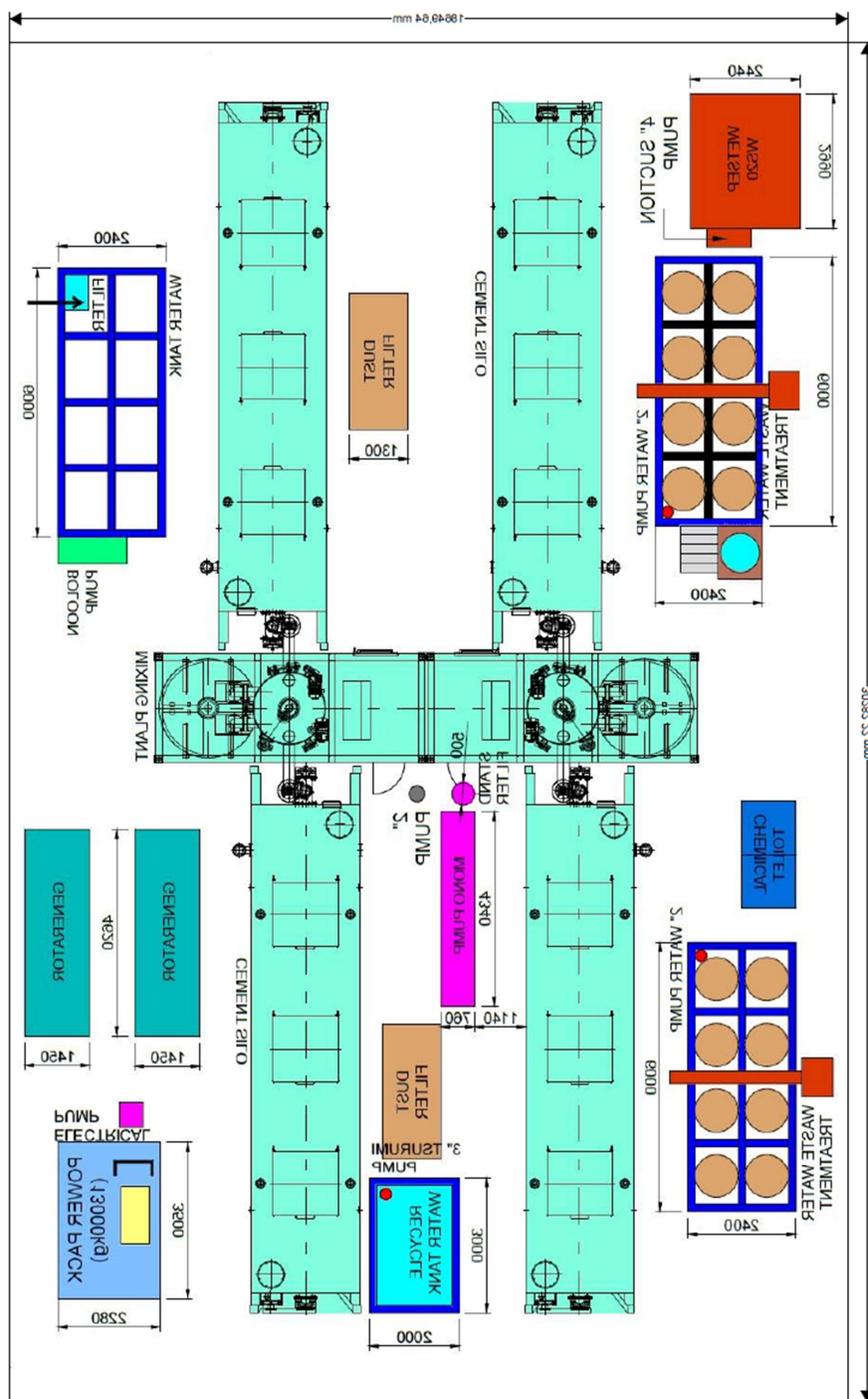
Photo 56 - IKIA Rig Datasheet, #1



**Photo 57 - IKIA Power Pack Configuration**

#### 4.4.2.1.1 LAND-BASED RESOURCES

Additional to the IKIA LHDCM Rig the following land-based resources shall be required to adequately perform the required soil improvement.



**Photo 58 - CSM Land-based support Set-up**

#### 4.4.2.1.1 MARINE-BASED RESOURCES

One of the IKIA LHDCM Rigs and other plant such as cement silos, mixer plants and diverse pumps, shall be mounted on dedicated flat top barge for maritime works purpose, as per the below configuration.

This specially designed barge shall be equipped with Real Time Kinematic Global Positioning System (RTK-GPS) for positioning purposes and with a double silt curtain for spoil and turbidity control.

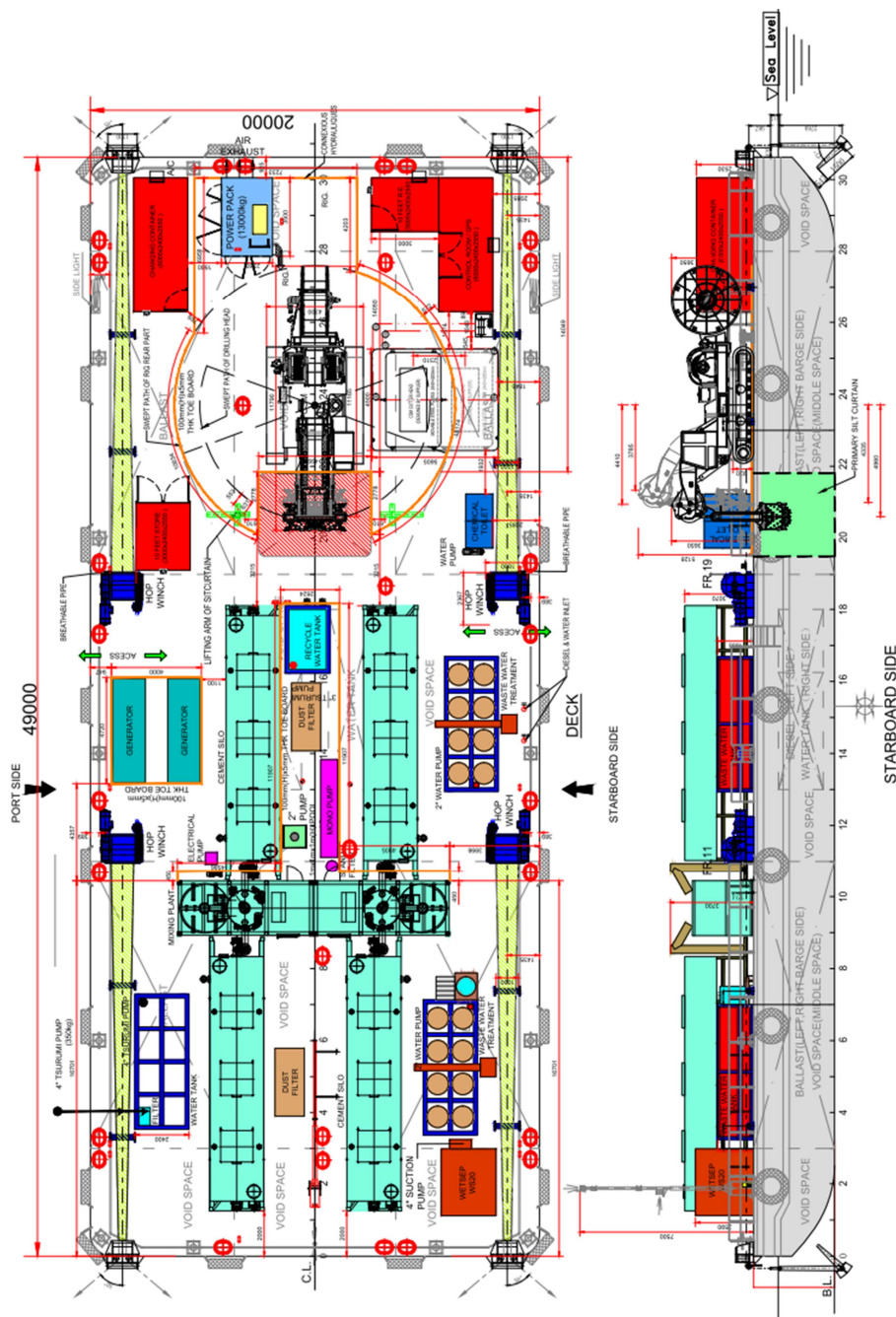


Photo 59 - CSM Marine-based support Set-up

#### 4.4.2.2 Construction Sequence and Methodology

##### 4.4.2.2.1 LAND-BASED CONSTRUCTION METHODOLOGY

###### **Positioning of Soil improvement rigs**

For the positioning of the Soil Improvement panels a full area survey shall be done to optimize and match land and marine grids and allow the positioning of said Soil Improvement panels. Panel setting out shall be done by topographically set pegs or by a Real Time Kinematic Global Positioning System (RTK-GPS) units which has the following advantages:

- Not affected by weather conditions;
- Operated at Real-time manners;
- Fully automatics;
- Easy in operation and installations;
- High accuracy (about 3 cm deviation in general).

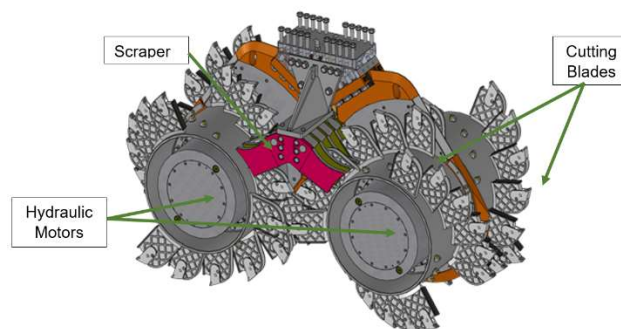
###### **CSM panels execution technique**

- Drilling (called mix-down phase) with bentonite mud delivery from platform level. Estimated mud volume needed 1,750 litres of bentonite per linear meter of CSM panel (section 2.80m x 1.20m);
- Bentonite slurry is to be prepared and stored for maturation during at least 12 hours. Target Marsh viscosity = 40-45 seconds. Target density = 1.02 / 1.03;
- Once bottom of treatment zone is reached, withdrawal (called mix-up phase) with incorporation of cement grout. Estimated volume = 790 litres of grout per linear meter of CSM panel (section 2.80m x 1.20m);
- Cement grout W/C ratio is estimated to be 0.667;
- Target density = 1.67.

The CSM tool can be divided into 3 different parts: 2 cutting wheels, a set of grout nozzles and a set of shear blades. These shear blades are located in between the wheels, on a fixed and rigid support.

Each of the cutting wheel is powered by an embedded hydraulic motor and carries two symmetrical drums. Each of these drums is equipped with a set of teeth on the tip of mixing blades.

For a cutting section of 2 800mm x 900mm; the cutting head is made of: 2 hydraulic motors powering 4 no. of drums. Each drum carries 6 rows of 3 mixing blades each. Each drum processes a set of 5 scrapers for a total of 20 scrapers on the cutting head.



**Photo 60 - Mixing Tool Detail**



### Treatment sequence

Associated construction sequence is parallel walls made of Primary/secondary panels. Secondary panels are foreseen to bite over a minimum of 300mm into primaries on each side. Secondary panels shall be installed no sooner than at least 12 hours after completion of both primaries.

## 4.4.2.2.2 MARINE-BASED CONSTRUCTION METHODOLOGY

### Barge Positioning

For the working in marine conditions, the positioning of the LHDCM barge for the installation of panels is relied on the information provided by the Real Time Kinematic Global Positioning System (RTK-GPS) units.

### **Working of the GPS system**

- The GPS system is a system using the RTK (Real Time Kinematic) function of deliberate survey GPS receivers to measure continuously the position and direction of the LHDCM vessels;
- It contains a fixed base station and a mobile station with 2 receiving antennas in the working barges. Observation data for of the longitude and latitude is transmitted between the stations and the computer software in the GPS unit will convert these coordinate date and calculate the deviation and the orientation of the working barge and displayed it in the monitor so that the accurate position of the working barge can be get.

### **Setting up of the stations**

- Set up the fixed base station on shore nearby the construction site consisting of GPS unit, antenna, receivers, transmitting antenna and transmitter;
- Fix the mobile station on working barge consisting of GPS unit, antenna, receivers, tow set of receiving antennas and receiver.

### **Positioning Procedure**

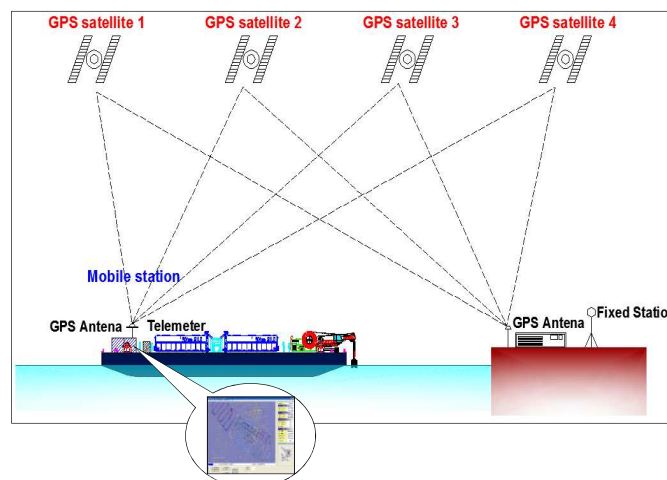


Photo 61 - GPS Setting



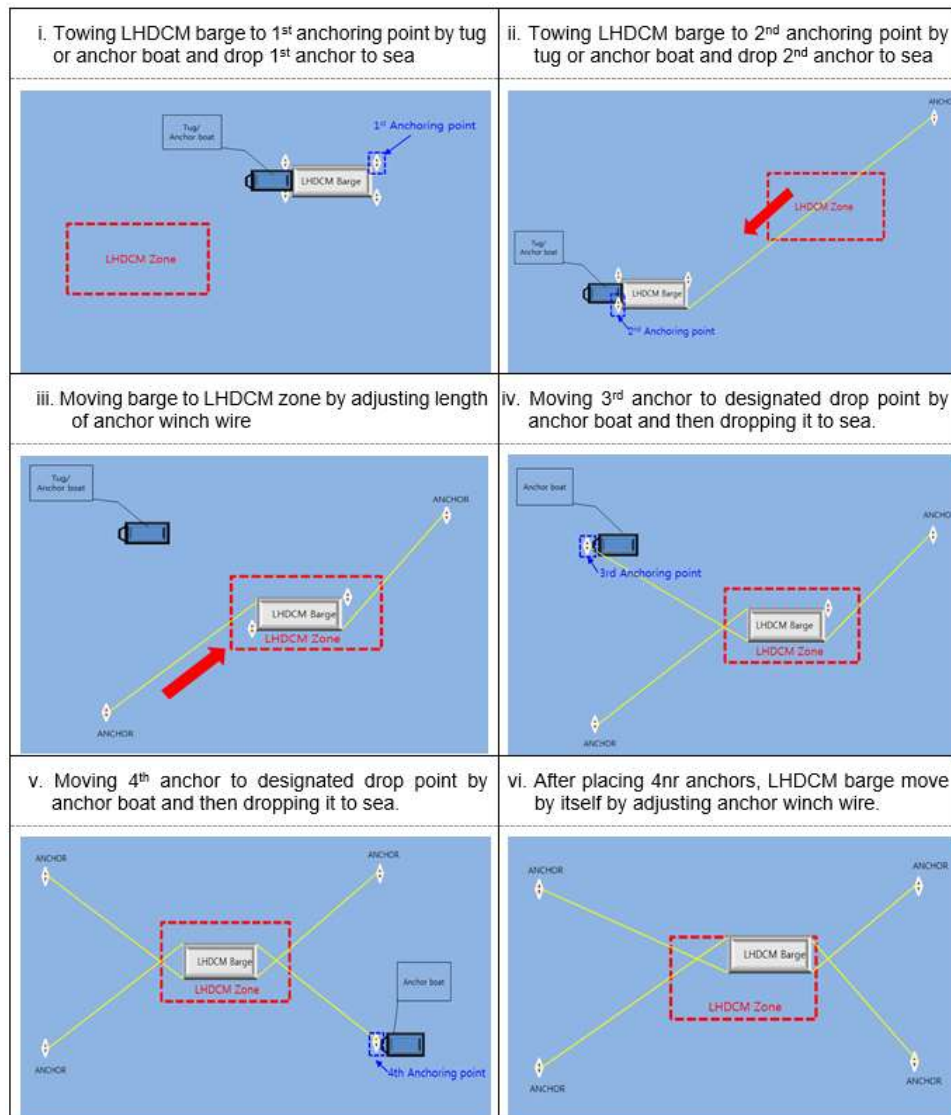


Photo 62 - Barge Positioning Sequence

### CSM panels execution

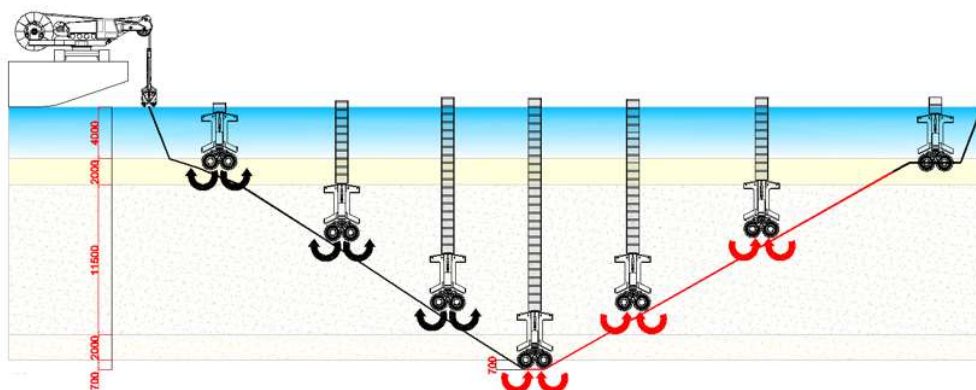


Photo 64 - CSM Panels Installation Sequence, #1

Sequence	1 Positioning	2 Penetration of soft layer	3 Penetration of stiff layer	4 Bottom cement slurry injection	5 Withdrawal with cement slurry	6 Rotate mixing wheels within sand blanket
Procedure	Set mixing wheels to the exact position and confirm the vertical stability	Penetration mixing wheels with normal rotation	Penetration mixing wheels until the required founding level. Without cement slurry.	After confirm founding level, start injection cement slurry.	After bottom cement slurry injection, withdrawal mixing wheels with reverse rotation and injection of cement slurry until 1m below top of sand blanket	After cement slurry injection, rotate mixing wheels within sand blanket for 5 min before raising into the water

Photo 65 - CSM Panels Installation Sequence, #2

### Silt Curtain

The barge shall be equipped with primary and secondary silt curtain systems as part of the emergency mitigation measures if adverse in-situ environmental results are recorded during the works.

The primary silt curtain system shall be set up containing the area of the cutting tool, and the secondary system shall be installed in a bigger area containing the entire barge if necessary. As shown below, the primary system entails an enclosed “Box type” steel platform. This entire structure is attached to the barge and surrounds the cutting tool.

The secondary silt curtain is composed of multiple wire ropes and fixtures around the edge of the deck.



Photo 66 - Silt Curtain Systems Set-up

#### 4.4.2.2.3 COMMON PROCEDURES

##### Cement slurry flowchart

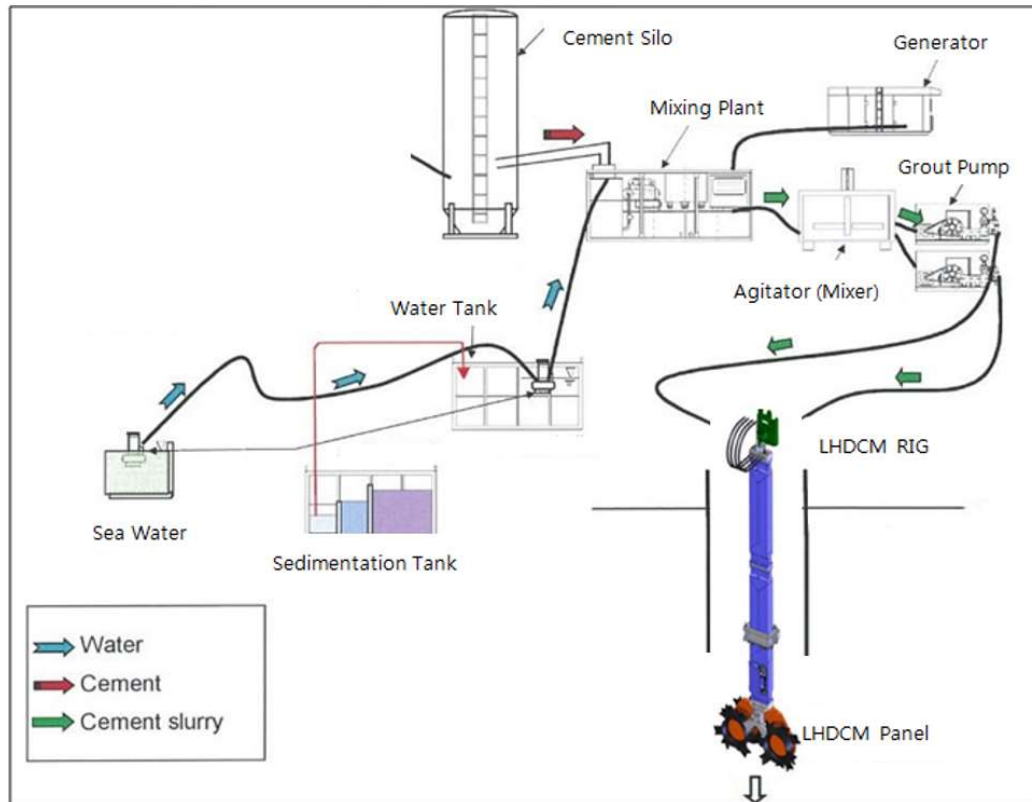


Photo 67 - Cement Flow Chart for the Installation of CSM Panels

##### Monitoring System of CSM Panel Installation

The IKIA rig is equipped with a computerized monitoring system which is employed to guarantee high quality production of panels, and to control all stages from execution to daily report generation. Batching and injection parameters are controlled by computer and are present to provide a pre-selected volume ratio and cement factor, which is closely related to shaft penetration rate. In turn, these data are automatically recorded and displayed, with visual confirmation to the rig operator that they are within the pre-selected parametric range. Full construction records are automatically generated for each panel for all salient drilling and injection parameters.

The monitoring system is composed of a sensor section and execution management section. The sensor section includes sensor detectors for depth, verticality, penetration and withdrawal speed, volume of slurry discharge, wheel rotation speed, and wheel rotation motor hydraulic pressure, and the execution management section consists of processing, monitoring and recording devices.

During execution, the monitoring system checks that the real-time data measured each second satisfy the quality standard values registered in advance for each depth and that acceptable quality columns are produced. If the standard values are not satisfied, alarm is issued, and changes can be made to installation parameters.

The monitoring system indicates the technical details as per below.

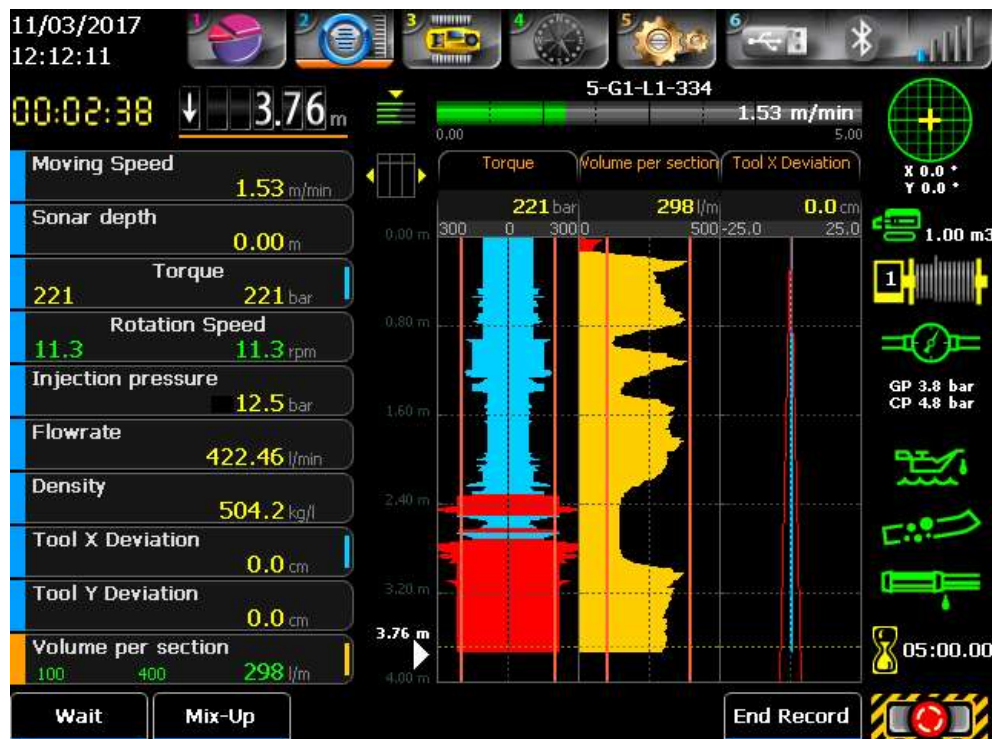


Photo 68 - Monitoring system for CSM panel installation

### Sampling and Testing

Core sampling and testing will be carried out by the JV. If necessary, qualified specialist subcontractor will be employed as backup for sampling and testing works.

### Scope of Work

The testing is foreseen to be the following:

- Rotary drilling and core sampling on 25% of the executed elements;
- Lab testing for Qu, Cu & E values, including report and PE endorsement.

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## 4.5 HYDRAULIC SYSTEMS

### 4.5.1. Water Supply

The layout of the pipeline will be set out topographically and marked accordingly.

Excavation of trenches will be done preferentially by mechanical means and final trimming by labour with special care to ensure that the width and depth do not exceed the maximum specified. A levelling instrument will be used to make depth markings all along the length of the excavation. Allowance for deeper excavation will be made to accommodate the PCC base for inspection chambers, junctions and at collars/joints of pipes.

Pipe installation will occur as per the following:

- Markings for pipe lines and of excavation depths will be made in ground and along the lines according to working the drawings.
- Trenches will be excavated to the required depths.
- Trench base and bedding will be prepared base for pipe laying as per the specification.
- Pipes will be laid on the prepared bedding and supported at adequate intervals.
- Under pressure leak testing will be executed for approval and issue of 'test certificate'.
- Encasement with sand/granular material will be provided.
- Trenches will be backfilled in layers including compaction

The water distribution system will be thoroughly disinfected before being put to use. The following simple procedures will ensure satisfactory results:

1. Flush and clean water tank(s) and distribution pipework with potable water to remove dirt and any foreign matter.
2. Fill the tank(s) with water mixed with chlorine solution at the rate of 50 parts per million. Retain chlorinated water in the system allowing the chlorine to spread throughout pipework.
3. Open the farthest draw-off points or drain plug/valve to draw water. Repeat the procedure till odor of chlorine is felt at all locations when
4. Drain out chlorinated water and fill the system with potable water.

### 4.5.2. Storm Water Drainage

The design location of the proposed drainage is shown on detailed design drawings.

Construction of a storm water drainage system normally includes:

- excavation, including preparation of foundations for box culverts, supply, bedding, laying, installation and jointing drainage structures;
- provision of anchoring systems including anchor blocks;
- supply, placing and compacting select fill;
- supply, placing and compacting granular and geocomposite material at weepholes; and
- supply and placing subsurface pipes and filter fabric at pits, headwalls and wingwalls

### 4.5.3. Waste Water System & Sewerage System

The layout of the pipeline will be set out topographically and marked accordingly.



Excavation of trenches will be done preferentially by mechanical means and final trimming by labour with special care to ensure that the width, depth and gradients are according to the specified. A levelling instrument will be used to make depth markings all along the length of the excavation. Allowance for deeper excavation will be made to accommodate the PCC base for inspection chambers, junctions and at collars/joints of pipes.

Pipe installation will occur as per the following:

- Markings for pipe lines and of excavation gradients will be made in ground and along the lines according to working the drawings.
- Trenches will be excavated to the required depths and gradients.
- Trench base and bedding will be prepared with the correct gradient for pipe laying as per the specification.
- Pipes will be laid down according to specified gradient.
- Hydraulic/smoke test will be done for approval and issue of 'test certificate'.
- Encasement with sand/granular material will be provided.
- Trenches will be backfilled in layers including compaction

#### 4.5.4. General Procedure

These works will be carried out at the same time that the excavations, for this purpose, excavators and dump trucks will be available for the removal of debris, among others; Parallel to the excavations the filling of the ditches with imported loan material will be carried out to improve the soil using a double drum roller; Likewise, transportation, laying, hydration, and compaction equipment (Dump Trucks, Roller and Tank) will be available; filling that will be done by properly compacted layers.

Excavations will be carried out in the established places as indicated in the contractual documents, the appropriate excavation ditches will be carried out, special care will be taken to place the respective signs and preventive signs to avoid accidents, for this activity there will be trained personnel which will supervise that everything is carried out safely and correctly.

The material will be collected in a clean, dry and delimited area in such a way that it represents a safe area of transport for the public and the equipment.

The placement of filler material will be carried out with a front loader or backhoe loader or a bobcat (this will depend on the accessibility of the equipment to the filling area), which will extend the material in horizontal uniform layers according to what is stipulated in the plans and accessories. In the backfilling areas that cannot be accessed with previously selected equipment, the placement is done manually with the use of trucks placing the material in spaced piles, then proceed with the extended manual.

Any contaminating material and / or that does not belong to the place and that could damage its technical characteristics will be removed immediately before starting the compaction.

The backfilling layers will be according to technical specifications where the percentage of compaction of the thickness filling or work specifications is indicated. In our environment, the specifications average layers of 20 to 30 cm, except in the case of some other general specification.

The Site Engineer and QA/QA manager will be responsible for controlling and organizing the equipment that will be used to determine the characteristics of the landfills and carry out and coordinate what is necessary for the work to be carried out within the framework of respectful safety as well as what is necessary in what respects spare parts and fuel for equipment.

The operators of the equipment will be trained to carry out the work and know all the risks included in the activity.



**Photo 69 - Excavations Works for Pipe Installation**

For the coating layer, it is essential to consider a distance between the surface to be compacted and the existing network; these parameters must be defined in the designs.

At the edges, joints, corners in which the use of the roller is impossible to be used, with the employer's acceptance, the compaction with Vibro rammers that meet the specifications established for this purpose and that are in optimal working conditions.

Each layer will be moistened, without saturating it, with clean water before starting the compaction process; this with the application of improving the adhesion of the fines of the material.

To dispose of the debris and eviction of material, the approval and/or location of the dump is requested to the Inspection previously to the use of the material it should be tested in exterior and approved laboratory, in order to confirm the quality of the soil or improvement material to be used

The sequence of all excavation operations is required, this must be such that it ensures the use of all the materials suitable and necessary for the construction of the works indicated in the project plans or indicated by the inspection.

For the activities concerning the connections, the health networks will continue in parallel so that progress is made according to schedule.

For the installation of the chambers, once the respective excavation and improvement of the soil have been carried out, the steel and concrete used for this purpose will be done following the regulations required in the employer requirements, all the materials used will have quality standards for the respective installation of it.

Recognition and delimitation of the work area with stakes, plastic mesh and danger warning tape. Additional warning signs are placed in places visible to the passer-by and drivers.

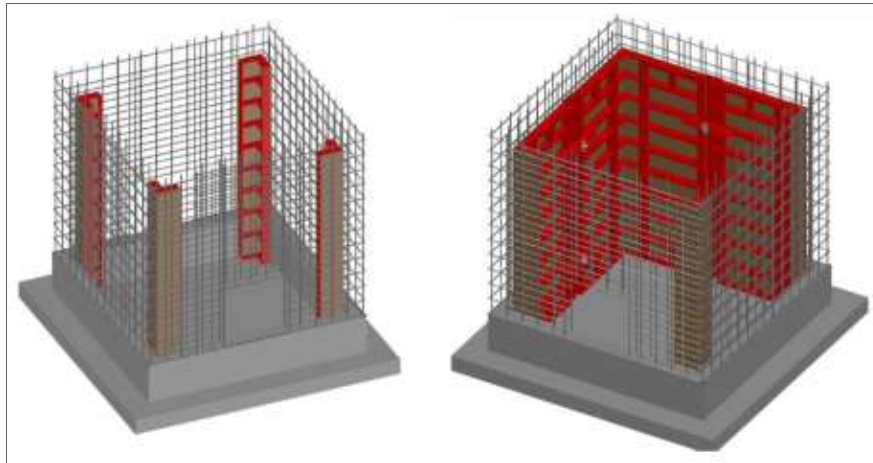
To strengthen the stability of the walls, provided that the excavation depth exceeds 1.50m, it must be placed in accordance with the technical specifications established for this purpose; except in the case that the land is of a firmness that allows working without the placement of fixing, this last action must be accepted by the employer.

If the casting dimensions of the chambers require excavations to be carried out at considerable depths, land cuts will be made that allow the implementation of such slopes that guarantee the stability of the sidewalls of the excavated terrain.

Levelling and compacting the foundation ground we proceed to the construction of the blind concrete layer that will act as a cleaning bed for the structure. The area covered by this material will be greater between 0.05m to 0.10m along the entire perimeter of the area of the chamber slab to be built on-

site.

The required steel will be placed on the foundation slab and chamber walls, according to the design plans. The formwork of the foundation slab and the perimeter wall is made; according to the design plans.

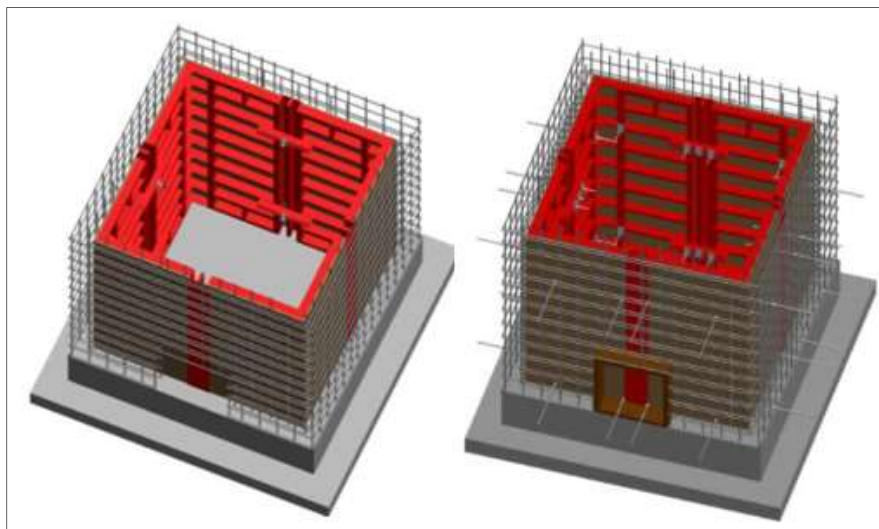


**Photo 70 - Chamber Execution Sequence, #1**

The pre-mixed and/or mechanical concrete will be poured, as appropriate, which will comply with the technical specifications established in the design drawings. This process will be executed as many times as necessary until reaching the required height of chamber construction and between each stretch of concrete, the additives and materials that the design plans indicated will be placed. (Binders, PVC tapes, etc.)

Once the concrete has been poured into the structure, the needle vibrator will be implemented.

Once the strength of the concrete required in the design drawings and technical specifications has been reached, the next step is to decouple the walls of the chamber and then cover the outer part of the walls with bitumen paint. The fixing of the entrance ladder to the chamber will be carried out by means of a mechanical anchor (expansive bolts) or as indicated in the design drawings.



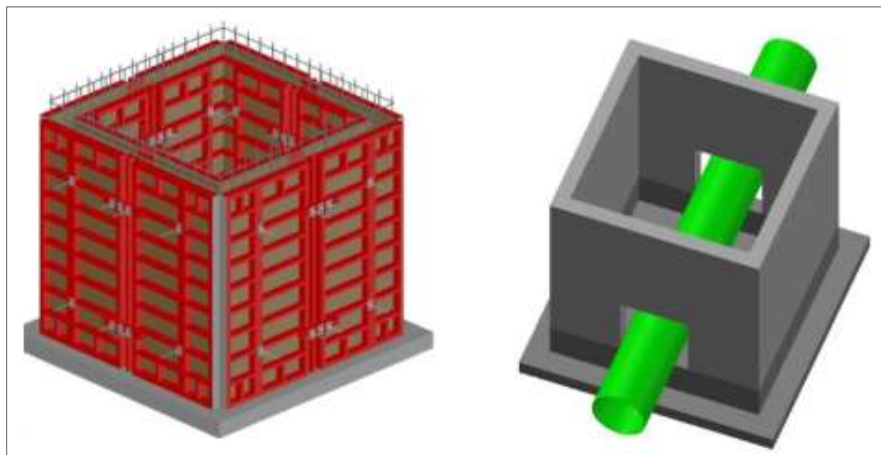
**Photo 71 - Chamber Execution Sequence, #2**

Once the height of the axis of the hydraulic assembly is defined, the pipe passage will be left on the walls of the chamber, using wood formwork embedded in the concrete or block wall for this purpose. The openings will be of dimensions and sections very close to those of the pipe to be assembled and the sealing will be carried out according to what is established in the design plans and technical specifications established by the customer.

The process continues with the assembly of the formwork of the upper one (in case of being embedded in the walls of the chamber) and subsequent placement of the corresponding reinforcement according to the plans.

The concrete order will be poured to reach the required level. The manufacture of removable/removable slabs is carried out separately and according to the details.

The placement of the entrance cover to the camera is carried out according to what is established in the design drawings. The metal welding works will be carried out in the camp located at the base of the work; following design specifications and materials.



**Photo 72 - Chamber Execution Sequence, #3**

At the end of the work process, an interior and exterior cleaning will be carried out to present the finished structure. For the construction of curb, in general, the subgrade or foundation bed must be completed in accordance with the slope and the cross-section stipulated in the project. Before laying the concrete the surface of the foundation must be dampened and well compacted.

All soft or unstable material must be removed to a minimum depth of 15 cm. under the level of the foundation of the ditches, and it will be replaced with granular material of such quality that, when wetted and compacted, take a suitable foundation base.

The formwork will be smooth and lubricated on the side in contact with the concrete and on the upper edge, it must be rigid enough to withstand the pressure of the plastic concrete, without deforming. It will be installed with the stipulated slopes, dimensions and alignments and will be firmly maintained by stakes, clamps, braces and braces that are necessary. The formwork of the exposed wall of the ditch curbs and curbs with reduced height for the construction of access ramps should not be removed before the concrete is set, but should be removed within six hours of placing the concrete to be made at the finish

Expansion joints of 8 to 10 mm will be left wide in the curbs, with a spacing of 3.5 meters and on both sides of the structures, the joints will be filled with material that meets the requirements stipulated in section 806 of the General Specifications for the Construction of Roads and Bridges of the MOP. 001-F-2002 and must be perpendicular to the curb line.

Before removing the formwork, the upper surface must be smoothed, using a suitable steamroller, giving it a uniform finish and maintaining the slope and specified cross-sections.

Immediately after removing the formwork, the upper surface and the faces that are to be visible must be smoothed, the edges should be rounded as indicated by the plans using a suitable steamroller, giving it a uniform finish and maintaining the specified slope and cross-section. After smoothing, you have to give them the final finish by passing a fine broom with movements parallel to the curb line

#### 4.5.5. Specific Procedures

##### 4.5.5.1 Excavation

Unless otherwise shown on the drawings, the pipes shall be laid in trench conditions.

The width of trench excavations for pipelines must be in accordance with the specifications and in accordance with the specified tolerances.

Extended excavation will be done for drainage structures other than pipes so that, at all points on the walls of the structure, the clear width between the structure wall and the face of the excavation is at least 300 mm or one third of the height of the face of the excavation, whichever is the greater.

Where inadequate foundation material is found it will be replaced with materials from cuttings, or with other acceptable material and compact to the specifications requirements

##### 4.5.5.1.1 Resources

###### **Materials:**

- Wood poles
- Wood board (ODB type)
- Steel board

###### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

###### **Equipment and tools:**

- Excavator
- Back hoe
- Dump truck
- Bob cat
- Hand tools
- Mechanical jacks

**Test:** No apply



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#### 4.5.5.1.2 Procedure

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- i. Survey benchmarks shall be set-out by Land Surveying crew.
- ii. Determine trench dimensions (Length, Width and depth).
- iii. Excavations less than 1.3 meters in depth may not require this degree of protection if examination of the ground by a competent person provides no indication of a potential cave-in.
- iv. Excavated material shall be stored at least 2 meters from the edge of the excavation and hard hats will be worn by all workers at the site when work is in progress.
- v. A stairway, ladder, ramp or other safe means of exit shall be located in trench excavations that are 1.30 meters or more in depth in case of manual excavation.
- vi. If an adverse condition develops, the excavation must be re-inspected and confirmed safe before work may resume.
- vii. On any excavation where depth is expected to exceed 1.3 meters or where unstable soil is likely to be encountered, shoring or shielding equipment that will be used in case of manual excavations.
- viii. Daily inspections of excavations, the adjacent areas, and protective systems shall be for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions.
- ix. Water control may involve the relatively simple removal of small amounts of water at the bottom of an excavation by manual or electrically driven sludge pumps.

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#### 4.5.5.2 Pipe Installation

##### **Perforated drains**

Perforated drains will be excavated (including topsoil) to the dimensions shown on the drawings.

Inadequate foundation material for perforated drains striped and dealt with in accordance with the requirements of the specifications.

Any inadequate foundation material from the foundation area will be removed and adequate fill material will be applied and compact to the requirements of the specification. Surplus materials from the construction will be dealt with in accordance with the specification.

Concrete lining will be done according with the drawings Lining installation will be done in accordance with the design and with the recommendations in the specifications.

Adequate movement joints will be built according to the design and specifications in order to control movement and cracking in concrete lining.

##### **Open Drains**

Open drains will be excavated (including topsoil) to the dimensions shown on the drawings.

Inadequate foundation material for open drains will be cleared, grubbed and striped of topsoil where construction of an earth structure is required to form an open drain, and dealt with in accordance with the requirements of the specifications.

Any inadequate foundation material from the foundation area will be removed before commencing to place material for the earth structure. Construct of the earth structure will be done in layers not exceeding 200 mm in depth, and compact to the requirements of the specification.

Surplus materials from the construction of open drains will be dealt with in accordance with the specification.

Concrete lining will have a minimum compacted thickness measured at right angles to the surface of the lining. Wire mattresses will only be used where shown on the drawings. Lining installation will be done in accordance with the design and with the recommendations in the specifications.

Adequate movement joints will be provided according to the specifications in order to control cracking in concrete lining.

### **Precast Concrete Pipe Structures**

Installation must be in accordance with the specifications and unless otherwise specified, pipe laying will commence at the outlet end and proceed upstream.

All foreign matter will be removed from inside and outside of pipes before laying.

Where "Embankment Installation" condition is specified, prior to commencement of placing bedding and laying pipes, compact embankment fill will be placed to a height above the top of the bed zone of at least 0.7 times the external diameter of the pipe and for a minimum lateral distance outside each trench wall of 2.5 times the external diameter of the pipe.

During installation, an alternative waterway area shall be provided.

Where "Trench Installation" condition is specified for pipes in an embankment, the embankment to the underside of the Selected Material Zone will be completed prior to the commencement of the excavation.

Pipes will be laid with the socket end placed upstream.

Anchor blocks will be provided at a spacing defined by the design and according to the specifications, with a defined maximum spacing and at bends or junctions for all storm water pipes laid on a grade exceeding 20% and where shown on the drawings. Anchor blocks will be built as per the drawings and in-situ concrete will be placed directly against all faces of the keys in the sides and base of the trench

#### **4.5.5.3 Backfill of Trenches and Disposal of Excavated Material Surplus**

Trench backfill will be done with material excavated from the trench where it is deemed to be suitable for backfill, otherwise materials from cuttings or other material acceptable will be used and compacted to the requirements of the specification.

Disposal of any surplus excavated material will be done on site for embankments construction or at other locations within the site or alternatively off site in accordance with the specification.

##### **4.5.5.3.1 Resources**

#### **Personnel**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager

- Worker
- Equipment operator

**Equipment and tools:**

- GPS based total station
- Hand operated tamper / vibratory plate compactor
- Roller
- Dump truck
- Excavator
- Motor grader
- Nuclear densimeter

**Materials:**

- Approved backfill.

**Test:**

- 3 Density tests per 500 m<sup>2</sup> shall be done (each layer) and all fill shall be compacted to not less than 80% Modified Proctor density and will be test by a qualified geotechnical specialist using a nuclear densimeter.

#### 4.5.5.3.2 Procedure

- i. Location of facilities shall be directed by land surveying crew according to set up layout.
- ii. Surveying benchmarks shall be set-out by Land surveying crew.
- iii. According to the location to be backfilled and compacted, the material will be placed, in uniform layers to a depth no longer than 250 mm and compacted using (depending of each case) a hand operated tamper, plate compactor or roller compactor until reaching level indicated in drawings and the density solicited. (In places that do not allow the use of heavy machine to compact, the layers should not be made deeper than 150 mm)
- iv. In any case the Contractor must take care the Proctor test results and monitor the moisture of the material prior to the compaction and in the middle of the process to obtain an optimal compaction by layer.
- v. After the compaction of each layer a surveyor team will record the levels to be able tracking all the process.

#### 4.5.5.4 Manholes (Chambers)

These structures shall not be installed later than 14 days after the installation of associated pipes, perforated or open drains.

An isolation joint will be Installed where a drainage structure will abut a structure or concrete pavement. The isolation joint will have width and performance according with the specification.

Base slabs for precast reinforced concrete manhole and gully pit type structures will be made of cast in-situ reinforced concrete, cast on a blinding layer of 50 mm thick plain concrete. Concrete work, including reinforcing steel and other embedded items, for cast in-situ invert slabs and link slabs will be executed in compliance with the specifications.

Precast units will be installed in accordance with the specification and the manufacturer's recommendations.

After the installation of the precast elements the transverse joint between adjacent elements will be sealed all around with a self-adhering membrane as per design and specifications requirements. Lifting holes will be sealed to prevent the ingress of materials as well as the cut of lifting hooks and the coating of the exposed steel to prevent corrosion.

In each junction box, gully pit, drop structure, etc deeper than 600 mm, an individual-rung ladder will be installed (step irons) on one internal wall for the full depth of the structure. The top of the uppermost rung must not be more than 600 mm below the top of the pit. The top of the bottom rung must not be more than 500 mm or less than 300 mm above the invert of the pit

#### 4.5.5.4.1 Resources

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**Personnel:**

- Superintendent
- Site engineer (yard) Site engineer
- Quality control manager Health & safety manager Worker
- Operator

**Equipment and tools:**

- Crane set
- Forklift set
- Steel bar cutter
- Teel bar bender
- Concrete truck mixer
- Concrete pump
- Plug-in vibratory rod
- Mechanical jack

**Material:**

- Rebar fy 4200 kg/cm<sup>2</sup>
- Concrete (320 kg/cm<sup>2</sup>)
- Plywood HR

**Test:**

- Burst test (for concrete 320 Kg/cm<sup>2</sup>)
- No destructive resistance test (sclerometer)

#### 4.5.5.4.2 Procedure

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- i. The reinforcement bars for the manholes, cover lids and cover plates shall be previously cut and bent at the rebar workshop and ensemble together according to the drawings and the construction requirements
- ii. The material of lifting hook for manholes is  $\phi 25$ mm round bar. It will be placed inside the rebar cage of the manhole walls, complying with the cover of the manholes, at the end of the first stage concrete pouring, which is 35 cm from bottom of the cover plate, after the place on site

maneuver the second concrete pour stage will take place, the lifting hook will be cut after the manhole installation. Before cutting it, the concrete around will be marked 2 centimeters around and then break it. After this prior procedure, the hooks will be cut using blowtorch. Thus, it is ensuring the second stage concrete has enough cover to avoid issues where the lifting hook was.

- iii. The hols for the connection with the pipe must be made according to the design specification and in any case the hole must have a cross reinforce around the hole to avoid cracks a tension.
- iv. The formwork to be used on this work will be made of plywood and square wood mold for all precast elements. The formwork is estimated to be reused for at least 3 times or less if the material is not in good conditions.
- v. Once formwork and embedded elements installation is finished, supervisor shall carefully perform inspection to ensure that it is consistent with the design and quality control specification, the pouring concrete will start using a concrete pump and a  $\Phi 50$  or  $\Phi 30$  plug-in vibratory.
- vi. The first stage concrete pouring will be placed in precast yard, it is 35 cm from top of the cover plate, a second concrete poring will be made on site (this is made to avoid any abortive job and be able to calculate the exactly slope or finish level of the pavement)
- vii. The curing process will take place in the precast yard, this process consists in cover the element with all the formwork walls with geotextile and sprinkle water, keeping wet the manhole. The first 7 days after formwork removal the concrete surface will be sprinkled with water and covered with geotextile. The curing geotextile shall be applied after the concrete surface has received the specified finishing treatment. After this period, the element will be sprinkled with curing compound, moved to storage and sprinkled again after it is set on its storage place.
- viii. When manhole precast strength reached required specified characteristic strength. We will use the Crane to hoist these manholes and transport to storage area.

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## 4.6 ELECTRICAL

### 4.6.1. Scope Of Work

- Switchyard Equipments for the 69 kV incoming line at the Main Substations
- Main Substation
- Generation System
- Reefer Substation RS4
- Reefer Substation RS6
- ERT & Reefer Combined Substation ERS3
- ERT & Reefer Combined Substation ERS5
- ERTG Container Substation ER7 and ER8
- CSW Substation
- Fire Pump Station
- Reefer Rack Equipment
- Crane Pit equipment
- CCTV
- Gate OCR System
- Crane OCR system for 4 cranes
- Fiber Optic System
- Scada System



- Cabling,
- Earthing,
- Lightning Protection,
- Illumination
- Cable Trays

#### 4.6.2. Assumptions

- Electrical scope starts at the incoming gantry of the 69 kV Line
- No separate training program, Employer is encouraged to actively participate in the testing and commissioning stage to get learning on the job.
- Temperature rise, Noise, NLL, LL, PD and Lighting impulse test only on one transformer per type.
- Power factor requirement at point of coupling with grid is 0.9
- CE marking not required since equipment not used in Europe
- Fuel quality as per commercial use Vehicles
- Existing Generator substation building
  - ✓ Has automatic louvers for the 8 new positions
  - ✓ Has fire resistance walls of 60 minutes as per the RFQ (or could be made 60-minute fire retardant)
  - ✓ Has already installed 2 full set of DG (operating condition)
  - ✓ Control system only for 2 DGs
  - ✓ The existing MV Switchgear has 2 bays we can use to connect 2 DGs
  - ✓ The existing MV Switchgear can be extended with an additional 6 bays
  - ✓ 3 spare day tanks available
  - ✓ 2 step up trafos available
  - ✓ Space for the additional 8 DGs available
  - ✓ Space for external fuel tanks available
- All Buildings have a power factor at the LV connection of 0.95
- Reefers have a power factor before compensation of 0.75
- STS have a power factor of 0,98 at 13.8 kV connection point
- ERTG have a power factor of 0.98 at 660V connection point
- STS and ERTG have a max THD V of 5% and THD I of 2%
- HV test during SAT is limited to a LIFE test with applied voltage
- HV test during FAT is limited to the relayed IEC standard tests
- LV panels behind the transformer are form 4a incomer and form 3b outgoing (above 250A)
- LV distribution panels are form 4a incomer and 2b outgoing
- Temperature rise test for LV Panels not included, however typical test report for similar unit will be submitted.
- Light poles have lowering crown, not canting mechanism – 2 drivers in total for the entire project to bring headframes down
- Generator sets based on Prime Power Rating 2200 kW
- The requirement for Power Transformers do not exist in EN 50464-1. Normal design is applied
- CCTV
  - ✓ We have assumed that the existing Video Management System is Milestone with

X protect Corporate license. Hence no separate base license is considered. Only additional Cameras.

- ✓ We have assumed that existing Monitors and Workstations would be used for monitoring of new cameras as well and hence our offer don't include separate monitoring equipment
- Fuel consumption requirement shown are for a 3200 kW PRP not for 2250 KW PRP.
- STS Crane should have a 300 Lux and compatible PLC for proper OCR working
- Employer will provide resources to operate Cranes & drive trucks with test containers for commissioning of the OCR system

#### 4.6.3. Technical Deviations

- Voltage transformer do not have fuses.
- Outdoor LV panels are IP 66 (not IP 67 since that is for underwater applications)
- Reactors for power factor compensation are 12,5% not 14% since nottypical.
- Tap changer ABB Type, not Reinhauser
- 60 dB (A) at 2 meter at full load for noise from transformers and generators is extremely low. Values can be confirmed after detail engineering
- Load step of 2 MW per generator within the envelop of +-10% in voltage and +-5% in frequency is not possible with a 2200 kW generator. We do however confirm this possibility with several generators in parallel.

#### 4.6.4. Equipment

High voltage Switchgear	ABB
Medium Voltage Switchgear	ABB Unigear for Main SS 25k – 2500A Busbar Medium
Voltage Switchgear	ABB Unisec for Others SS 20k – 630A Busbar Power
Transformers	ABB
Distribution Transformers	ABB
Low Voltage Switchgear Main	ABB Artu K (similar to MNS)
Low Voltage Switchgear Distribution	ABB Gemini
Reefer Outlets	ABB (Mipco is now ABB)
Alternator	ABB
Scada	ABB
Lighting fixtures	Philips
Crane Connection boxes	Conductix
Generator	Cummins
Medium and Low Voltage Cable	General Cable

#### 4.6.5. 69 KV Switchyard Equipment

In order to comply with project's requirements and engineering design, it is necessary to supply and install 69 kV Switchyard Equipment.

##### 4.6.5.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot

- Pick-up of materials from storage.
- Removal of packaging prior to installation
- Inspection of inside floor of the building
- Marking out on floor for PASS and yard equipment positioning and installation of anchoring on floor
- Positioning and assembly of PASS and yard equipment Modules
- Laying of secondary cables for electrical connections of the PASS and yard equipment Modules
- Installation of secondary instruments of the PASS and yard equipment Modules
- Primary steel/copper installation and connection of the PASS and yard equipment Modules
- Installation and connection of connecting cables of the PASS and yard equipment Modules
- Installation and connection of secondary earthing of the PASS and yard equipment Modules
- Inspection of cable connection of PASS and yard equipment Modules
- Treatment before restoring SF6 Gas for PASS Module
- Primary steel/copper installation and connection of PASS and yard equipment Modules
- Installation and connection of connecting cables of PASS and yard equipment Modules
- Installation and connection of secondary earthing of PASS and yard equipment Modules
- Inspection of cable connections of PASS and yard equipment Modules
- Restoration of SF6 gas to nominal pressure
- Precommissioning tests
- Checks, tests and inspections according to doc. "QUALITY CONTROL PLAN – ERECTION"

#### 4.6.5.2 Resources

##### Equipment

- Forklift truck
- Truck-mounted crane
- Mobile scaffolding
- Torque wrenches
- Mechanic's tool box
- Electrician's tool box
- Assembly accessories
- Folding resin ladder with non-slip aluminum rungs

#### 4.6.5.3 Procedure - Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>

Inspection of inside floor of the yard	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available</li> </ul> <p>and all personnel are trained in its use and maintenance fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</p>
Marking out on floor for PASS and yard equipment positioning and installation of anchoring on floor	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> </ul>



			<ul style="list-style-type: none"> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available</li> </ul> <p>and all personnel are trained in its use and maintenance fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</p>
Positioning and assembly of PASS and yard equipment Modules	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available</li> </ul> <p>and all personnel are trained in its use and maintenance fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</p>
Laying of secondary cables for electrical connections of the PASS and yard equipment	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of</li> </ul>

			<p>installation (block the casters) nor climbed</p> <ul style="list-style-type: none"> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available</li> </ul> <p>and all personnel are trained in its use and maintenance</p> <ul style="list-style-type: none"> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
<p>Installation of secondary instruments of the PASS and yard equipment</p>	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ hot works are under permit to work system and</li> </ul>

			<p>carried out by competent personnel</p> <ul style="list-style-type: none"> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>face and respiratory PPE are worn when performing hot works</li> </ul>
Primary steel/copper installation and connection of the PASS and yard equipment	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocutation</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ hot works are under permit to work system and carried out by competent personnel</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>face and respiratory PPE are worn when performing hot works</li> </ul>

Installation and connection of connecting cables of the PASS and yard equipment Modules	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ hot works are under permit to work system and carried out by competent personnel</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>face and respiratory PPE are worn when performing hot works</li> </ul>
Installation and connection of secondary earthing of the PASS and yard equipment Modules	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation</li> </ul>

	<ul style="list-style-type: none"> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>		<p>(block the casters) nor climbed</p> <ul style="list-style-type: none"> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ hot works are under permit to work system and carried out by competent personnel</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>□ face and respiratory PPE are worn when performing hot works</li> </ul>
Inspection of cable connection of PASS and yard equipment Modules	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed,</li> </ul>



			supervised and executed <input type="checkbox"/> working at heights is under permit to work system <input type="checkbox"/> only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed <input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance <input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights
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#### 4.6.6. MV Switchgear

In order to comply with engineering design and project's requirements, it is necessary to supply and install medium voltage electrical panels according to approved single line diagrams in the respective substation in the scope.

This Method Statement refers to the installation of medium voltage electrical panels, present chapter sets the construction methodology to perform this work

##### 4.6.6.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot
- Withdrawing materials from the stores
- Removal of packaging prior to installation
- Marking out the panel's position
- Forming a support surface for offloading the panel
- Moving panels Checking per doc.: "QUALITY CONTROL PLAN –ERECTION"

##### 4.6.6.2 Resources

###### COMPONENTS AND ACCESSORIES

- Medium voltage panel
- Base frames

###### EQUIPMENT

- Mobile crane
- Truck-mounted crane
- Movement rollers
- Trans pallet
- Reinforced panel movement trolley
- Marking out equipment
- Electric drill
- Electric dowel hole drill
- Material for support surface and movement of panels
- Tackle
- Electric extension cords
- Mechanical tool boxes
- Folding resin ladders

###### GENERAL ASPECTS

#### 4.6.6.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Marking out the panel's position	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets,</li> </ul>

#### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

	<ul style="list-style-type: none"> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>		<ul style="list-style-type: none"> <li>railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
Forming a support surface for offloading the panel	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all operators have undergone certification training in safe manual handling techniques</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Moving panels	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with</li> </ul>

	<ul style="list-style-type: none"> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>		<ul style="list-style-type: none"> <li>manufacturers' instructions</li> <li><input type="checkbox"/> all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all operators have undergone certification training in safe manual handling techniques</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
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#### 4.6.7. Diesel Generator System

In order to comply with engineering design and project's requirements, it is necessary to supply and install medium voltage electrical panels according to approved single line diagrams in the respective substation in the scope.

This Method Statement refers to the installation of Diesel Generator System, present chapter sets the construction methodology to perform this work

##### 4.6.7.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot
- Withdrawing materials from the stores
- Removal of packaging prior to installation
- Marking out the equipment's position
- Forming a support surface for offloading the diesel generators and complete system
- Moving the diesel generators and complete system
- Checking according to doc.: "QUALITY CONTROL PLAN –ERECTION"

##### 4.6.7.2 Resources

###### COMPONENTS AND ACCESSORIES

- Diesel engine: rated voltage 480V, rating 2080kW prime power
- Radiator + exhaust
- Generator set control panel:

###### GENERAL ASPECTS

###### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

- 
- Generator circuit breaker panel
  - Generator common center control panel & synchronization equipment
  - Fuel handling system & piping
  - Fuel Storage tanks-1200 Liter each

#### EQUIPMENT

- Mobile crane
- Truck-mounted crane
- Movement rollers
- Trans pallet
- Reinforced panel movement trolley
- Marking out equipment
- Electric drill
- Electric dowel hole drill
- Material for support surface and movement of panels
- Tackle



#### 4.6.7.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
Marking out the Diesel	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> </ul>

Generator's position	<ul style="list-style-type: none"> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>		<ul style="list-style-type: none"> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
Forming a support surface for offloading the Diesel Generator's	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all operators have undergone certification training in safe manual handling techniques</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>

Moving Diesel Generator's	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all operators have undergone certification training in safe manual handling techniques</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works               <ul style="list-style-type: none"> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul> </li> </ul>
Installation Diesel Generator's			<p>Prior to start installation, Site Engineer (Electrical) should ensure that approved shop drawings related to the installation area are referred and that required materials are available at site as per approved material submittals.</p> <p>Site Engineer (Electrical) has to ensure that all the materials are received at site as per approved material submittal and verify the ratings.</p> <p>The name plate will be checked against equipment data sheet to confirm conformity with the approval.</p> <p>Material Inspection Request should be raised for material verification upon delivery at site.</p> <p>Ensure all civil works are completed for the area including floor paint to carry out the installation, and clearance is obtained from respective authorities to proceed further installation of DG set.</p> <p>Installation procedures are to be followed as per manufacturers recommendations.</p> <p>Installation works shall be carried out only with respect to approved shop drawings of latest revision.</p> <p>Diesel Generator Set will be off loaded to the place nearest to the installation and protected properly from dust &amp; environment, etc. Prior to installation, the foundation will be checked for cleanliness and level.</p> <p>Site Engineer must ensure the orientation of DG set as per approved shop drawing Exhaust duct &amp; fuel oil pipe installation shall comply with the relevant clauses of specifications and as per manufacturer recommendation.</p> <p>Ensure that the installation of Diesel Generator Set is</p>

			<p>carried out in accordance with manufacturer's and authority's installation recommendations, requirement of applicable standards and in accordance with recognized industrial practices and specified in project specification to ensure that installation complies with requirements.</p> <p>Alternator neutral terminal &amp; Body shall be connected with external earth as per approved shop drawing.</p> <p>Alternator control panel shall be connected as per approved shop drawing and manufacturer recommendations</p> <p>Cable connections between alternator, control panel and Emergency Main Distribution Board shall be done as per approved shop drawing.</p> <p>From the Emergency Main Distribution Board to other sub emergency panels, Power Distribution work shall be done as per approved shop drawing</p> <p>Installation of muffler, fuel supply system, exhaust ducts, circuit breaker installation connections to BMS and control wires shall be carried out as per approved specifications.</p> <p>Pre &amp; Post installation start up and commissioning at site using available site load shall be performed in coordination with the manufacturer's local dealer in the presence of consultant representative as appropriate. Detailed procedure shall be submitted for Testing pre-commissioning and commissioning checks for consultant's approval prior to commissioning of genset. Applicable operating instruction, service manuals, recommended spares shall be submitted in O&amp;M manual.</p> <p>Required power and control termination shall be carried out as per approved drawings.</p> <p>DG Set Earthing shall be done as per authority Regulation, specification and approved drawings.</p> <p>After inspection of DG Set proper care will be taken to protect the unit from dust by suitable covering, and shall further be released for the Testing work.</p>
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#### 4.6.8. LV Switchgear and LV Panels AC/DC

In order to comply with project's requirements and engineering design, it is necessary to supply and install Primary LV panel.

The present chapter sets the construction methodology to perform this work.

##### 4.6.8.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot
- Pick-up of materials from stores.
- Removal of packaging prior to installation

- Marking out the panel's position
- Unloading of panel onto prepared foundation
- Check according to doc.: "QUALITY CONTROL PLAN –ERECTION"

#### 4.6.8.2 Resources

##### COMPONENTS AND ACCESSORIES

- AC/DC switchgear
- Primary LV panel, POWER CENTER

##### EQUIPMENTS

- Forklift truck
- Truck-mounted crane
- Movement rollers
- Pallet truck
- Reinforced panel movement trolley
- Marking out equipment
- Power drill
- Heavy duty power drill
- Material for support surface and movement of panels
- Crowbars
- Power extension leads
- Mechanic's tool boxes
- Electrician's tool boxes
- Folding resin ladders

#### 4.6.8.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> </ul>

##### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A





			all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Identification and marking of MV cables	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate</li> </ul>

			lifting equipment <input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed <input type="checkbox"/> working at heights is under permit to work system <input type="checkbox"/> only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed <input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance fall arrest PPE (lifelines, harness, etc.) are worn when working at heights
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#### 4.6.9. Power and Distribution Transformers

In order to comply with project's requirements and engineering design, it is necessary to supply, installing, unloading and outfitting the power and distribution Transformers.

The present chapter sets the construction methodology to perform this work

##### 4.6.9.1 ACTIVITY

- Movement of personnel & materials SAFELY, using means of transport
- SAFELY Personnel movement on foot
- Withdrawing materials from the stores
- Removal of packaging prior to installation
- Inspection of foundation
- Unloading and positioning of transformer on concrete foundation
- Installing of transformer outfitting components, positioning and assembly of components
- Connecting of pre-cabled secondary cables of equipment
- Installing and connecting of secondary earthing system
- Positioning of conservators and connecting of tubes for oil treatment.
- Preparation, installation and connection of power / generator line for transformer oil treatment machine
- Treatment of transformer oil.
- Pre-commissioning tests from equipment to local transformer board
- Checks, tests and inspections according to doc. "QUALITY CONTROL PLAN ERECTION"

##### 4.6.9.2 Resources

###### COMPONENTS AND ACCESSORIES

- Transformer tank

- Components for outfitting
- Conservators
- Oil treatment plant
- Generator for oil treatment plant

#### EQUIPMENT

- Forklift truck
- Crane
- Truck-mounted crane
- 15m-high mobile platform
- Torque wrenches
- Mechanic's tool box
- Electrician's tool box

#### 4.6.9.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>

#### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

	<ul style="list-style-type: none"> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Injury to third parties</li> </ul>	
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
Inspection of foundation	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>



Unloading and positioning of transformer on concrete foundation	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all operators have undergone certification training in safe manual handling techniques</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul> <p>PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</p>
Installing transformer outfitting components, positioning and assembly of components	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are</li> </ul>



			<p>repaired or replaced</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>face and respiratory PPE are worn when performing hot works</li> </ul>
Connecting of pre-cabled secondary cables of equipment	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> fire fighting equipment is installed near the area where hot works are conducted</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work</li> </ul>

			<p>system</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>face and respiratory PPE are worn when performing hot works</li> </ul>
<p>Installing and connecting of secondary earthing system</p>	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>°</li> <li>Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> fire fighting equipment is installed near the area where hot works are conducted</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> </ul>



			<ul style="list-style-type: none"> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>face and respiratory PPE are worn when performing hot works</li> </ul>
Positioning of conservators and connecting of tubes for oil treatment (VALID FOR POWER TRANSFORMERS).	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
Preparation, installation and connection of power / generator line for transformer oil treatment machine	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms,</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> all manufacturers' handling and installation procedures for equipment is strictly followed</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> </ul>



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(VALID FOR POWER TRANSFORMERS)	<ul style="list-style-type: none"> <li>° ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>		<ul style="list-style-type: none"> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all operators have undergone certification training in safe manual handling techniques</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available</li> </ul> <p>and all personnel are trained in its use and maintenance</p>
Treatment of transformer oil (VALID FOR POWER TRANSFORMERS).	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ hazardous substances, whenever possible, are substituted by less / non-hazardous ones</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all manufacturers' handling and installation procedures for equipment is strictly followed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ competent personnel are engaged in handling dangerous substances and a full chemical assessment is made</li> <li>□ an eye wash station and spillage containment equipment is installed</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ all operators have undergone certification training in safe manual handling techniques</li> <li>□ all local emergency contact numbers are</li> </ul>

## GENERAL ASPECTS

### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

			<p>clearly displayed and competent first aiders are in place</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> emergency response equipment e.g. spill kits, fire fighting, medical emergency equipment function properly and defective items are replaced immediately</li> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li><input type="checkbox"/> face and respiratory PPE are worn when performing hot works</li> </ul>
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#### 4.6.10. AC/DC Panel - Rectifier - Batteries

In order to comply with project's requirements and engineering design, it is necessary to supply, installing, unloading and outfitting the to install the panels AC/DC - rectifier - batteries

The chapter sets the construction methodology to perform this work

##### 4.6.10.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot
- Pick-up of materials from stores.
- Removal of packaging prior to installation
- Marking out the panel's position
- Unloading of panel onto prepared foundation
- Check according to doc.: "QUALITY CONTROL PLAN – ERECTION"

##### 4.6.10.2 Resources

###### COMPONENTS AND ACCESSORIES

- AC/DC panel Rectifier/Converter - batteries

###### EQUIPMENT

- Equipment Forklift truck



- Truck-mounted crane Movement rollers Pallet truck
- Reinforced panel movement trolley Marking out equipment
- Power drill
- Heavy duty power drill
- Material for support surface and movement of panels Crowbars
- Power extension leads Mechanic's tool boxes Electrician's tool boxes Folding resin ladders.

#### 4.6.10.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
Removal of packaging	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> </ul>

prior to installation	<ul style="list-style-type: none"> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<ul style="list-style-type: none"> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute /point-of- work risk assessment before starting works</li> </ul>
Marking out the panel's position	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded</li> <li>/ interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel are present in the lifting area</li> <li>during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
Unloading of panel onto prepared foundation	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms,</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> </ul>

	ladders and scaffolding ° Lifting operations ° Cranes, fork lifts, etc. ° Damaged or defective PPE for mechanical works ° Manual handling		<input type="checkbox"/> all operators have undergone certification training in safe manual handling techniques <input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed <input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed <input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance
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#### 4.6.11. High Mast Installation

In order to comply with project's requirements and engineering design, it is necessary to supply, installing, unloading and outfitting the High Mast and Light Fixtures.

##### 4.6.11.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot
- Pick-up of materials from stores.
- Removal of packaging prior to installation
- Control of support base completed by third parties
- Installing mast
- Installing and connecting light fixtures
- Connecting cabling to control board
- Installing and connecting secondary earthing system
- Checks, tests and inspections according to doc. "QUALITY CONTROL PLAN-ERECTION"

##### 4.6.11.2 Resources

###### COMPONENTS AND ACCESSORIES

- Pole
- Light fixture mounting ring and mounting accessories
- Light fixtures
- Auxiliary cabling for electrical parts
- Control board
- Accessories for connection of secondary earthing system

###### EQUIPMENT

- Forklift truck
- Crane
- 40 m-high mobile platform

- Power drill
- Torque wrenches
- Mechanic's tool box
- Electrician's tool box

#### 4.6.11.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk</li> </ul>

	<ul style="list-style-type: none"> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	parties	assessment before starting works
Control of support base completed by third parties	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all manufacturers' handling and installation procedures for equipment are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> all operators have undergone certification training in safe manual handling techniques</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> suitable and sufficient permanent / temporary lighting is in place</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> reflective vests PPE are worn by personnel working in poorly lit areas</li> </ul>
Installing mast	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Installing mounting ring	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available so that lone workers can contact</li> </ul>





	<ul style="list-style-type: none"> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>		<p>somebody else in case of an emergency</p> <ul style="list-style-type: none"> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Installing and connecting light fixtures	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Slipping, tripping, falling</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ lone workers are knowledgeable and know their job details</li> <li>□ appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Connecting cabling to control board	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ lone workers are knowledgeable and know their job details</li> <li>□ appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Installing and connecting secondary earthing system	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> </ul>

## GENERAL ASPECTS

	<p>tools</p> <ul style="list-style-type: none"> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> fire fighting equipment is installed near the area where hot works are conducted</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li><input type="checkbox"/> face and respiratory PPE are worn when performing hot works</li> </ul>
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#### 4.6.12. MV and LV Cables and Terminations

To comply with project's requirements and engineering design, it is necessary to supply, installing, unloading and laying the power MV and LV cables with their terminations, markings and connections to equipment and devices

##### 4.6.12.1 Activity

- Movement of personnel using means of transport

- Personnel movements on foot
- Pick-up of materials from stores
- Removal of packaging prior to installation
- Preparation and preliminary activities for laying
- MV cable laying
- LV cable laying
- Identification and marking of MV cables
- Voltage Withstand and Insulation Tests according to ICE Standard 60502-2
- Connection to equipment and/or power board
- Inspection and tests

#### 4.6.12.2 Resources

##### COMPONENTS AND ACCESSORIES

- MV cable reels
- MV terminal kits
- LV cable reels
- Accessories for LV cables
- Cable lugs, heat shrink, shields, glands, etc.

##### EQUIPMENT

- Forklift truck
- Reel trailer
- Reel stand
- Winch
- Spring to feed in cable
- Pipe cleaner brush
- Pilot wire
- Hemp rope
- Pull cable
- Rollers
- Pivot clamp
- Cable sock
- Lubricant
- Electrician's tool box
- Mechanic's tool box
- Gas cylinder
- Hydraulic press
- Hand press
- Cable cutter
- Heat shrink hot air gun
- Winders with extensions
- Instruments for electrical tests

#### 4.6.12.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Pick-up of materials from stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>



Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Preparation and preliminary activities for laying	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Inhalation of hazardous substances</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
MV cable laying	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures,</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid</li> </ul>



	<ul style="list-style-type: none"> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Inhalation of hazardous substances</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<ul style="list-style-type: none"> <li>manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
LV cable laying	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Inhalation of hazardous substances</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<ul style="list-style-type: none"> <li>Ensure that:</li> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and</li> </ul>

			<p>signage is in place</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area</li> </ul> <p>during lifting works and the area is barricaded / signed</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
<p>Identification and marking of MV and LV cables</p>	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Inhalation of hazardous substances</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel is present in the lifting area</li> </ul> <p>during lifting works and the area is barricaded / signed</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified</li> </ul>

			tasks is made available and all personnel are trained in its use and maintenance <input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights
Voltage Withstand and Insulation Tests according to ICE Standard 60502-2 Check integrity of insulation	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Inhalation of hazardous substances</li> <li>° Injury to third parties</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Connection to equipment and/or power board	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Lone working</li> <li>° Inadequate ABB supervision</li> <li>° Damaged or defective PPE for electrical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Inhalation of hazardous substances</li> <li>° Injury to third parties</li> </ul>	Ensure that: <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>

#### 4.6.13. Reefer Sockets

In order to comply with project's requirements and engineering design, it is necessary to supply, installing, unloading and outfitting the cable ladders, reefer sockets, distribution boards, junction boxes, light fixtures, panel onto prepared foundation

##### 4.6.13.1 Activity

- Movement of personnel using means of transport
- Personnel movements on foot
- Pick-up of materials from stores.
- Removal of packaging prior to installation

- Marking out the panel's position
- Unloading for installation of cable ladders, reefer sockets, distribution boards, junction boxes, light fixtures, panel onto prepared foundation
- Check according to doc.: "QUALITY CONTROL PLAN –ERECTION"

#### 4.6.13.2 Resources

##### COMPONENTS AND ACCESSORIES

- Cable ladders,
- Reefer sockets,
- Distribution boards, Junction boxes,
- Light fixtures
- Conduit pipes with accessories

##### EQUIPMENT

- Movement rollers
- Pallet truck
- Reinforced panel movement trolley
- Marking out equipment
- Power drill
- Heavy duty power drill
- Material for support surface and movement of panels
- Crowbars
- Power extension leads
- Mechanic's tool boxes
- Electrician's tool boxes
- Folding resin ladders

#### 4.6.13.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
SAFELY	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately</li> </ul>

##### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

Personnel movement on foot	conditions	radiation	<p>managed through a Heat and Cold Weather Working Procedure</p> <ul style="list-style-type: none"> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Preparation and installation of mounting brackets for parts and/or equipment (on holes/ceiling-mounted brackets prepared by BAM)	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Explosion and blast injury</li> <li>° Asphyxia, suffocation</li> <li>° Absorption of hazardous substances</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all manufacturers' handling and installation procedures for equipment is strictly followed</li> <li>□ lone workers are knowledgeable and know their job details</li> <li>□ appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency</li> <li>□ all operators have undergone certification training in safe manual handling techniques</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ suitable and sufficient permanent / temporary lighting is in place</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>



			<input type="checkbox"/> reflective vests PPE are worn by personnel working in poorly lit areas
Installing cable ladders	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Explosion and blast injury</li> <li>° Asphyxia, suffocation</li> <li>° Absorption of hazardous substances</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available sothat lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Installation of power distribution boards	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Explosion and blast injury</li> <li>° Asphyxia, suffocation</li> <li>° Absorption of hazardous substances</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available sothat lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> </ul>
Installation of Reefer Sockets	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms,</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Explosion and blast injury</li> <li>° Asphyxia, suffocation</li> <li>° Absorption of hazardous substances</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> lone workers are knowledgeable and know their job details</li> <li><input type="checkbox"/> appropriate communication channels are available sothat lone workers can contact somebody else in case of an emergency</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> </ul>

	ladders and scaffolding ° Lifting operations ° Cranes, fork lifts, etc. ° Damaged or defective PPE for mechanical works		<input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed <input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance
Installation of junction boxes (JB)	° Inadequate risk assessment ° Extreme weather conditions ° Portable electrical tools ° Inadequate ABB supervision ° Hot works ° Working at heights ° Platforms, ladders and scaffolding ° Lifting operations ° Cranes, fork lifts, etc. ° Damaged or defective PPE for mechanical works	° Serious injuries (fractures, amputations) ° Back injuries ° Explosion and blast injury ° Asphyxia, suffocation ° Absorption of hazardous substances ° Injury to third parties	Ensure that: <input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used <input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed <input type="checkbox"/> lone workers are knowledgeable and know their job details <input type="checkbox"/> appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency <input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced <input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed <input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance
Installation of standard light fixtures	° Inadequate risk assessment ° Extreme weather conditions ° Portable electrical tools ° Inadequate ABB supervision ° Hot works ° Working at heights ° Platforms, ladders and scaffolding ° Lifting operations ° Cranes, fork lifts, etc. ° Damaged or defective PPE for mechanical works	° Electric shock injuries ° Electrocutation ° Serious injuries (fractures, amputations) ° Back injuries ° Fall from heights ° Exposure to UV-radiation ° Injury to third parties	Ensure that: <input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used <input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed <input type="checkbox"/> lone workers are knowledgeable and know their job details <input type="checkbox"/> appropriate communication channels are available so that lone workers can contact somebody else in case of an emergency <input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced <input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed <input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance

#### 4.6.14. Cable Trays and Accessories for Earthing Lightning

In order to comply with project's requirements and engineering design, it is necessary to supply, installing, unloading and outfitting the cable trays and earthing lightning installations

#### 4.6.14.1 Activity

- Movement of personnel & materials SAFELY, using means of transport
- SAFELY Personnel movement on foot
- Withdrawing materials from the stores
- Removal of packaging prior to installation
- Check positioning of metalwork supplied by third parties
- Cut Unistrut drawn elements to measure
- Positioning of suspended parts with relevant bracketing racks
- Positioning of cable tray ladder connected with jointing elements
- Installing and connecting secondary earthing system
- Checks, tests and inspections according to doc. "QUALITY CONTROL PLAN – ERECTION"

#### 4.6.14.2 Resources

##### COMPONENTS AND ACCESSORIES

- Straight cable ladders (L 3000)
- Accessories for assembly (plates + nuts & bolts)
- Unistrut , 41x41x2.5
- Bracketing racks
- Nuts & bolts for assembly, including:
  - -bolts
  - -washers
  - Grover washers
  - -nuts
- Accessories for connection of secondary earthing and lightning systems

##### EQUIPMENT

- Forklift truck
- Truck-mounted crane
- 40 m-high mobile platform
- Mechanic's tool box
- Mobile scaffolding
- Power/battery-operated drill
- Folding fiberglass ladder with non-slip aluminum rungs

#### 4.6.14.3 Procedure – Tasks, Hazards, Consequences and Control Measures

Task Description	Hazards	Consequences	Control Measures
Movement of personnel & materials SAFELY, using means of transport	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>• works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>• all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>• all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
SAFELY Personnel movement on foot	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Exposure to UV-radiation</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Withdrawing materials from the stores	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Removal of packaging prior to installation	<ul style="list-style-type: none"> <li>° Sharp edges and moving parts</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Fall from heights</li> <li>° Impact with moving objects</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ all high-risk activities are controlled by a last minute / point-of- work risk assessment before starting works</li> </ul>
Laying the secondary earth	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> </ul>

#### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A



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cable	<p>conditions</p> <ul style="list-style-type: none"> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>	<p>injuries (fractures, amputations)</p> <ul style="list-style-type: none"> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<ul style="list-style-type: none"> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ hot works are under permit to work system and carried out by competent personnel</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>□ face and respiratory PPE are worn when performing hot works</li> </ul>
Forming secondary (welded derivation) earth connections	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>°</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with</li> </ul>

## GENERAL ASPECTS

### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

	<p>Inadequate ABB supervision</p> <ul style="list-style-type: none"> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>		<p>manufacturers' instructions</p> <ul style="list-style-type: none"> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li>□ works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li>□ only electrical tools fit for tasks and correctly voltage rated are used</li> <li>□ ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ fire fighting equipment is installed near the area where hot works are conducted</li> <li>□ inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ hot works are under permit to work system and carried out by competent personnel</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li>□ face and respiratory PPE are worn when performing hot works</li> </ul>
Forming secondary (compression) earth connections	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> </ul>



	<ul style="list-style-type: none"> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> </ul>		<ul style="list-style-type: none"> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> fire fighting equipment is installed near the area where hot works are conducted</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li><input type="checkbox"/> face and respiratory PPE are worn when performing hot works</li> </ul>
Installing earth spikes	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Electrocution</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> </ul>

	defective PPE for mechanical works		<ul style="list-style-type: none"> <li><input type="checkbox"/> all structures, materials, etc. adjacent to welding areas are adequately protected</li> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> only electrical tools fit for tasks and correctly voltage rated are used</li> <li><input type="checkbox"/> ABB's electrical safety standard "The 7 Steps" are strictly followed</li> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> fire fighting equipment is installed near the area where hot works are conducted</li> <li><input type="checkbox"/> inspection and maintenance of tools are regularly scheduled and damaged items are repaired or replaced</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> hot works are under permit to work system and carried out by competent personnel</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> <li><input type="checkbox"/> face and respiratory PPE are worn when performing hot works</li> </ul>
Check positioning of metalwork supplied by third parties	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Portable electrical tools</li> <li>° Inadequate ABB supervision</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li><input type="checkbox"/> all openings are covered with unbreakable material, barricaded and signage is in place</li> </ul>

			<ul style="list-style-type: none"> <li><input type="checkbox"/> all lifting equipment is regularly inspected as per maintenance schedules</li> <li><input type="checkbox"/> only competent and certified lifting operators operate lifting equipment</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> working at heights is under permit to work system</li> <li><input type="checkbox"/> only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li><input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li><input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
Cut Unistrut drawn elements to measure	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> works conducted in places exposed to extremes of temperature are adequately managed through a Heat and Cold Weather Working Procedure</li> <li><input type="checkbox"/> all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li><input type="checkbox"/> all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> </ul>
Positioning of suspended parts with relevant bracketing racks	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Leakage of hazardous chemicals</li> <li>° Damaged or</li> </ul>	<ul style="list-style-type: none"> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall into open holes</li> <li>° Impact with falling objects</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> operations are conducted at the lowest possible level</li> <li><input type="checkbox"/> lifting equipment fit for tasks is used to avoid manual handling</li> <li><input type="checkbox"/> all loads are fastened securely in line with manufacturers' instructions</li> <li><input type="checkbox"/> when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li><input type="checkbox"/> ladders are properly selected and used</li> <li><input type="checkbox"/> only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li><input type="checkbox"/> scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li><input type="checkbox"/> all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the</li> </ul>



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	<p>defective PPE for mechanical works</p> <ul style="list-style-type: none"> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>		<p>manufacturers' instructions</p> <ul style="list-style-type: none"> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel are present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high-risk activities are controlled by a last minute / point-of-work risk assessment before starting works</li> <li>□ PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance</li> <li>□ fall arrest PPE (lifelines, harness, etc.) are worn when working at heights</li> </ul>
<p>Positioning of cable tray ladder connected with jointing elements</p>	<ul style="list-style-type: none"> <li>° Inadequate risk assessment</li> <li>° Extreme weather conditions</li> <li>° Open holes</li> <li>° Inadequate ABB supervision</li> <li>° Hot works</li> <li>° Working at heights</li> <li>° Platforms, ladders and scaffolding</li> <li>° Lifting operations</li> <li>° Cranes, fork lifts, etc.</li> <li>° Damaged or defective PPE for mechanical works</li> <li>° Inadequate emergency response</li> <li>° Manual handling</li> </ul>	<ul style="list-style-type: none"> <li>° Electric shock injuries</li> <li>° Serious injuries (fractures, amputations)</li> <li>° Back injuries</li> <li>° Fall from heights</li> <li>° Impact with falling objects</li> <li>° Exposure to UV-radiation</li> <li>° Injury to third parties</li> </ul>	<p>Ensure that:</p> <ul style="list-style-type: none"> <li>□ operations are conducted at the lowest possible level</li> <li>□ lifting equipment fit for tasks is used to avoid manual handling</li> <li>□ all loads are fastened securely in line with manufacturers' instructions</li> <li>□ when working at heights collective fall protection (scaffolding, nets, railings) is mounted before starting works</li> <li>□ ladders are properly selected and used</li> <li>□ only competent certified scaffolders erect, dismantle and inspect scaffolding</li> <li>□ scaffolding can be neither moved from its place of installation (block the casters) nor climbed</li> <li>□ all machinery with moving parts are sufficiently guarded / interlocked and only competent operators operate / maintain it in line with the manufacturers' instructions</li> <li>□ all openings are covered with unbreakable material, barricaded and signage is in place</li> <li>□ all lifting equipment is regularly inspected as per maintenance schedules</li> <li>□ only competent and certified lifting operators operate lifting equipment</li> <li>□ all works, including those carried out by contractors, are adequately risk assessed, supervised and executed</li> <li>□ working at heights is under permit to work system</li> <li>□ only authorized personnel is present in the lifting area during lifting works and the area is barricaded / signed</li> <li>□ all high risk activities are controlled by a last</li> </ul>

## GENERAL ASPECTS

### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

			minute / point-of-work risk assessment before starting works <input type="checkbox"/> PPE in good condition for the identified tasks is made available and all personnel are trained in its use and maintenance <input type="checkbox"/> fall arrest PPE (lifelines, harness, etc.) are worn when working at heights
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## 4.7 PAVEMENTS

In this section, the paving proposed by RHDHV for the new container terminal is reviewed and a new proposal is outlined.

The CBR value at the bottom of the pavement section will be assumed to be larger than 15% according to the soil improvement proposal in the yard area.

Two different pavement zones are determined as follows according to container handling methods, equipment and vehicles throughout the terminal.



Photo 73 - Pavement Layout

### 4.7.1. Definitions

#### 4.7.1.1 Pavement Zone 1: Container Stacks at RTG Yard (Row 1-4)

From the loads described in (5) the critical load is the one generated by the 6-high container stack in blocks pattern.

As mentioned before, the CBR value in the natural soil is considered to be larger than 15% as a consequence of the soil improvement in the esplanade. Hence, the 150mm sub-grade layer is not necessary according to the principles of the BPA.

Using the Material Equivalent Factor of the BPA Manual, the section proposed in **Erreur ! Source du renvoi introuvable.** is modified into potential alternative that provide an easier construction schedule:

80mm	Concrete block pavement (CBP)
300mm	Laying course material
370mm	C <sub>25/30</sub> Concrete Base
150mm	sub-base material CBR>80%
>15%	CBR Improved soil

Table 2 - Zone 1: Alternative Concrete Block Pavement Design Section.

#### 4.7.1.2 Pavement Zone 2: Container Stacks at RTG Yard (Row 5-9)

From the loads described in (5) the critical load is the one generated by the 6-high container stack in blocks pattern.

As mentioned before, the CBR value in the natural soil is considered to be larger than 15% as a consequence of the soil improvement in the esplanade. Hence, the 150mm sub-grade layer is not necessary according to the principles of the BPA.

Using the Material Equivalent Factor of the BPA Manual, the section proposed in **Erreur ! Source du renvoi introuvable.** is modified into potential alternative that provide an easier construction schedule:

80mm	Concrete block pavement (CBP)
300mm	Laying course material
400mm	C <sub>25/30</sub> Concrete Base
150mm	sub-base material CBR>80%
>15%	CBR Improved soil

Table 3 - Zone 2: Alternative Concrete Block Pavement Design Section.

#### 4.7.1.3 Run RTG Beams

The RTG runway beam will be as per the reference design but will include a C8/10 CBGM base (min 80 mm; max 110 mm) plus a 150 mm subbase material with CBR > 80%. This solution will be consistent with the overall pavement project.



#### 4.7.1.4 GATE COMPLEX ROADS

The next figure identifies the pavement surfaces to be installed at the Gate Complex.

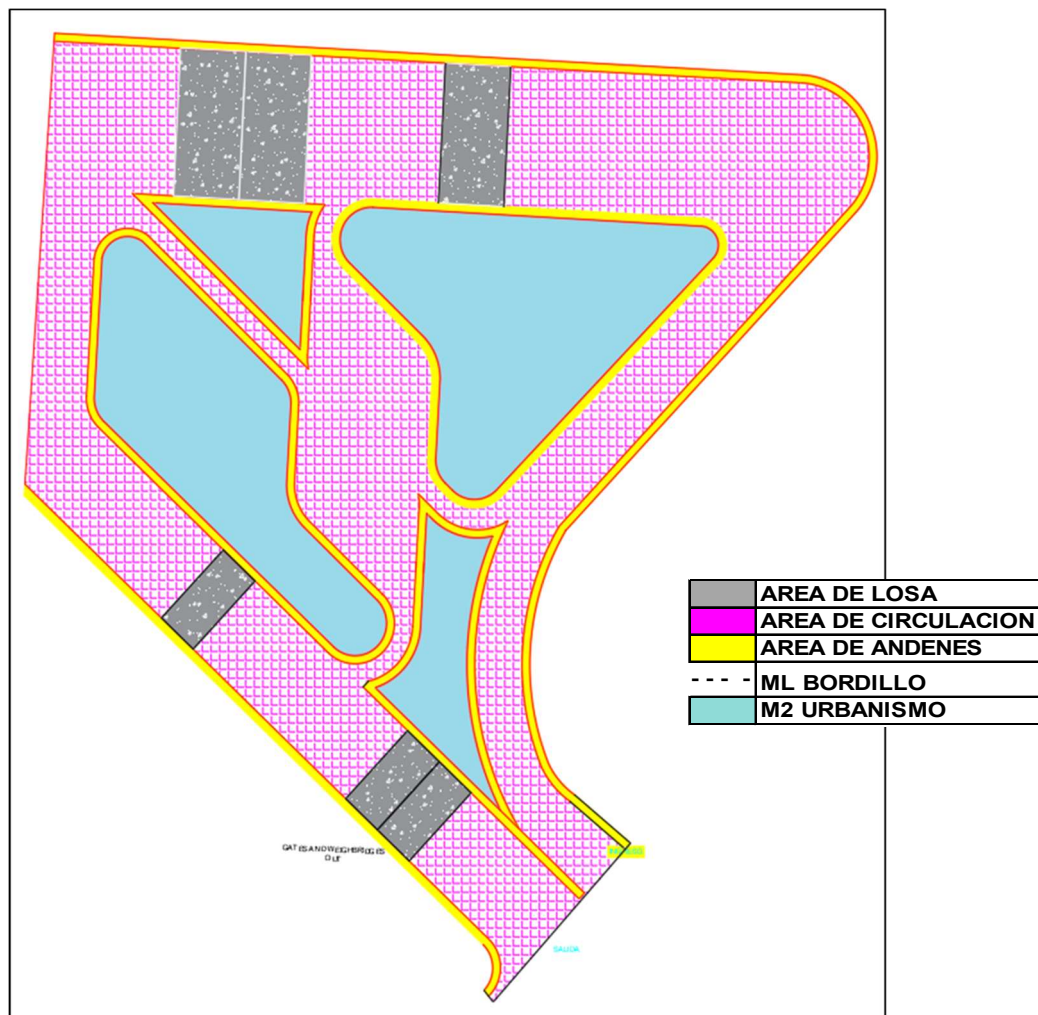


Photo 74 – Gate Complex Pavement Layout

According to the Clarification N° 23 The solution for this area there will be the described in the document “20181217 INFORME DE DISEÑO DE PAVIMENTO Patio 6”, into the numeral 2.1.1 conclusion and recommendations, the solution consists in a Pavement milling of 5.0 cm.

In this area, work will begin with milling of the existing pavement structure on the Road's area, removal and rethinking of the new layout of the Gate Area complex. Once these preliminary works have been completed, in the road area (indicated in Magenta) will be carried out to subsequently place the infrastructure to supply the needs of the Gates, OCR and TSB areas. Once these works are completed, the pavement structure will be replaced according to design; at the same time the approach slabs for the Gates area and OCR area will be built and finally the rolling layer will be placed

#### 4.7.2. Resources

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##### 4.7.2.1 Common Base (C25/30) and Sub-base (CBR >80%)

**Materials:**

- Sub base CBR>80%
- C 25/30 (concrete base)

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Heavy machine operator

**Equipment and tools:**

- GPS based total station
- Hand operated tamper / vibratory plate compactor
- Roller
- Dump truck
- Excavator
- Motor grader
- Nuclear densimeter

##### 4.7.2.2 Concrete Block Pavers - CBP

**Materials:**

- SAND (according to ASTM C33)
- CONCRETE PAVERS (200mm\*100mm\*80mm) (T = 3.8 mpa)
- GEOTEXTILE 450g/m<sup>2</sup>

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker (concrete, rebar, formwork)
- Heavy machine operator

**Equipment and tools:**

- Trucks
- Forklift

- Vibrator roller
- Bobcat
- Hand tools
- Total station
- Level

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#### 4.7.2.3 Reinforced Concrete

##### **Materials:**

- Concrete
- Rebar fy 4200 kg/cm<sup>2</sup>

##### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker (concrete, rebar, formwork)
- Heavy machine operator

##### **Equipment and tools:**

- Survey equipment
- Excavator
- Dump truck
- Loader
- Roller
- Sprinkler
- Concrete mixer truck

#### 4.7.3. Procedure

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##### 4.7.3.1 Common Base (C25/30) and Sub-base (CBR >80%)

The Base and sub base will be prepared carefully, in order to allow a pavement structure of an adequate and uniform thickness. This allows to provide a homogeneous bond between the concrete slab, or pavers, and its foundation which is important for the later behavior of the pavement structure.

It will always be avoided that water is sucked from the cement paste into the substructure or the base.

This will be accomplished by applying a plastic sheet on the substructure of the pavement. The latter work will be done with care, to prevent the sheet from tearing or being pulled loose by the wind

###### 4.7.3.1.1 CONCRETE BASE C25/30

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- The template installation should be stable, horizontal and vertical, and the adjacent template joints should be tight and smooth, and there should be no leakage or height inequality.**

- ii. -There may be a gap between the supported formwork and the ground, and we will use cement mortar to seal the gap before pouring.
- iii. -C25/30 concrete should be mixed in strict accordance with the design mix ratio. After the mixing procedure is completed, transport the concrete by a concrete tanker.
- iv. -It should be sprinkle water on the surface of the pouring area 10-20 minutes before pouring the concrete. After the concrete is transported to the site, it has to pouring directly from the tanker into the template, and make it uniform by mason.
- v. After the concrete is poured, using vibrating bar for vibrating it , and at the same time continuing to pour new concrete.
- vi. -After the concrete is vibrated and compacted, roughly leveling it with the scraper first. After the moisture of the concrete surface layer evaporates 80%, then finish the surface. Polishing the surface twice with a sander; using mason for surface finishing.
- vii. -After completing the surface finishing, should cover the concrete with geotextile and spray water on it to keep the concrete wet at least 7 days for maintenance.
- viii. When constructing the site, it is planning to support the template to be 24m long and 6m wide. This size is a typical construction size. When the length and width are not met, it is adjusted according to the site conditions.
- ix. -All construction joints and expansion joints are covered with a geotextile (150g/cm<sup>3</sup>) before laying the medium coarse sand and glued to the concrete surface with bitumen.

#### 4.7.3.1.2 Sub-base CBR > 80%

- i. Location of facilities shall be directed by land surveying crew according to set up layout.
- ii. Surveying benchmarks shall be set-out by Land surveying crew.
- iii. According to the location to be backfilled and compacted, the sub base will be placed, in uniform layers to a depth no longer than 250 mm and compacted using (depending of each case) a hand operated tamper, plate compactor or roller compactor until reaching level indicated in drawings and the density solicited. (In places that do not allow the use of heavy machine to compact, the layers should not be made deeper than 150 mm)
- iv. In any case the Contractor must take care the Proctor test results and monitor the moisture of the material prior to the compaction and in the middle of the process to obtain an optimal compaction by layer.
- v. After the compaction of each layer a surveyor team will record the levels to be able tracking all the process.

#### 4.7.3.2 Concrete Block Pavers - CBP

##### 4.7.3.2.1 SETTING OUT

Consideration will be given to the laying pattern and the orientation of laying pattern. This will be provided by the Designer and shown on the detailed drawings. However, it is often the case with slabs/flags, that a width may be specified and random lengths at the pavior's discretion. Setting out of datum points will be materialized in order to assist in to achieving falls, straight lines, curves etc.

For dimensionally large project as this one, in order to ensure consistent alignment, it will be helpful to set out a reference grid using flush nails or paint, typically on a 10m x 10m grid or bigger over the base surface. Major lines are also to be set out according to datum points.

Areas of paving demarcated by boundaries such as change in level, change in pattern or type of paving unit or other perimeter feature will have the lengths of all sides and diagonals measured at final surface levels, to confirm in advance of laying that the effect of longitudinal falls, cross falls, setting out errors

or other unforeseen factors will not prevent the specified paving patterns being achieved using the paving elements provided for the contract.

When perimeters and major lines have been confirmed and feasibility checked, minor lines should be set up at intervals, in advance of laying, to represent a multiple of paving unit width plus joint width. This will prevent the pattern locally overtaking the major lines of the pattern and also prevents joint widths increasing abnormally.

Paving materials should be stored in an appropriate location, to minimize trafficking on the prepared base during installation.

#### 4.7.3.2.2 LAYING PATTERN

For a rigid pavement construction, laying pattern generally makes a negligible contribution to the overall structural integrity of the pavement. If excessive strain occurs within the pavement surface course, due to thermal contraction or movement of the base, cracks might become focused along a continuous line of joints. However, this is not a problem which laying pattern may prevent.

The laying pattern must conform to that given in the drawings. Some simple rules need to be followed:

- A cut is required at any change in surface shape to prevent lipping. It is accepted that this can lead to triangular shapes which contravene the rules about cutting given below.
- Straight joints are usually provided in one direction but stepped joints in the other direction.
- Joint widths must be within the permitted range.
- With cropped setts, sufficient space must be allowed everywhere for grout to run easily into the joint.

The standard details at drainage features and other ironwork must be followed, especially if an expansion joint detail is specified.

#### 4.7.3.2.3 JOIN WIDTH

When laying a rigid pavement, joint width is an important factor.

The purpose of the mortar joint is to prevent ingress of water during the service life of the pavement and to provide structural integrity to the surface course. Jointing mortar contributes both strength and flexibility to the pavement surface.

Minimum joint width is a function of both the maximum particle size within the jointing mortar and the degree of flexibility it is intended to provide in conjunction with the paving units. Joint width is to be set by the detailed drawings.

#### 4.7.3.2.4 CUTS AND CUTTING IN

The paved area will be covered as far as possible with full sized paving units.

Longer units will be employed at ends of rows, in preference to cutting down standard units so that length is less than the shortest specified unit length.

Where trimming will be required, cut sizes smaller than a third of the original plan size of the paving unit will be avoided as possible. Cut units will be laid concurrently as paving proceeds. With rigid paving it is not permissible to leave gaps in the surface course, to be filled at a later time. If this is unavoidable, e.g. because of the unavailability of a cover, all bedding mortar not covered by a unit will be removed.

#### 4.7.3.2.5 PREPARING THE BASE

Rigid pavements require a sound, strong physical connection between base material and bedding mortar. For a bound base this means an effective adhesion bond, for an unbound base this means an effective frictional connection. Both require cleanliness.

For the purpose the pavement will be laid upon a bound base, the surface will be cleaned of all debris and dust prior to the laying of the bedding mortar. Cleaning with water will be done removal of all loose materials. Any contaminants such as hydraulic or fuel oil spillage will be thoroughly removed, using chemical and mechanical means as required.

The base will be checked for level to ensure the laying course will be the correct thickness. If is too high material will be removed. If it is too low the whole base will be removed and replaced or a proprietary product solution may be used.

#### 4.7.3.2.6 PREPARING PAVING UNITS

A rigid pavement requires a strong adhesion bond between paving units and both bedding and jointing mortar. Paving units will have all dust and debris removed from all faces. Cleaning with water will be done at a timing sufficiently short prior to laying in order to avoid recontamination.

#### 4.7.3.2.7 INSTALATION OF PAVING UNITS

Before paving starts all necessary tools will be prepared and ready for use. The essential tools typically required for this procedure are:

- Mixing machine for bedding mortar.
- Barrow for transporting bedding mortar from mixer to point of laying.
- Shovel for moving bedding mortar and general handling of dry or blended mortar products.
- Trowel for preparing and levelling bedding mortar.
- Tub and mixing equipment for adhesive priming mortar.
- Brush or trowel for applying adhesive priming mortar.
- Tub or bucket for cleaning water.
- Sponge for cleaning.
- Short wooden level.
- Long level.
- Sett hammer – weight relevant to size of paving unit.
- String lines for setting out rows and patterns.
- Cutting equipment if required.

A small sample area will be prepared to confirm that the specified mix is suitable for the paving units being laid and to confirm surcharge height.



Bedding mortar will be laid to a previously defined surcharge height to allow for compaction to line and level when tamping down the paving element, however a lower height may be adopted if the test procedure confirms that full contact has been made between bedding mortar and the underside of the paving unit and that no voids exist in the bedding mortar. A close visual examination of the laid bedding will confirm this fact when a laid paving unit is lifted as a check.

The surface of the cement treated base is to be coated with the bedding mortar laid out for a minimum width of two rows of paving units, to the required surcharge height. This is to ensure adequate stability of the freshly laid bedding mortar adjacent to paving units being placed and aligned.

The bedding mortar shall not at any time be spread in advance of more than 4 rows of paving units. The fresh bedding mortar will be levelled prior to placement of each paving unit using either a trowel or the blade of the sett hammer.

The underside of the paving unit is to be coated with priming mortar immediately prior to the paving unit is being placed onto the fresh bedding mortar. Priming mortar will be applied by brushing or trowel. In every case it will be ensured that the underside of the paving unit is fully wetted out with the adhesive priming mortar and that the surface is fully coated.

Adhesive priming mortar will be applied to a thickness according to manufacturer's instructions, and will not under any circumstances be applied to one or more paving units in advance of their being placed on the bedding mortar.

Paving units will be hammered firmly to line and level without delay and thereafter they will not to be disturbed.

The short level will be used to slide across the freshly laid paving units and check for lips and local level. The long level will be used to check level over wider areas.

#### 4.7.3.2.8 PROVISION OF CONTRACTION JOINTS.

Contraction joints in the surface course of a pavement laid over a non-rigid bound base, such as a cement treated base, shall be positioned where it is most convenient for the setting out and laying pattern of the surface course.

A vertical strip of polythene membrane will be introduced within a line of open joints along the line of the proposed contraction joint. The polythene strip will be set within the bedding mortar, for its full depth, and allowed to stand freely upright in the open joint, for its full height. None of the polythene strip is allowed to protrude above the surface of the pavement. Jointing mortar will be used to fill the joint void, uncontrolled, finding its own level each side of the polythene membrane thus forming an induced break or contraction joint.

#### 4.7.3.2.9 GROUND OF MORTAR JOINTS.

Fresh pavement jointing mortar will be a pourable self-compacting grout which, when applied, fills the joint in one operation.

Paving units will not have their joints filled to within 2 mm to 3 mm of their top surface. Jointing mortar shall not be allowed to rise to be flush with the pavement surface.

The application will be done by pouring the grout over the area and using a squeegee to spread and guide the slurry into the open joints. Alternatively, and where required, the application will also be achieved by using a can with a fine nozzle, or by injecting the joint with a handgun.

Before starting to grout the joints it will be ensured that necessary tools are prepared and ready for use. The essential tools typically required for this procedure are:

- Mixing machine for jointing mortar.
- Barrow for transporting jointing mortar from mixer to point of work.
- Alternatively: Tub and mixing equipment for jointing mortar.
- Suitable squeegee for spreading fresh mortar.
- A pressurized fresh water supply with a flexible hose capable of reaching all extents of the area to be jointed.
- Optional – a grout cleaning machine.

Joints shall be clean and cleared of all foreign matter. The area to be jointed shall be thoroughly soaked with clean water and maintained in a wet condition until jointing mortar is applied.

Jointing mortar shall be mixed to a free-flowing liquid slurry grout. When using a proprietary mortar product, the manufacturer's method statement shall be consulted and adopted.

Freshly mixed mortar will be spread over the surface whilst the surface is wet and the mortar will be forced into the open joints using the squeegee.

Water shall be applied to the surface at any time in the form of a fine spray, to prevent drying of the mortar on the surface. When further settling of the fresh mortar within the joints has ceased, excess mortar will be removed using the squeegee.

Water will be immediately applied to the surface in the form of a fine spray, taking care not to disturb the mortar in the joints, until the surface is thoroughly wetted. Water and excess water will then be removed using the squeegee.

The process of wetting and removal will be repeated; water always being applied to the surface in the form of a fine spray, taking care not to disturb the mortar in the joints. The surface is thereafter maintained in a damp condition by periodic application of water in the form of a fine spray. It shall never be allowed to dry, even in small places, until final cleaning is done. The surface will be rinsed clear with clean water after sufficient time has elapsed for the joint mortar to have become sufficiently stable to resist action of cleaning.

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#### 4.7.3.3 Reinforced Concrete

##### 4.7.3.3.1 MIXING AND TRANSPORT CONCRETE

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The concrete mixing plant will have sufficient capacity in order to be able to continuously supply concrete to the paving machines. The ready-mix, its constituents and admixtures will be previously tested and approved before its application.

The loading equipment for the materials shall be in good condition and shall have sufficient capacity to be able to continuously feed the bins. The bucket of the loaders shall not be wider than the bins. The content of the cement silos and the water tank are in proportion to the production rates.

A communication system between the concrete mixing plant and the construction site will be put in place in order to coordinate the batching and paving operations.

Sufficient trucks will be available to continuously supply the paving machines. The number of trucks will depend on the yield at the construction site, the loading capacity of the trucks and the cycle time (i.e. the transport time plus the time required to load and unload a truck). The loading capacity and the type of truck to be used will depend on the nature of the work, the haul roads and the concrete paving machines.

The necessary measures will be taken to prevent changes of the water content and temperature of the concrete during transport.

#### 4.7.3.3.2 FORMWORK AND STEEL REINFORCEMENT PLACING

A formwork will be placed, aligned and leveled according to the detailed designs. In order to place the side forms properly the alignment of the runway has to be staked out carefully. This will be accomplished by driving iron rods firmly into the subgrade soil or the base at a spacing of maximum 5 m. The elevations corresponding to the top of the forms will be marked on the rods and they are connected with a string line that will be coincident to the top of the forms.

Steel assembly will be done ensuring that the type and number of bars is in accordance with the design and specification.

The longitudinal and transverse reinforcement will be transported, unloaded and stored at the construction site in compliance with specific rules:

- delivery in packs that contain exactly the number of bars that are required to make the reinforcement mesh for the entire pavement width;
- unloading these packs with a crane equipped with a loading beam to uniformly suspend the steel pack so as to avoid permanent deformation;
- storage of the packs in clean areas.

The transverse reinforcement is placed on the base, at intervals that are checked with templates. Subsequently the longitudinal bars are laid on the transverse reinforcement bars, in such a way that bar splices are skewed at an angle that depends on the width of the pavement. At each splice the two bars are tied together with two iron wires.

#### 4.7.3.3.3 PLACING THE CONCRETE

All equipment necessary for executing the paving will be present on site and has to function properly. This concerns primarily: manual needle vibrators and vibrating screed, equipment for floating the concrete surface, for applying the curing compound, for sawing the joints, etc.

This equipment will meet both the requirements for quality and for the envisaged rate of production.

The profile of the finishing equipment has to be even, in order to obtain a good final pavement smoothness. To check this, a gauge will be placed at each end of the screed to be controlled. Subsequently, a string is tensioned between the two gauges and the distance between the string and the finishing surface of the screed is measured at various points. Another method that may be used consists of checking the evenness with a level and levelling rod.

The consolidation equipment will be able to generate uniform vibrations with the right frequency and amplitude.

The concrete will be supplied by truck mixers and will be offloaded between the forms and spread with the help of a crane or an excavator. The drop height of the concrete mix will be limited and the concrete piling will happen gradually so as to prevent segregation or pre-consolidation. The supply and the placement of the concrete will be synchronized to the same rate, on the one hand to avoid interruptions in the placement of the concrete and on the other hand to avoid that too much time is elapsing between depositing and finishing the concrete.

The concrete will be consolidated with manual needle vibrators and a vibratory screed. The consolidation will happen first with the manual vibrators, in particular along the edges and subsequently with the vibratory screed. The freshly placed concrete edges will be strutted by the side forms or by adjacent linear elements or existing paving slabs.

The finishing will be completed by using a hand float attached to a handle by a double hinge.

#### **4.7.3.3.4 EXECUTION OF JOINS.**

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All the equipment that is necessary to make joints in the fresh or hardened concrete will be present at the construction site.

The saw blades will be suitable to the quality of the concrete, i.e. to the hardness and the abrasion resistance of the aggregates.

The beam for making a construction joint shall be rigid and shall allow the realization of a straight joint perpendicular to the axis of the runway. This beam will be adapted to the type of pavement.

##### **Contraction joints**

Crack onsets will be executed to avoid uncontrolled cracking of the concrete by shrinkage. Contraction joints have a crack onset will extend to a depth defined in the detailed drawings. These will be made by sawing. The saw cutting shall occur as soon as possible, between 5 and 24 hours after placement of the concrete and ensuring that the concrete has hardened sufficiently in order to prevent the edges of the joint from being damaged.

After having made the crack onset, the concrete surface along the joint shall be smoothened again. However, manual corrections shall be kept to a minimum since they can cause spalling of the joint edges later.

##### **Expansion joints**

Expansion joints will be executed according with the detailed drawings. The execution of expansion joints will require special attention as per the following:

- the wooden joint filler board shall be firmly attached to the base by means of metal stakes, so that it cannot move while the concrete is being placed;
- the height of the joint filler board shall be slightly (2 to 3 cm) shallower than the thickness of the concrete slab, in order not to hinder the placement of the concrete. As soon as the concrete has been placed, the concrete above the joint filler board shall be removed over a width at least equal to the thickness of the board, so that no “concrete arch” is made at the top of the joint;
- expansion joints shall always be provided with dowels. At one end of each dowel a cap filled with a compressible material accommodates the movements of the concrete.

### **Construction joints**

Construction joints - also called end-of-day or working joints – will be executed at the end of the daily production or when the paving process will be foreseen to be interrupted for at least 2 hours. The face of these joints will be plane, vertical and perpendicular to the axis of the pavement. These joints will always be doweled.

Upon resuming the paving, the fresh concrete is placed against the concrete that has already hardened. The concrete will be consolidated on both sides of the joint with a separate manual needle vibrator.

### **Sealing the joints**

Joints are to be sealed with a joint sealant to prevent water infiltration under the paving slabs in the future. To this end, hot or cold joint sealants or prefabricated joint can be used. To achieve a durable seal, this work will be done with the utmost care.

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## **4.8 ROADMARKING**

The scope of this construction method is proposed to complete the line marking on all the pavements inside the port.

### **4.8.1. Resources**

#### **Materials:**

- Primer
- High traffic paint

#### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

#### **Equipment and tools:**

- Air compressor
- Hydro cleaner

- 
- Spreaders (pressure paint applicators)

#### 4.8.2. Procedure

- Prior to any paint application, the surface will be cleared of all dirt, loose material and other contaminants. A hydro cleaner machine will be used to clean the area. If any particles are needed to remove, an air compressor will be used; additionally, the area should be completely dry. If it is not, the contractor will wait until is dry or will use a drying machine.
- Before applying the paint, a primer will be applied all over the painting area. The primer thickness is around 25 microns.
- The area will be paint with traffic paint by using Spreader pressure painting equipment and template for ensuring the shape of the symbols and lines, please refer to pictures below. The control speed and the thickness of the paint must be pre-calibrate in the machine and tested; The surface will be paint in two coats. It will have a minimum thickness of 350 microns for each layer of line marking. Depends on the planning the two coats can be painted in the same shift, waiting the required full drying time for the product used. Or, in a big area all the line marks will be done the first layer and other day finish with the second coat.
- Immediately after the paint be placed, should be spread the glass bead all over the painted area. The glass beads are type 1. The beads will be embedded in the paint by gravity.
- All the area must be signaled to prevent the pass of any vehicle or person.



## 4.9 BUILDINGS

### 4.9.1. Main Buildings - Definitions

#### 4.9.1.1 CSW - Cold Storage Warehouse

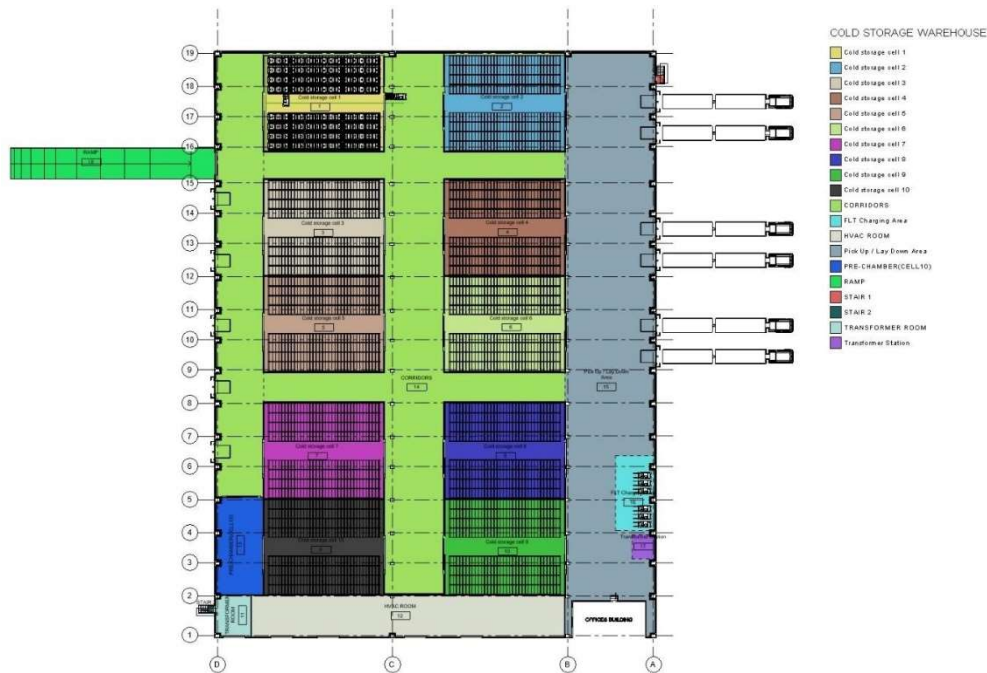


Photo 75 - Cold Storage Warehouse Layout

#### Rooms Material Datasheet

- Walls

To this building will be considered metallic panel system with PIR thermal core to the interior walls, to the exterior walls will be considering metallic panel with a purlins of reinforcement structure to the cladding.

- Floors

The floor will be made of concrete slab, and a dry shake topping, except the -25-degree cell this will be had an epoxy paint over.

The floors of the cells area will be having a PIR panel bellow the concrete slab.

- Ceiling

To the cell ceilings of PIR panel will be supported on the top of adjacent walls, where necessary, suspended from the main structure steel work.

To the rest of the warehouse the ceiling will be a drywall water resistant.

- Roof

The roof Panel will be made of PIR insulated with a steel cover.

- Doors and windows

All the doors for this building will be insulated, except the machine areas.

The windows will be made with a double glazed and cover with an aluminum louver.

- Finishing datasheet

750 - COLD STORAGE WAREHOUSE					
Number	Name	Area	Wall Finish	Ceiling Finish	Floor Finish
1	Cold storage cell 1	313 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
2	Cold storage cell 2	313 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
3	Cold storage cell 3	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
4	Cold storage cell 4	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
5	Cold storage cell 5	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
6	Cold storage cell 6	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
7	Cold storage cell 7	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
8	Cold storage cell 8	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
9	Cold storage cell 10	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Concrete with dry shake topping
10	Cold storage cell 9	314 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Quartz epoxy flooring finishing
11	TRANSFORMER ROOM	39 m <sup>2</sup>	PIR PANEL 60MM	NONE	Concrete with dry shake topping
12	HVAC ROOM	357 m <sup>2</sup>	PIR PANEL 60MM	NONE	Concrete with dry shake topping
13	PRE-CHAMBER(CELL10)	124 m <sup>2</sup>	PIR PANEL 100MM	PIR PANEL 100MM	Quartz epoxy flooring finishing
14	CORRIDORS	1860 m <sup>2</sup>	PIR PANEL 60MM	RH GYPSUM	Concrete with dry shake topping
15	Pick Up / Lay Down Area	1254 m <sup>2</sup>	PIR PANEL 60MM	RH GYPSUM	Concrete with dry shake topping
16	FLT Charging Area	79 m <sup>2</sup>	PIR PANEL 60MM	RH GYPSUM	Concrete with dry shake topping
17	Transformer Station	15 m <sup>2</sup>	PIR PANEL 60MM	RH GYPSUM	Concrete with dry shake topping
18	RAMP	171 m <sup>2</sup>	STEEL PANEL EXTERIOR	NONE	Concrete floor finishing
19	STAIR 1	4 m <sup>2</sup>	STEEL PANEL EXTERIOR	NONE	Concrete floor finishing
20	STAIR 2	3 m <sup>2</sup>	STEEL PANEL EXTERIOR	NONE	Concrete floor finishing
<b>Grand total</b>		<b>7046m2</b>			

Table 6 - Cold Storage Warehouse Finishing Datasheet

#### 4.9.1.1.1 COLD STORAGE WAREHOUSE OFFICES

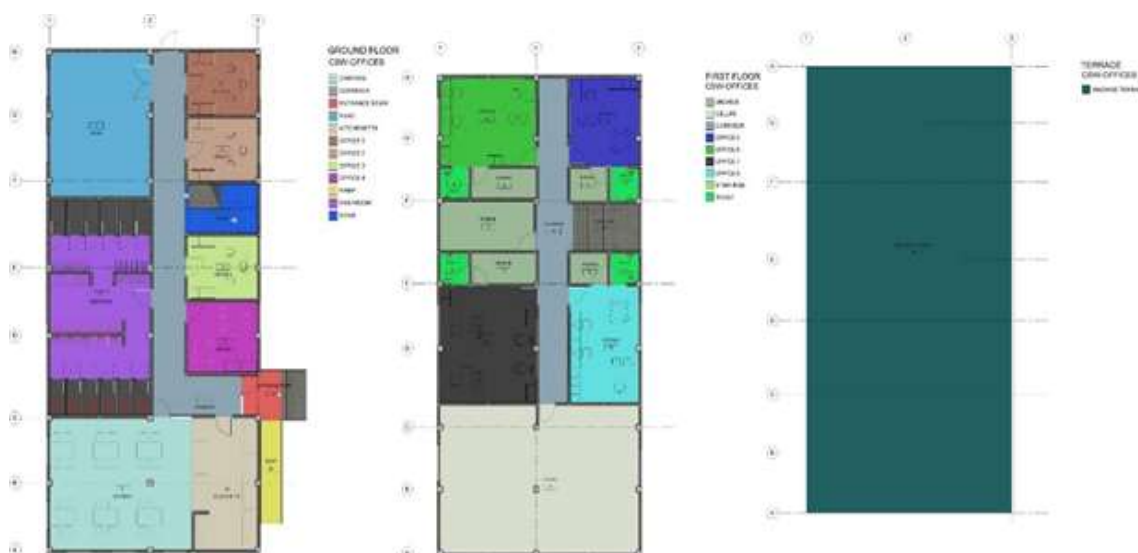


Photo 76 - Cold Storage Warehouse Offices Layout

#### Rooms Material Datasheet

- Walls

To this building will be considered block works of 15 and 20cm, plaster and painted. To the toilets will be cover with ceramic tiles 30x30 full height.

#### GENERAL ASPECTS

##### 4.2.1 I) Arrangements and Construction Methods Statements – rev A

- Floors

The floor will be having a porcelain tiles 60x60cm to interior and restrooms will be having ceramic tiles 30x30cm.

- Ceiling

To the toilets areas the ceiling will be a drywall water resistant. For the rest will be Armstrong type 60x120cm.

- Roof

The roof Panel will be made of PIR insulated with a steel cover.

- Doors and windows

All the doors for exterior will be metallic and to the interior will be wooden doors. The windows will be double glazed.

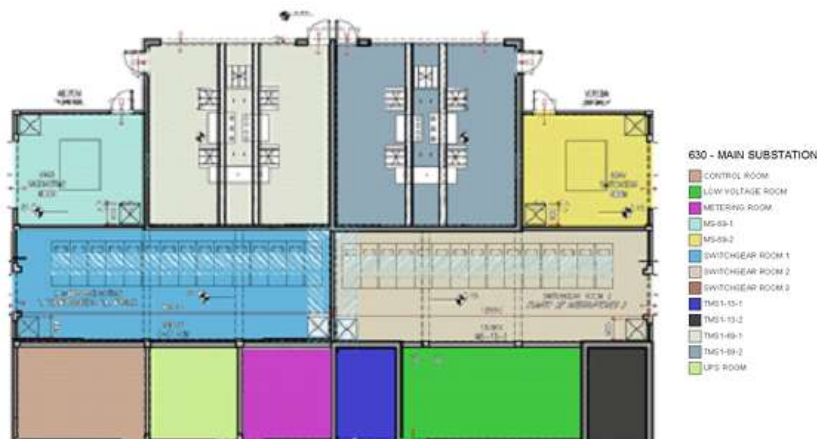
- Finishing data sheet

750 - COLD STORAGE WAREHOUSE OFFICES					
Number	Name	Area	Wall Finish	Ceiling Finish	Floor Finish
1	CORRIDOR	40 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
2	OFFICE 4	14 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
3	OFFICE 3	13 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
4	STAIR	10 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
5	OFFICE 2	13 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
6	OFFICE 1	13 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
7	HVAC	41 m <sup>2</sup>	Plaster and Paint	NONE	SCREED CEMENT
8	RESTROOM	39 m <sup>2</sup>	Ceramic tiles 300X300 full height	RH GYPSUM PANEL	CERAMIC TILES NON SLIP 300X300
9	CANTEEN	53 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
10	KITCHENETTE	24 m <sup>2</sup>	Ceramic tiles 300X300 full height	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
11	OFFICE 5	19 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
12	TOILET	3 m <sup>2</sup>	Ceramic tiles 300X300 full height	RH GYPSUM PANEL	CERAMIC TILES NON SLIP 300X300
13	ARCHIVE	4 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	CERAMIC TILES NON SLIP 300X300
14	OFFICE 6	26 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
15	ARCHIVE	6 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	CERAMIC TILES NON SLIP 300X300
16	TOILET	3 m <sup>2</sup>	Ceramic tiles 300X300 full height	RH GYPSUM PANEL	CERAMIC TILES NON SLIP 300X300
17	ARCHIVE	15 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	CERAMIC TILES NON SLIP 300X300
18	TOILET	3 m <sup>2</sup>	Ceramic tiles 300X300 full height	RH GYPSUM PANEL	CERAMIC TILES NON SLIP 300X300
19	ARCHIVE	6 m <sup>2</sup>	Plaster and Paint	NONE	CERAMIC TILES NON SLIP 300X300
20	OFFICE 7	35 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
21	CELLAR	91 m <sup>2</sup>	Plaster and Paint	NONE	CERAMIC TILES NON SLIP 300X300
22	OFFICE 8	25 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
23	TOILET	3 m <sup>2</sup>	Ceramic tiles 300X300 full height	ARMSTRONG TILES 600X1200	CERAMIC TILES NON SLIP 300X300
24	ARCHIVE	4 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	CERAMIC TILES NON SLIP 300X300
25	CORRIDOR	31 m <sup>2</sup>	Plaster and Paint	ARMSTRONG TILES 600X1200	PORCELAIN TILES 600X600
26	STAIR RISE	10 m <sup>2</sup>	Plaster and Paint	NONE	RISER
27	ENTRANCE STAIR	9 m <sup>2</sup>	External Plaster and Paint	NONE	CONCRETE FINISH
28	RAMP	6 m <sup>2</sup>	External Plaster and Paint	NONE	CONCRETE FINISH
29	MACHINE TERRACE	6 m <sup>2</sup>	External Plaster and Paint	NONE	CONCRETE FINISH
Grand total		559m <sup>2</sup>			

740 - Gate complex – Troubleshooting building					
Number	Name	Area	Wall Finish	Ceiling Finish	Floor Finish
1	OFFICE	35 m <sup>2</sup>	PLASTER AND PAINT	ARMSTRONG TILES 60X120	PORCELAIN TILES 60X60
2	HALL TOILET	4 m <sup>2</sup>	PLASTER AND PAINT	ARMSTRONG TILES 60X120	PORCELAIN TILES 60X60
3	TOILET 1	3 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
4	TOILET 2	2 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
5	DISABLE TOILET	4 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
6	TOILET 3	3 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
7	WAITING AREA	54 m <sup>2</sup>	PLASTER AND PAINT	ARMSTRONG TILES 60X120	PORCELAIN TILES 60X60
Grand total		105 m <sup>2</sup>			

**Table 7 - Cold Storage Warehouse Offices Finishing Datasheet**

#### 4.9.1.2 Main Substation



#### 4.9.1.3 Reefer E-RTG Substation

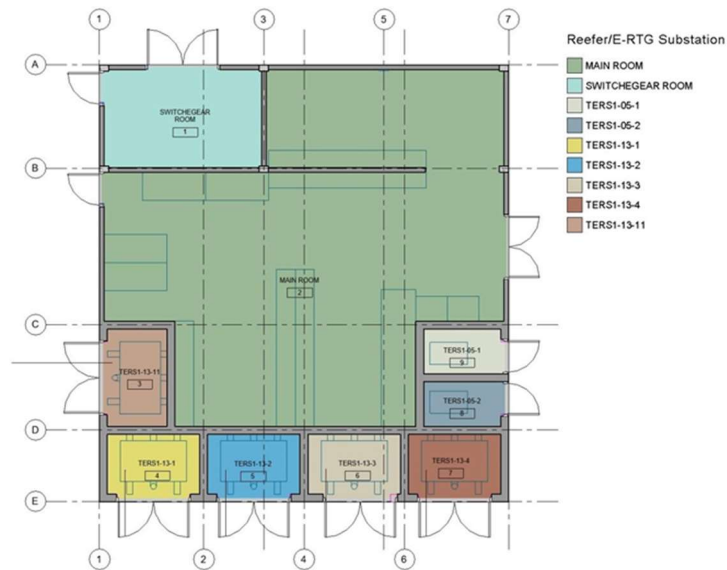


Photo 78 - Reefer E-RTG Substation Layout

#### Rooms Material Datasheet

- Walls

For the perimeter walls 15 cm blocks will be considered, except the transformer room, this will be concrete walls of 25cm (included steel reinforcement)

- Floors

The floor will be made of concrete slab, and a dry shake topping.  
The openings of trench will be closed with a metallic grating, and a galvanized manhole cover.

- Roof

The roof slab will be finished with an insulated coating.

- Doors and windows

All the doors for this building will be metallic  
The windows will be made with mesh in the transformers rooms

- Finishing data sheet

630 - Diesel generator building and Fuel storage					
Number	Name	Area	Wall Finish	Ceiling Finish	Floor Finish
1	SWITCHGEAR ROOM	16 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
2	MAIN ROOM	110 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
3	TERS1-13-11	6 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
4	TERS1-13-1	6 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
5	TERS1-13-2	6 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
6	TERS1-13-3	6 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
7	TERS1-13-4	6 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
8	TERS1-05-2	3 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
9	TERS1-05-1	3 m <sup>2</sup>	Plaster and Paint	NONE	Concrete with dry shake topping
Grand total		160 m <sup>2</sup>			

Table 9 - Reefer E-RTG Substation Finishing Datasheet

#### 4.9.1.4 Troubleshooting Building



**Photo 79 - Troubleshooting Building Layout**

#### Rooms Material Datasheet

- Walls

To this building will be considered steel panel of exterior with a purlin of reinforcement, and to the interior drywall plaster and painted with Rockwool.

To the toilets will be cover with ceramic tiles 30x30 full height.

- Floors

The floor will be having a porcelain tiles 60x60cm to interior and restrooms will be have ceramic tiles 30x30cm.

- Ceiling

To the toilets areas the ceiling will be a drywall water resistant. The rest, will be Armstrong type 60x120cm.

- Roof

The roof Panel will be made of PIR insulated with a steel cover.

- Doors and windows

All the doors for exterior will be metallic and to the interior will be wooden doors. The windows will be double glazed.

- Finishing data sheet

740 - Gate complex – Troubleshooting building					
Number	Name	Area	Wall Finish	Ceiling Finish	Floor Finish
1	OFFICE	35 m <sup>2</sup>	PLASTER AND PAINT	ARMSTRONG TILES 60X120	PORCELAIN TILES 60X60
2	HALL TOILET	4 m <sup>2</sup>	PLASTER AND PAINT	ARMSTRONG TILES 60X120	PORCELAIN TILES 60X60
3	TOILET 1	3 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
4	TOILET 2	2 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
5	DISABLE TOILET	4 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
6	TOILET 3	3 m <sup>2</sup>	CERAMIC TILES 30X30	RH GYPSUM	CERAMIC TILES NON SLIP 30X30
7	WAITING AREA	54 m <sup>2</sup>	PLASTER AND PAINT	ARMSTRONG TILES 60X120	PORCELAIN TILES 60X60
<b>Grand total</b>		<b>105 m<sup>2</sup></b>			

**Table 10 - Troubleshooting Building Finishing Datasheet**



## 4.9.2. Common Procedures

### 4.9.2.1 Formwork and Stripping

The scope of this procedure covers the following elements: footings, beams, walls, columns, slab of foundation and mezzanine, reinforced walls.

Join Venture, will apply the appropriate methods for the formwork and stripping, protecting the life of people, selecting the materials per the application, it should be made of metal or impermeable plywood to give the shape of the structure, using qualified manual labor for this type of work, use of mechanical equipment if necessary to meet the needs of the employer.

#### 4.9.2.1.1 PROCEDURE

The formwork must be properly braced or tied together, so that they retain their position and shape. The forms and their supports must be designed in such a way that they do not damage the previously constructed structure. The design of the formwork must consider the following factors:

- (a) Speed and method of concrete placement;
- (b) Construction loads, including vertical, horizontal and impact loads;
- (c) Special requirements for formwork for the construction of shells, folded slabs, domes, Architectural concrete or other types of similar elements.

Join venture, previously to the casting, will deliver the design of formwork structural calculation for approval by the Engineer

The installation of the formwork will be done with the support of surveying equipment to ensure its location and alignment and leveling both vertical and horizontal.

It will be verified and approved that the formwork is positioned correctly, according to the designs, and must be firmly fixed in such a way that they do not suffer displacements during emptying or allow the leakage of grout.

The formwork will be installed before each emptying, respecting the guidelines provided in the plans, and will be fixed in such a way that they do not move during the casting of concrete.

- In any case, the Contractor must submit all the necessary information about the structure, and they will be as follows:
- Sequence of concrete placement, as a critical factor
- The location and order of assembly and removal of the props for composite construction
- The dimension of the camber necessary for slabs or other structural elements in order to compensate for the deflection of the structure. The camber builds measurements that are achieved should be made at the level of the panel after the initial setting and before removing the supports of the formwork.
- Locations and details of architectural concrete. When the architectural details are to be cast in the structural concrete, they must be indicated or referred to in the structural plans since they can have a key role in the design of the formwork.

- Clamps or steel tensioners that pass through the concrete on one side of the formwork to the opposite side, will be treated in a special way to prevent corrosion with a mixture composed of polymer and protective corrosion inhibitor of environmental climatic agents.

**Important:** However, it is advisable to use an alternative method to this with prior approval of the Engineer.

- The formwork must be designed for a minimum live load of horizontal projection design.

The design load for both combined loads, living and dead must be the minimum design if powered cars are used. Windings and struts should be designed to withstand all horizontal loads, such as wind, cable tension, inclined supports, concrete discharge, and starting and stopping equipment. Wind loads or other windbreaks attached to the formwork must be considered in addition to the loads already mentioned. The horizontal load shall not be less than that of the floor edge design, or 2% of the total dead load in the formwork, distributed as a uniform load per lineal meter of the edge of the slab, whichever is greater.

- For the removal of the formwork from the other parts of the structures, the following minimum terms shall be required:
  - Walls and columns (2) two days
  - Slabs (14) fourteen days

Or as directed by the Engineer, in any case the formwork should be sprayed with a accepted stripping helper to avoid any crack on the element. The supports of the formwork and the struts should not be removed from the beams, floors and walls, until these elements have sufficient strength to support their own weight and any load superimposed

- The life time of the formwork will depend of the material, but in any case will be permit formworks with visible bends, crack or any defect that could carry on defects on the element or a fatality risk for the personal on site.

#### **Materials:**

- MDP plywood
- Steel boards

#### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

#### **Equipment and tools:**

- Mechanical jacks
- Clamps
- Hands tools
- Exterior corner bezels

- GPS base/total station
- Scaffolding

#### 4.9.2.2 Cast in Place Concrete (Foundations, Columns, Beams and Slabs).

This procedure applies to all cast in place concrete works carried on the project, development like a general method of construction. If is necessary, the Contractor will development a specific construction method.

##### 4.9.2.2.1 PROCEDURE

- Prior to any work that involve cast in place concrete the Contractor should verify the tie of the bars and construction joints have been retightened, dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete shall be placed and adequately anchored, dimensions of formwork and shoring a clamping of the formwork will be double checked.
- The weather condition must be checked and in hot weather according to ACI 318- chapter 26.5.5 and in any case do not place concrete during rainstorms or high velocity winds or when rain or high winds are forecast.
- Construction and expansion Joints shall be constructed where and as indicated on the Drawings; the construction joints must be clean and free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
- When the placement consists of several layers, concrete delivery should be scheduled so that each layer is placed while the preceding one is still plastic to avoid cold joints. If the underlying layer has stiffened just beyond the point where it can be penetrated by the vibrator, bond can still be obtained by thoroughly and systematically vibrating the new concrete into contact with the previously placed concrete; however, an unavoidable joint line will show on the surface when the form is removed." ACI's Guide for Consolidation of Concrete (ACI 309R-87)
- According to good construction practice, in any case drop concrete freely into place from height greater than 1.60 meters will be permitted and horizontal layers should not exceed 600 mm in depth and bring up evenly in all parts or forms.
- After concrete placement begins, continue concrete placement without significant interruption. Plan and implement precautions to prevent any delay, between layers being placed, from exceeding 20 minutes. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete
- In any circumstance is allowed add any chemical material that not where specified on the concrete design to change or improve the status of the material on site.
- All curing process should comply with Employer Requirements and ACI 318- 14 chapter 26.5.3 curing concrete.
- If any crack (not superficial) will be detected, the Contractor must development a method statement to repair the crack properly, the Employer should be informed and notified of the procedure adopted.

#### Materials:

CONCRETE (the design should be specified by each element)

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

**Equipment and tools:**

- Batching plant
- Concrete mixer truck
- Concrete pump
- Hand tools
- Plug-in vibratory rod

**Test:**

Tests shall comply with ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field, C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens and other applicable standards.

#### 4.9.2.3 Rebar Works

The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure:**

- Prior to any work start, each bar must have compiled this characteristics:
- All material use in this activity shall be from an approved manufacturer.
- All reinforcing steel shall be free from grease, oil or other harmful material that affect adhesion of concrete to the steel. In case bars get dirty or rusty, shall be cleaned and prepared by brushing with wire brush or with chemicals.
- Steel reinforcement shall be stored in suitable dry conditions to prevent damage, surface contamination and excessive oxidation. Steel bars shall be stored in a storage area designed according the conditions of each working area; additionally, must be classified according similar dimensions or elements. Bars would be safely stored on wooden blocks to avoid dirt and rust.
- Depending on the diameter or quantity of rebar works, cut bars manually (Manual Cutter) or mechanically (Steel rebar cutting machine, metal cut-off saw or angle grinder) at REBAR workshop.
- The cut bars will proceed to be bended (depending on the diameter) manually or mechanically, in any case the schedule bar and drawings must clearly indicated dimensions and bends.

**Materials:**

- Rebar Fy 4200 Kg/cm<sup>2</sup>

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

**Equipment and tools:**

- Rebar cutter/bender
- Hand rebar bender
- Angle grinder
- Rebar work bench
- Metal cutting chop saw
- Forklift
- Hand tools

#### 4.9.2.4 Steel Works Installation

This procedure applies to all steel works installation of the project; this documents has been development like a general method of construction. If is necessary, the Contractor will development a specific construction method.

**Procedure:** General consideration for excavation works

- The elements to be assembled will be stored as far as possible in the same place of the assembly area, so it is necessary to define a place for their correct storage in order to avoid risks for people and the environment. Join venture will assign the place of storage, trying as far as possible, that is close to the place of assembly in order to minimize the transport and movement of trucks inside the work.
- In any case the loading or unloading of elements will be done with the use of a crane, and its capacity will be determinate by the weight of the element to be moved, the angle and high of the lifting
- The supervisor must inspect that the equipment and tools are in optimum condition, prior to the execution of the work. Personnel should use PPE according to the recommendations given by supervisor in charge
- All the elements that can be pre-assembled on floor must be assembled before to be lifted.
- The area of lifting should be signaled and must be free of any obstacle.
- Before to any lifting all the sling, rope or chains should be inspected.
- Immediately after the element will be on position should be tie or assured to a stable base or structural element.

**Materials:** Non-applicable

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

**Equipment and tools:**

- Crane
- Slings, rope or chains
- Hand tools
- Mechanical jacks

**4.9.2.5 Masonry Works**

**4.9.2.5.1 CONCRETE BLOCKWORKS 0.15M, 0.20M AND 0.25M.**

The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure**

**Preliminary considerations Concrete**

The concrete preparation, concrete supplier, cast in place, curing etc. will be carried out according to the respective method of concrete.

**Admixtures**

Admixtures, chemical components or alike will be mixed according to the manufacturer and previously approved the material.

**Concrete mix used for blocks**

This material shall be pre-designed to give a minimum crushing strength of 50 Kg/cm<sup>2</sup>. Concrete shall be mixed in the mechanical mixer.

Curing and Drying of blocks shall be continuously moist for at least 14 days. Cured blocks shall be allowed to dry for a period of 4 weeks before being used for allowing their initial shrinkage before they are laid in the wall.

**Blocks**

All specifications of solid concrete blocks, including specifications for actual dimensions, tolerances, sizes, shapes and webs, grades of blocks etc. shall conform to NTE INEN 3066.



All blocks shall be sound and free of cracks or other defects. For exposed construction, face or faces shall be free of chips or other imperfections, and the overall dimensions of the blocks shall be in accordance to tolerance as specified.

### **Methods on site**

Before starting the block works should be slightly moistened to avoid absorption of water from mortar some minutes previously to install.

Joints shall not be bigger than 8 mm and will be perfectly horizontal and vertical. Joints shall be raked 10 mm deep while mortar is wet.

The following measures should be taken like recommendation to prevent formation of cracks:

- a) While curing, the block masonry should be lightly sprinkled with water and not made excessively wet.
- b) Expansion joints shall be provided in walls exceeding 30 m in length.
- c) Reinforcement should be provided in the bed joints in block work, one course above and below windows and one course above doors, in order to distribute the shrinkage/ temperature stresses occurring at the corners of openings more uniformly throughout the walls.
- d) A reinforced to masonry will be made by concrete column variation of 75mm to 150 mm thick and width equal to block masonry thickness according reinforcement specification.

### **Mortar**

Mortar for masonry shall be prepared in accordance with NTE INEN 2518. The mix proportions shall be 1:6 for 200 mm or thicker walls and 1:4 for thinner walls. In preparing the cement mortar, the components shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of the required consistency. The prepared mortar shall be used within 30 minutes of mixing.

The aggregate shall be according to NTE INEN 2536

### **Curing of masonry**

Masonry work as it progresses will be well watered/cured on both faces for at least 10 days after completion. All green work shall be protected from rain by suitable coverings using plastic membranes.

### **Materials:**

- Cement
- Concrete
- Blocks 15cm, 20cm and 25cm
- Water
- Plastic membrane

### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer

- 
- Quality control manager
  - Health & safety manager
  - Worker
  - Equipment operator

**Equipment and tools:**

- Spirit level
- Wooden/Aluminum straight edge 3 m long
- Mason Square
- Line and pins
- Plumb rule
- Boning rods
- Trowels
- Spades
- Mortar pan
- Circular Saw

#### 4.9.2.5.2 CONCRETE PLASTER – INTERIOR AND EXTERIOR.

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The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure**

Internal Plastering on surfaces of Brick and Concrete

Surface where plastering is to be done should be cleaned.

Level pegs on walls will be fixed with reference to the off lines to brick walls set out in floors. (Using center plumb bob and nylon thread).

All the brick walls will be watered before pasting mortar on walls.

First coat mortar filling up to 15 mm will be applied on surfaces where required mortar thickness exceeds 25mm.

Vertical joint of structural columns / walls & brick walls will be treated by fixing 200mm width mesh with wire nails / concrete nails by centering the mesh to the vertical wall joint.

All the embedded service lines and provisions (Conduits, Boxes and etc.) will be completed on brick walls and check with the MEP drawings.

Joints between walls and beams will be formed up to a maximum of 20mm and will be sealed using 30 minutes' fire rated flexible filler.

Internal plastering on surfaces of concrete columns, beams & walls which are aligned with surfaces of brick walls will be plastered and other concrete surfaces will be finished with cement base easy plaster.

**External Wall Plastering**

Alignment and fixing level pegs on external wall surfaces will be done using the surveying instrument / center plumb bobs.

Projections on the wall surfaces will be chipped off and cleaned after completing the level pegs on walls.

First coat mortar filling up to 15 mm will be applied on surfaces where required mortar thickness exceed 25mm.

Cement paste on concrete surfaces will be applied to improve the bonding of plaster to the concrete surfaces.

Maximum width of 20mm horizontal grooves between walls and beams will be formed by cutting using grinders with diamond wheels after plastering the wall surface. This groove will be filled with approved weather sealant.

External wall plaster will be finished with rough surface.

1:10 slope at the external side of the window sill will be formed while plastering the window reveals.

**Materials:**

- Standardized Cement mortar (Approved by Employer)
- Water
- Stucco
- Sealer (Approved by Employer)

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

**Equipment and tools:**

- Wooden/Aluminum straight edge 3 m long
- Meter steel tape
- Line and pin strings
- Plumb
- Trowels
- Metallic pallet
- Mechanic beater

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#### **4.9.2.6 FINISHINGS**

##### **4.9.2.6.1 PLASTER AND PAINT**

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The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure:** Preliminary considerations

Remove any hardware material none related to the painting works, if not possible (like glass screens, exterior cladded panels or railings already fixed), cover/protect the surfaces with plastic sheets to prevent from splatter.

The floor must be covered with a 1.20-meter width plastic sheet from the wall base. The surface area must be even and smooth. Sandpaper is used to remove blemishes, imperfections and loose particles. Prior the painting works, a sealer must have been applied on the walls.

### **Procedure**

Paint preparation: mix water with paint in a 1:4 relations (satin paint and elastomeric paint), homogenize with a clean spatula for walls until complete mixture.

This information is according to the paint supplier to be submitted for approval.

Will be applied the paint on a brush and trace the upper, lower, and lateral borders, including wall intersections.

The upper border of the painting area must surpass the ceiling level by 10 centimeters.

For walls with skirting, the lower border of the painting area must settle about 5 centimeters above the encounter with the floor.

To cover the windows and door's frames from splatter, should be used painting tape and newsprint paper.

To the paint works, will be used a plush or fabric paint roller and will start painting from the top to the bottom of the wall. A paint brush could be used likewise.

For exterior walls, the painting works must start from the upper floor to the last.

For working at height, fixed and movable scaffolding would be erected according the area requirements.

For interior walls, a second coat of paint would be applied 3-4 hours after the first coat, using the same method described above.

2 coats of paint are recommended to provide great coverage, resistance and a washable surface.

For exterior walls, a second coat of paint would be applied 8-10 hours after the first coat, using the same method described above.

2-3 coats of paint are recommended to provide great elasticity, durability and a waterproof surface.

Total curing last 7 days.

### **Materials:**

- Satin Paint
- Elastomeric Paint

### **Personnel:**

- Painter
- Painter Assistant
- Work resident

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- HSE Supervisor
  - QAQC Supervisor

**Equipment and tools:**

- Grit sandpaper
- Natural bristles paint brush
- Plush or fabric paint roller
- Painting tape
- Newsprint paper
- Minor Hand Tools

#### 4.9.2.6.2 CERAMIC AND PORCELAIN TILES.

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The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure:** Surface Preparation

All surfaces to received tile shall be structurally sound clean, dry and free from oil and all foreign matters.

Surfaces to receive tile shall be plumb, horizontal level or at the slope as specified and true with square corners.

Prior to placing of tile the concrete surface shall be kept thoroughly wet.

**Mixing**

Mixing and applications of Adhesive and grouting shall be complied with manufacture's procedure and recommendations.

**Wall Tile**

The wall to receive tiles shall be finished with the approved plaster.

The plastering to the wall surfaces must be fully cured and free from any contamination, dust and crack before commencing the wall tile works.

Setting out shall be done as per approved shop drawings.

The surveyor shall mark the finished floor level on the wall of the room.

Porcelain tile shall be soaked in water and it should be removed 20 minutes before use.

Wall tile fixing shall start from the fixed strip level.

Approved adhesive materials shall be applied to the wall as continuous and the wall tiles are fixed to the adhesive with twisting/sliding action to give the finished bed thickness not more than 3mm.

Tile shall be correctly positioned in both directions by using 2mm plastic spacers to achieve even joints.

The tile shall be fixed in a way to get solid bedding and adhesion over the whole of the tile background.

Excessive adhesive material shall be removed with trowel without disturbing tiles. The cut tiles and the tiles on the sides of sanitary fittings and fixings shall be properly cut and laid in a neat manner.

The fixed tile shall be left for minimum of 24 hours to cure before grouting or according to the technical instructions of the adhesive material.

Before start grouting, all spacers should be removed and ensure that there is no damages.

Simultaneously the tile shall be cleaned with the dry cloth to give a aesthetic look. The grouting mixing and application shall be followed as per manufacturer's data sheet/recommendations.

### **Floor Tile Installation**

In interior finishing works, all tiles shall only be set and laid after the fixing of window and door frames and trims, stop rails, electrical, plumbing installations as well as the application of plaster unless otherwise specified.

For wet area only the approved water proofing system shall be installed.

Carry out a 24 hours' water test for water tight purpose prior to start with tile activity for wet area only.

The surveyor shall mark the required level of the bedding screed /protection screed to the specified thickness and in true alignment and horizontally or to slope as specified as per the approved drawings.

Setting out shall be done as per approved layout drawings. Joints shall be true to line, truly horizontal, continuous and without steps.

For wet and dry area, ceramic tile shall be fixed by approved Tile adhesive.

Ceramic tile shall be soaked in water and it should be removed 20 minutes before use. Adhesive shall be applied on working area not more than one square meter at a time or as per manufacturer's recommendations/procedure.

Tile shall then be laid on the adhesive layer with a twisting motion ensuring good contact between tile and adhesive bed. For this purpose, the adhesive manufacturer's instructions should be followed strictly to achieve the 100% mortar coverage.

Tile shall be correctly positioned in both directions by using 2mm plastic spacers in order to accommodate the difference between wall and floor tiles as per approved drawings.

The tile shall be neatly cut to a close fit where the necessary at abutments, around the outlets, pipes and the like.

Particular care will be taken in 'Wet' areas to prevent low spots that may promote water pooling the tolerance in the overall level shall not be more than 5mm from required level.

Localized variation in level for nominally flat floor shall be max of + or – 3mm, when tested by 3meters straight edge.

Excessive adhesive shall be removed with trowel before the material has set. The fixed tile shall be left for minimum of 24 hours to cure before grouting.

### **Materials:**

- Water
- Ceramic/porcelain tiles
- Adhesive and grouting



**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

**Equipment and tools:**

- Tape measure
- Framing square
- Marker
- Buckets
- Tile trowel
- Rubber mallet
- Sponges
- Tile spacers 2mm
- Gloves
- Safety glasses
- Tile cutter
- Grout float
- Spirit level
- Mechanical mixer

#### 4.9.2.7 Metallic Carpentry

##### 4.9.2.7.1 COLD CHAMBER CONSTRUCTION

The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure:** \*Insulate PIR coating are installed before the concrete flooring filled

After cured the flooring finish, floor angles are fitted on the base to the required dimension of the cold room.

#### **Wall panels installation**

Wall panels are installed on the fixed floor angles, will be erected the first panel on the floor angle, start to end.

A thin layer of sealing compound will be applied on the joining face of the panels. Will be join the corner of panel with wall panel by capping external and aluminum angle internal.

This process is the same to the whole wall.

Finished, will be applied sealing compound in the joining face of the panels.

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### **Ceiling panels installation**

Ceiling panels are installed top the rest on the top edges of the wall panels.

A thin layer of sealing compound will be applied on the outer plate seam of the ceiling panels, which is to be positioned on the farthest end of the wall panels and suspension rods and top hat.

This process is the same to the whole ceiling.

Proceed with the next panel and apply the sealing compound in the same way as before, against the wall panels as well as against the ceiling panels are installed. Finished, will be applied sealing compound in the joining face of the panels.

Silicon sealants are filled at the joints of panels to ensure leak proof wall, ceiling surface.

### **Doors installation**

Insulated doors as per the approved drawings will be fitted in the cut out of the wall panel and located as per requirement and storage opening convenience.

PVC curtain will be hang from the top of the door to avoid air infiltration.

#### **Materials:**

- Insulated panel
- Bolts and cover
- Accessories
- Insulated doors
- Insulation flooring

#### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

#### **Equipment and tools:**

- Drill
- Reciprocating saw
- Pressure plier
- Shear
- Rubber mallet
- Spatula
- Level ruler and plumb
- Chalk line kit
- Silicone gun

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#### 4.9.2.7.2 PIR THERMIC INSULATIONS PANELS AND PVC SHEET INSTALLATION FOR WATERPROOFING CONCRETE SLABS

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The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure:** Surfaces Preparation

Surfaces must be cleaned and free of any leftovers or debris from construction works. Rain sewers are to be displaced in the locations, quantities and specified diameters of the project. Levels and spilled concrete falling into the sewers will be within the approved amount by the project and the construction company through their respective delegates

**THERMIC INSULATION PANELS INSTALLATION**

The panels must have a paper protection on one of its sides, which will be in contact with the PVC sheet and so, avoid direct contact between the two materials.

Thickness selected will be according to the drawings specifications.

The distribution of the panels on top of the concrete slabs will be done in an interleaved position, in the same way it is done in a masonry wall.

The panels will be aligned and assured by mechanic fixings with nails, fixing plug, and washers.

At least fixings will be done in each 1m x 2m panel (one in each corner of the paper and three in the center).

Depending on the installer judgment and weather conditions at the moment of installation, the number of fixings may increase.

The depth of perforation in the concrete slab will be 2" maximum done by a 5/16" in diameter drill bit. The panels must be cut according to the shape of the slab, walls, construction details as equipment's baseline, skylights, sewers, etc.

Remaining pieces may be used as long as they have at least one mechanical fixing to ensure the stability to the slab. Mechanical fixings guarantee the stability of the panels during the installation and following protection with the PVC sheet.

**PVC SARNAFILL SHEET INSTALLATION**

The installation will be done directly over the PIR panels on the side with the protective paper properly fixed to the concrete slab. The cuts can be done with scissors or blade. When working on details on vertical surfaces, the installation will be done directly over the concrete or walls of the plastered masonry.

All the chops that are to be joined with each other must be done by an overlapping of at least 5cm wide, pointing at the direction of the flow of water that will run over them in the case of rain. For that, an approved heat-sealing gun type Liester 110v will be used at the temperature that the manufacturer states and with any accessories listed in the technical specifications.

**Materials:**

- PIR panel
- Bolts with fisher plug
- Expansion bolts
- Nails
- Silicon
- PVC membrane
- Aluminum profiles

**Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

**Equipment and tools**

- Power-driver
- Circular saw
- Drill
- Silicon gun
- Leister heater gun machine

#### 4.9.2.7.3 METALLIC WALL CLADDING

The scope of this construction method is proposed for all works of the project that are according with the activity.

**Procedure:** Surfaces Preparation

Surfaces must be cleaned and free of any leftovers or debris from construction works. Rain sewers are to be displaced in the locations, quantities and specified diameters of the project. Levels and spilled concrete falling into the sewers will be within the approved amount by the project and the construction company through their respective delegates.

**PLACING PANELS ON WALLS AS FOLLOWS**

Install omegas horizontally on walls as support of panels. Install panels in place according shop drawings.

Doors/Windows cut panel according drawings and manufacturer's indications and install flashings to guarantee esthetic finishes.

Panels should be installed according to installation shop drawings.

After overlapping panels fixers are going to be installed to keep panels altogether. At the moment of the installation of the panels, panels will be supported to masonry of buildings, lift to place by hand or mechanical equipment (Telehandler or ManLift) and fastened to the supporting metallic structure.

#### **WALL PANEL INSTALLATION SEQUENCE**

Removal of lower protective film panel Cleaning

Stacking in 5 or 10 groups.

Set panels, workers and equipment accordingly to the activity.

#### **Materials:**

- Wall panels.
- Accessories.

#### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer
- Quality control manager
- Health & safety manager
- Worker
- Equipment operator

#### **Equipment and tools:**

- Telehandler / Manlift.
- Hand tools.
- Scaffolding.

#### **4.9.2.7.4 METALLIC ROOF, RIDGE AND GUTTER.**

The scope of this construction method is proposed for all works of the project that are according with the activity.

#### **Procedure:** Placing Panels on Roof

Panel installation should normally be started considering the opposite sense wind direction, so that the overlap is in the direction of the wind.

Before uploading the packs of panels on top of the structure, freestanding scaffolding towers or ladders used as a methodology will be installed so that workers have easy access, using their respective harnesses with a lifeline. Workers can climb by means of a telehandler or stairs complying with safety regulations.

Panels should be installed according to installation shop drawings.

A ridge cap will be installed where both panels meet at the ridge of the structure. Once finished one side of the roof, repeat over installation process.

Panels must be placed and secured by overlapping vertically to the length of each side of the roof (complete rows) individually or simultaneously.

After overlapping panels fixers are going to be installed to keep panels altogether.

At the moment of the installation of the panels, a worker will be located at the far end of a telehandler and at the other end the people who will secure and join the panels with their respective harness and life leash thus protecting the security.

When installing the panels on the other side of the roof, the same safety procedure will be followed, thus avoiding occupational accidents.

Cuts shall be done with special scissors tool; never use grinder. Pencils should never be used to mark cutting lines because coal (pencil or any variety) accelerates the normal process of oxidation of the material.

Ridge: The correct installation and proper use of Cumber, avoid common problems such as leaks, aesthetics, entry of insects, etc. When installed you should always be careful to overlap them a minimum of 10cm. fixing to the sheets must always be done by self-tapping bolts. In the case of meetings of 3 or more cumbers, associations must be as airtight as possible; the use of silicone for sealing the joints is indispensable.

Gutter: The sections of the guttering are proceeded to align them on the floor with a levelling line, then in each union they are secured with stick screws and silicon is placed. It is important that at each joint of the gutters, there is an overlap of 5 cm.

It is recommended to make stretches no larger than 10 meters in order to be able to lift with the Platform Lift and place them on previously installed structure, preferably that the joints are in the beam that serves as support. Each connection shall be secured with screws and waterproofed with silicone.

Once all the sections of gutters have been hoisted, the lid is placed on each end and with a small grinder the cuts are made for the downpipes. The gutters are adjusted on each support with an angle, which will be secured to the structure of the gutter support by self-drilling screws and / or hilt ½ nails, depending on the ease of doing the job.

To give the slope to the guttering, which is not more than 1 cm in the whole length, shims will be placed in each support. Shims are permanent and will be used to keep levelled the gutter. Shims will be made out of galvanized-steel sheets from 3mm up to 12mm and placed on mooring beams of gutter.

#### **Materials:**

- Panels.
- Accessories.
- Electro welded beams
- Laminated angles
- Cold formed purlin
- Extras

#### **Personnel:**

- Superintendent
- Site engineer (yard)
- Site engineer



- 
- Quality control manager
  - Health & safety manager
  - Worker
  - Equipment operator

**Equipment and tools:**

- 35 Ton Crane.
- Telehandler / Manlift.
- Hand tools.
- Scaffolding.

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**4.9.2.8 Carpentry**

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**4.9.2.8.1 WOODEN DOORS**

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The contractor shall submit shop drawings and/or samples of each type of doors, windows, louvers, ventilators and other aluminum and alternative work, to the Engineer for his approval.

**Procedure**

All wood door shall be veneered finish with polyurethane coating to manufacturer's specification.

**Doors installation Layout**

First, the reconfirmation of measures in the work is carried out, then proceeds to send the measurements to the factory for the production of the door leaves and the leaves that will be installed in the gaps of all the buildings of the work.

**Installations of wooden frames**

The first thing that is done is all the gaps in the doors is to color the wooden frame and then install the sheet of each according to the corresponding code according to plans the codes.

**Final details**

After all the doors are installed in the gaps of the doors, proceed to place the door leaf with its accessories that are hinged plates and kick doors and lacquer the doors and door leaves again if they have any failure

**Materials:**

- MDF RH
- Polyurethane coating
- Bolts with Fisher plug
- Expansion bolts
- Nails
- Hex bolt
- Aluminum "F" profile
- Catalyzed lacquer

**Personnel:**




- 
- Superintendent
  - Site engineer (yard)
  - Site engineer
  - Quality control manager
  - Health & safety manager
  - Worker
  - Equipment operator

**Equipment and tools:**

- Screwdriver
- Circular saw
- Grinder
- Emery
- Silicone gun




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**APPENDIX – TESTING AND MONITORING PLAN**

<div><div></div><div>SOLETANCHE BACHY</div></div> <div><div></div><div>SOLETANCHE BACHY CIMAS</div></div>	TESTING AND MONITORING PLAN											
<div><div></div><div>CI PORT &amp; TECNAC</div></div>	30.jan.20		FTO-CAL-04						V1			




PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE			
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION		DECISIÓN MAKING	
1	DEMOLITIONS	BS 6187 Construction plans.	PS		X	Security of the near existing structures	N.A.	None	Visual Inspection	N.A.	N.A.	Property status report	Existing stability of the structures	Measures to be evaluated during the inspection stage and definition of the demolition method Personnel experience in demolition work	PPC	JV PBO	JV PBO & EMPLOYER		
2	DREDGING	Construction's Plans, dredgin methology and BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 7	PS		X	Tides	Draft arrangement indicated in construction plans	According to acceptance criteria defined in Dredging methodology	Measure	Tide Gauge	monthly	Tide Report	Accuracy of measuring equipment	Calibrated Equipment	PIC	JV PBO	JV PBO		
			PS		X	Position Control	Indicated in construction plans	0.5 m	Measure	Topography Equipment (Total Station)	During horizontal positioning	topographical data	Accuracy of measuring equipment	Calibrated Equipment	PIC	JV PBO	JV PBO		
			PS		X	Bathymetry before and after dredging	Required dredging level indicated in Construction Plans	0.5 m	Measure	Bathymetry Equipment	Before and after dredging in monthly periods	Digital: 3d drawing in Autocad 2015 Physical: Signed Plan	Great tidal differences Measurement equipment pressure 2	Make Tidal Compensation Calibrated equipment and periodic checks	PPC	JV PBO	JV PBO & EMPLOYER		
			PS		X	Soil Sampling for Improvement	Indicated in dredging methology	Indicated in dredging methology	Samplings	Sampling soil equipment	25 m in longitudinal direction and at 10 m intervals in transverse direction with respect to the docking line	Laboratory report	Accuracy of measuring equipment Material does not comply	Calibrated Equipment Material Replacement	PIC	JV PBO	JV PBO		
			PS		X	Dredging	Required dredging level indicated in Construction Plans	300 mm	Measure	Bathymetry Equipment	Before and after dredging in monthly periods	Digital: 3d drawing in Autocad 2015 Physical: Signed Plan	Overburden excavation	Topography and bathymetry controls	PPC	JV PBO	JV PBO & EMPLOYER		
4	EXCAVATION	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 8	PS		X	Overburden excavation	According to construction plans	Indicated in dredging methology	Measure	Topography Equipment (Total Station)	During the excavation and at the end	Topographical data	Topographic Control	Filled with 15/20 grade concrete or granular material	PPC	JV PBO	JV PBO		
			PP		X	Trench and Cable Bottom Bottom Compaction	95% of the modified proctor	Larger than specified	Measure	Densimeter and sand substitution method	each 40 m	Laboratory report	preliminary tests	re-consolidate	PPC	JV PBO	JV PBO		
5	FILLED	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9	PP	X		Cleanless	Liquid Limit	Menor o igual 65%	Samplings	Laboraty equipments	for each type of filling selected	Laboratory report	Preliminary tests	Designer evaluation	PIC	JV PBO	JV PBO		
			PP				Plastic Limit	Menor o igual 35%											
			PP				Free of vegetation, peat, organic matter, according to standard and type of filling	Applicable regulations											
			PP			Durability test	Chlorides and Sulfates	chlorides, expressed as chloride ions - 0.6% by weight; • sulfates, expressed as sulfate ions: 0.6% by weight.											
			PP			Physical properties	Granulometry	According to the contract signed											
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9	PP		X	Compaction	Thickness	not more than 300 mm	Measure	Flexometer, Topography	Per layer	Topographical data	Higher thicknesses	Topographic control	PPC	JV PBO	JV PBO		
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9  BS 1377: Pt 4 - 1990.	PC		X	Compaction	Moisture content	1% y -3%,	Measure	Laboraty equipments	Per working days	Laboratory report	preliminary tests	Cover the material in case of rain  Let dry in case of higher humidity	PPC	JV PBO	JV PBO		
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9  BS 1377: Pt 4 - 1990.	PC		X	Densidad	According to the type of filling, defined in constructive methodology	greater than or equal to the specified	Measure	Laboraty equipments	By test area variations in the material 3 tests each 2500 m2	Laboratory report	Preliminary compaction tests	Adjust designs according to preliminary tests  Additional tests	PPC	JV PBO	JV PBO		

<div><div></div><div>SOLETANCHE BACHY</div></div> <div><div></div><div>SOLETANCHE BACHY CIMAS</div></div> <div><div></div><div>CIPORT &amp; TECNAC</div></div>	TESTING AND MONITORING PLAN									
	30.jan.20	FTO-CAL-04					V1			

PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
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No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE			
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION		DECISIÓN MAKING	
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9	PC	X		Fillings around the pipe	without clay lumps retained in a 75 mm sieve or rocks and stones retained in a 38 mm sieve.	No tolerance	Measure	Laboraty equipments	for each type of filling selected	Laboratory report	preliminary tests	Designer evaluation	PPC	JV PBO	JV PBO		
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9	PC	X		Field CBR	According desings	greater than or equal to the specified	Measure	Laboraty equipments	Agreement with the client	Laboratory report	preliminary tests	Designer evaluation	PPC	JV PBO	JV PBO & EMPLOYER		
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 9	PC	X		CPT and SPT to under water filled	According desings	greater than or equal to the specified	Measure	Laboraty equipments	Agreement with the client	Laboratory report	preliminary tests	Designer evaluation	PPC	JV PBO	JV PBO & EMPLOYER		
6	GRAVEL FILLINGS	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 10	PC	X		Source	Physical Characteristics	"free of laminations and weak cleavage planes and will be of such character that will resist disintegration or erosion by the action of air, water, humidification and drying and impact due to the action of waves. "	Visual Inspection	N.A.	By source or beta	Report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
		"Manual on the use of rocks in coastal and coastal engineering ", Construction industry Special Publication 83 of the Research and Information Association (CIRIA),	PC	X		Clasification	Specific weights of rock sizes ELCL, LCL, UCL and EUCL in order of increasing size	EUCL - high class extreme limit - 97% -100% UCL - upper class limit - 70% - 100% LCL upper class limit - 0% - 10% ELCL low end extreme limit - 0% -2%	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
		BS EN 13383.	PS	X		Training process	Natural	No tolerance	Sampling	N.A.	random sample comprising at least 20 individual rocks per source	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Petrographic	Sedimentary, igneous a metamorphic	No tolerance	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Density	2.65 Mg/cu.m.	Min 2.65 Mg/cu.m.	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Form	Thickness Length Ratio	Max 20% mayor de 3: 1	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Fractured Faces	Broken or flat surfaces	"Max 5% per number with less than 50% crushed or broken "	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Absortion	Amount of absorption water being submerged	Max 1.5% mass cattle	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Breaking Strength	Compression test	Minimum average value of 60 Mpa	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Hardness	Wear - Abrasion Resistance	Max micro-Deval coeff: of 30	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		
			PS	X		Durability test	Strength (resistance to magnesium and sulfates)	Maximum loss of 25% of mass	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO		

<div><div></div><div>SOLETANCHE BACHY</div></div> <div><div></div><div>SOLETANCHE BACHY CIMAS</div></div>		TESTING AND MONITORING PLAN											
<div><div></div><div>CIPORT &amp; TECNAC</div></div>		30.jan.20			FTO-CAL-04						V1		

PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	




No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE					
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESSMENTS	MITIGATION		IMPLEMENTATION	DECISIÓN MAKING				
			PS	X		Integrity	presence of fissures	Non significant fissures with 1.5 m drop	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
			PS	X		Sonnenbrand	Basalt Decay	No significant sign of decomposition	Sampling	Laboraty equipments	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
			PS	X		Color	Natural Color	Not required	Sampling	N.A.	random sample comprising at least 20 individual rocks per source		Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 10	PC	X		Placement	According to construction plans	it does not require	Measure	Topography Equipment and Probing Equipment	No more than 10 m in the measurement profile	Topographic Portfolio Survey Report	Evaluation of areas and volumes	Topographic control	PIC	JV PBO	JV PBO				
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 10	PC	X		Geotextile as a filter layer	puncture resistance, durability in seawater	Indicate in design	Indicate in design	N.A.	Per production lot	Quality certificate	Poor material quality	Material tests	PPC	JV PBO	JV PBO & EMPLOYER				
7	SOIL IMPROVEMENT (FILLING MATERIAL)		PP	X		Cleanless	Maximum silt content dispersed in the granular material	no more than 5%	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
							materia orgnica	0%	Sampling		By Beta and / or type of material or every 20,000 m3										
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 11.5.3	PP	X		Aggregate	Aggregate Impact Value	"Dry <30% Saturated <40% "	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
						Durability	Strength (resistance to magnesium and sulfates)	Maximum loss of 30% of mass	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
						Absorption	Amount of absorption water being submerged	Max 6%	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
						Compaction	Density	> 2.3Mg / m 3	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
						Cleanless	Plastic Limit	<6%	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
		BS 1377: Parte 2: 1990	PP	X		Composition	Gradation	According with BS 1377	Sampling	Laboraty equipments	By Beta and / or type of material or every 7,500 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO				
						AASHO T234 o T235, o BS 1377	PP	X		Internal angle of friction	Proof of Cut	According to AASHO T234	Sampling	Laboraty equipments	By Beta and / or type of material or every 20,000 m3	Laboratory report	Sources study	Selection of the most appropriate source	PIC	JV PBO	JV PBO
						BS 1377: Parte 4: 1990,				PS	X		Compaction	Density	"According to BS 1377: Part 4: 1990 and preliminary studies "	Field test	Laboraty equipments	One each 200 m2	Laboratory report	Sources study	Selection of the most appropriate source
8	SOIL IMPROVEMENT (VERTICAL DRAINAGE)	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 11.5.4	PS	X		Properties	Load Capacity	at least 250 m3 / year when subjected to a Side pressure of 300kN / m2 and folded by 20% vertical compression.	Evaluation or comparison in coditions similar to that of work	N.A.	At the beginning	Inspection report	Evaluation of similar drains already built	N.A.	PIC	JV PBO	JV PBO				
9	SOIL IMPROVEMENT (MIXTURE)	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 11.6.5	PP	X		SOIL - CEMENT	Design	Blending rate, optimal soil moisture, proctor.	Laboratory stadies	Laboratory equipments	one for each type of mixture	Design of soil-cement	Materials studies	optimal material selection	PIC	JV PBO	JV PBO				
			PP	X		Mixed with lime	Design	Blending rate, optimal soil moisture, proctor.	Laboratory stadies	Laboratory equipments	one for each type of mixture	mixture design	Materials studies	optimal material selection	PIC	JV PBO	JV PBO				



<div><div></div><div></div></div> <div></div>		TESTING AND MONITORING PLAN											
		30.jan.20	FTO-CAL-04						V1				




PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE	
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION	DECISIÓN MAKING
10	SOIL IMPROVEMENT (STONE COLUMNS)	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 11.7.8  BS 812 Pt.2: 1995	PP	X		Saturated Density	Dry Surface	> 2.600 kg / m 3	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m3	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X		Absorption	amount of water in weight	<3%	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m4	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X		Cleanless	Plastic Limit	No plastic	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m5	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X		Durability	sulphate concentration	<0.6%	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m6	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X			Solidity (resistance to magnesium and sulfates)	Mass loss after 5N or cycles <12% for sodium sulfate and <18% for magnesium sulphate	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m7	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X		Hardness	Peeling index	<40	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m8	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X			Unconfined compression resistance	> 100Mpa	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m9	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X			abrasion	<15%	Sampling	Laboratory equipment	By Beta and / or type of material or every 20,000 m10	Laboratory report	Study of information sources	Selection of the most appropriate source	PIC	JV PBO	JV PBO
			PP	X		Dynamic replacement	# Strokes	According to design parameters	Direct measurement	N.A.	According to Design parameters	Control record of dynamic replcement	renego on parameters design	Designer Evaluation  increase number of substitutions  Another soil improvement methodology	PIC	JV PBO	JV PBO
			PP	X			Volume of material incorporated	According to design parameters	Direct measurement	N.A.	According to Design parameters				PIC	JV PBO	JV PBO
			PP	X			Penetration Percentage	According to design parameters	Direct measurement	Tape measure, Topography	According to Design parameters	Limit pressure report and pieometric module			PIC	JV PBO	JV PBO
			PP	X			Piesometric Module	According to design parameters	Direct measurement	Piezometer	According to Design parameters				PIC	JV PBO	JV PBO
			PP	X			Load - Deformation - Time	According to design parameters	Field test	Plate test equipment	According to Design parameters	Laboratory report			PIC	JV PBO	JV PBO
11	PILES	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 12  BS 8004	PS	X		Geometry	External dimension	-1% to + 1%.	Direct measurement	Measuring Tape	Each one	Dimensional Control Report	Pipe Factory Inspection	Evaluación Diseñador	PIC	JV PBO	DESIGNER
						Identification	Marking with the following: 1. Manufacturing number 2. Dimatro 3. Length 4. Marks every 250 mm in the upper 3 m	All PILES	Visual Inspection	N.A	All piles	Piles identification	Pipe Factory Inspection	Evaluación Diseñador	PIC	JV PBO	JV PBO
		BS 7668, BS EN 10113-1, BS EN 10155, BS EN 10210-1 (o equivalente)	PP	X		Materials	Chemical and physical properties	According to BS 7668, BS EN 10113-1, BS EN 10155, BS EN 10210-1 (or Similar)	Visual Inspection	N.A	According to BS 7668, BS EN 10113-1, BS EN 10155, BS EN 10210-1 (or Similar)	Quality certificate	Pipe Factory Inspection	Designer evaluation	PIC	JV PBO	DESIGNER
									Sampling	Laboratory Equipment	3 samples from each source	Laboratory Reports	Pipe Factory Inspection	Designer Evaluation	PIC	JV PBO	DESIGNER
		AWS	PP		X	Elongation with spot welding	Procedure specification WSP	N.A.	N.A.	N.A	One for each type of welding for pile connection	procedure	Define the types of welding that will be required for joining piles	N.A.	PIC	JV PBO	JV PBO
			PP		X	Elongation with spot welding	Inspection UT	De acuerdo a Especificación de Procedimiento WPS	Measure	UT Equipment	Each weld	Inspection report	Development of WPS Procedure Specification for the particular project	Welders are qualified according to WPS procedure specification	PIC	JV PBO	JV PBO
			PP		X	Elongation with spot welding	Dye penetrant test	De acuerdo a Especificación de Procedimiento WPS	Visual Inspection	Dye penetrant test equipment	Each weld	Inspection report	Development of WPS Procedure Specification for the particular project	Welders are qualified according to WPS procedure specification	PIC	JV PBO	JV PBO
			PP		X	Driving	Resisted / rejected	Definir en criterios de hincado	Visual Inspection	Driving Equipment	Each pile	Driving record	Soil studies and driving behavior of surrounding piles PDA tests	Hacer cumplir criterio o evaluación del diseñador	PIC	JV PBO	DESIGNER

<div><div></div><div>SOLETANCHE BACHY</div></div> <div><div></div><div>SOLETANCHE BACHY CIMAS</div></div> <div><div></div><div>CIPOPT &amp; TECNAC</div></div>	TESTING AND MONITORING PLAN									
	30.jan.20	FTO-CAL-04					V1			




PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE	
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION	DECISIÓN MAKING
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 12	PP		X	Position	Theoretical location according to plans	± 75 mm	Topographic Control	Automatic Level	Each pile	Driving record	The conditions of positioning of the piles are evaluated, help with guidance to preserve the position	Topographic controls during installation	PPC	JV PBO	CUSTOMER RELEASE DESIGNER APPROVAL (in case of default)
		BS 8004	PP		X	Verticality	Verticality	1/75 Relacion de longitud en una de las caras	Topographic Control	Spirit level and flexometer	Each pile	Driving record	The conditions of positioning of the piles are evaluated, help with guidance to preserve the position	Topographic controls during installation	PPC	JV PBO	CUSTOMER RELEASE DESIGNER APPROVAL (in case of default)
			PP		X	Load capacity	Dynamic Load Test	Carga de Diseño	Measure	Dynamic Load Test	Random to Designer Criteria (minimum 7% of the total piles)	PDA (Dynamic Load Test) Record	NA	NA	PPC	JV PBO	DESIGNER APPROVAL (in case of default)
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 12	PP		X	Pile Decapitated	Pile Decapitated	± 15 mm	Topographic Control	Automatic Level	Each pile	Driving record	Topographic Control	Prefabricated installation adjustments	PPC	JV PBO	CUSTOMER RELEASE DESIGNER APPROVAL (in case of default)
12	CONCRETE OF MARINE STRUCTURES	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.2  BS EN 12620	PC	X		Minimum requirements	Compressive strenght	C40/50 Type	Sampling	Compressive strenght equipment	Preliminary tests	Final concrete mix design report, includes laboratory reports and quality certificates	Preliminary tests and / or review of concrete formula materials	Adjustments to Manufacturing Formulas	N.A.	JV PBO	JV PBO THE CUSTOMER IS INFORMED
							Content of cement	min 400 Kg/m3 Max 450 Kg/m3	Design	N.A.							
							Water / cement ratio	0.38	Design	N.A.							
							Type of aggregate	Thick: 10/20 o 4/20 according to BS EN 12620 Fine 0/4 (MP) a BS EN 12620	Sampling	Laboratory Equipment							
							Maximum size added	20 mm	Sampling	Laboratory Equipment							
							Chlorides	C10/20	Sampling	Laboratory Equipment							
							settlement	S3	Sampling	Laboratory Equipment							
							Cementitious material	Portland cement complying with BS class EN197-1 High slag cement to BS146: 2002	Sampling	Laboratory Equipment							
13	CONCRETE IN OTHER STRUCTURES	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.2  BS EN 12620	PC	X		Minimum requirements	Compressive strenght	C32/40 Type	Sampling	Compressive strenght equipment	Preliminary tests	Final concrete mix design report, includes laboratory reports and quality certificates	Preliminary tests and / or review of concrete formula materials	Adjustments to Manufacturing Formulas	N.A.	JV PBO	JV PBO THE CUSTOMER IS INFORMED
							Content of cement	min 370 Kg/m3 Max 425 Kg/m3	Design	N.A.							
							Water / cement ratio	.045	Design	N.A.							
							Type of aggregate	Thick: 10/20 o 4/20 according with BS EN 12620 Fine 0/4 (MP) to BS EN 12620	Sampling	Laboratory Equipment							
							Maximun size added	20 mm	Sampling	Laboratory Equipment							
							Chlorides	C10/20	Sampling	Laboratory Equipment							
							settlement	S3	Sampling	Laboratory Equipment							
							Cementitious material	Portland cement complying with BS class EN197-1 High slag cement to BS146: 2002	Sampling	Laboratory Equipment							
14	NON REINFORCEMENT CONCRETE	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.2	PC	X		Minimum requirements	Compressive strenght	C32/40 Type	Sampling	Compressive strenght equipment	Preliminary tests	Final concrete mix design report, includes laboratory reports and quality	Preliminary tests and / or review of concrete formula materials	Adjustments to Manufacturing Formulas	N.A.	JV PBO	JV PBO THE CUSTOMER IS INFORMED
							Content of cement	min 325 Kg/m3 Max 375 Kg/m3	Design	N.A.							
							Water / cement ratio	0.5	Design	N.A.							
							Type of aggregate	Thick: 10/20 o 4/20 according to BS EN 12620 Fino 0/4 (MP) to BS EN 12620	Sampling	Laboratory equipment							

<div><div></div><div>SOLETANCHE BACHY</div></div> <div><div></div><div>SOLETANCHE BACHY CIMAS</div></div>		TESTING AND MONITORING PLAN		
<div><div></div><div>CIPORT &amp; TECNAC</div></div>		30.jan.20	FTO-CAL-04	V1




PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE	
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION	DECISIÓN MAKING
		BS EN 12620					Maximun size added	20 mm	Sampling	Laboratory equipment		certificates					
							Chlorides	C10,20	Sampling	Laboratory equipment							
							settlement	S3	Sampling	Laboratory equipment							
							Cementitious material	Portland cement complying with BS class EN197-1 High slag cement to BS146: 2002	Sampling	Laboratory equipment							
15	PAV2 CONCRETE BS8500	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.2  BS EN 8500	PC	X		Minimum requirements	Compressive strenght	C28/35 TYPE	Sampling	Compressive strenght equipment					N.A.	JV PBO	JV PBO THE CUSTOMER IS INFORMED
							Content of cement	Max 300 Kg/m3	Design	N.A.							
							Water / cement ratio	0.55	Design	N.A.							
							Type of aggregate	magnesium solidity be MS 18	Sampling	Laboratory equipment							
							Maximun size added	20 mm	Sampling	Laboratory equipment							
							Chlorides	C10,20	Sampling	Laboratory equipment							
							settlement	S2	Sampling	Laboratory equipment							
16	WATER FOR CONCRETE	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.7	PS	X		Purity	soluble sulfate, chloride or other chemical content, sediment and pH value.	Drinking Water	Sampling	Laboratory Equipment	By source	Laboratory Record	Evaluation of available sources	Select a suitable source	N.A.	JV PBO	JV PBO
17	CONCRETE ADDITIVES	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.8.2	PS	X		Minimum requirements	Chemical and physical properties	According to BS EN 934 Part 2: 2001	Visual Inspection	N.A.	By type of additive	Data Sheet	Experience of using each type of additive in other projects.  Additive in good condition	Check Due Dates	N.A.	JV PBO	JV PBO
18	RECEPTION OF THE CONCRETE	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.9	PP		X	Temperature	Concrete temperature	less than or equal to 32 °C	Direct measurement	Inmersion thermometer	By production batch received	Concreting control	Temperatures greater than 32 °C	Rechazo del lote	PIC	JV PBO	JV PBO
			PS		X		Air temperature	Less than 25 °C	Direct measurement	Thermometer	By production batch received	Concreting control	High ambient temperatures that may affect the curing and development of concrete  Special healers Curing Products, Shadow, membranes, wetting Night work or in the morning hours or any method of curing according to ACI - 308-92	PIC	JV PBO	JV PBO	
			PS		X	Compression resistance	Compression resistance	The minimum average resistance determined from any group of 4" "test results" "shall be: f cu + 3  The minimum resistance determined from any test result "" is: f cu - 1.5  f what is the required resistance in N / mm 2	Sampling according with BS 1881	Laboratory Equipment	One sample each 40 m3 or by tipe of concrete	Laboratory report	Preliminary concret tests	Designer evaluation	PIC	JV PBO	JV PBO
19	REINFORCING STEEL	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.16 y Normas BS, EC o ASTM	PP	X		Properties	Chemical and physical properties	According with BS, EC o ASTM	Revision	N.A.	Each batch or draft receives	Quality certificate	Make an evaluation to select the most reliable suppliers	Laboratory tests on the material	PIC	JV PBO	JV PBO
			PS	X		Properties	Chemical and physical properties	According with BS, EC o ASTM	Laboratory tests	Laboratory equipment	Random sampling of the received bars	Laboratory report	Breach of the material	Lot Rejection	N.A.	JV PBO	JV PBO

<div><div></div><div>SOLETANCHE BACHY</div></div> <div><div></div><div>SOLETANCHE BACHY CIMAS</div></div>		TESTING AND MONITORING PLAN		
<div><div></div><div>EIPORT &amp; TECNAC</div></div>		30.jan.20	FTO-CAL-04	V1

PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE		
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20	PREFABRICATED	BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.20	PS	X		Manufacture	Lenght	Hasta 3 m ± 6 mm 3 a 4.5m ± 9 mm 4.5 a 6m ± 12 mm Adicional por cada 6m subsiguientes ± 6 mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
							Cross Section	Hasta 500 mm ± 3 mm 500 a 750 mm ± 5 mm Adicional por cada 250 mm subsiguientes ± 2 mm Con una tolerancia máxima de ± 15 mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
							Straightness or arc (deviation from the expected line)	Hasta 3m ± 6 mm 3 a 6 m ± 9 mm 6 a 12 m ± 12 mm Adicional por cada 6m subsiguientes ± 6 mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
							Quadrature	Longitud de lados más cortos Hasta 1.2m= 3mm De 1.2m a 1.8m= 5mm más de 1,8 m = 6mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
							Turn	Hasta 600 mm de ancho y hasta 6 m de largo 6mm  Más de 600 mm de ancho y para cualquier longitud. 12mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
							Flatness	menor o igual a 5 mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
							Bolt Position and Accessories	± 6 mm	Medicion	Flexometro	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Revisón de formaletas	N.A.	JV PBO	JV PBO	
			BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.20.6	PP	X		Recepción	Acceptance	No estar rajadas o reparadas. Sin bordes rotos si el refuerzo está expuesto o no. No deberá tener ningún refuerzo con cubierta. Acabado de acuerdo a especificaciones de referencia. Cumplir tolerancias dimensionales	Inspección visual	N.A.	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Controles desde Fabricación	PIC	JV PBO	JV PBO
			BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.20.8	PS	X			Brand and Registrations	-Tipo y número de referencia. - Fecha de manufactura. Número de formaleta -Resultados de Resistencia. -Ubicación en las obras. - Método de curado y duración. - Certificados de Calidad de Materiales	Inspección visual	N.A.	Cada elemento	Recepción de Prefabricados	Inspeccion antes y durante fabricación	Controles desde Fabricación	PIC	JV PBO	JV PBO
			BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 13.20.14	PS		X	Instalación	Heights	According to the final level of the project	Measure	topography equipment	Each item Installed	Topographic Portfolio Survey Report	Prefabricated dimensional control	Adjustment in installation dimensions	PIC	JV PBO	JV PBO
		vertical front line exposed between adjacent units						less than or equal to 5 mm	Measure	topography equipment	Each item Installed	Topographic Portfolio Survey Report	Prefabricated dimensional control	Item setting	N.A.	JV PBO	JV PBO	
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 15.7	PS	X		Defensas	Chemical and physical properties of materials (coatings, fixings, chains and accessories)	Review by Designer, in addition the chains must be electrically welded and the stud link chain complies with Grade 30 Class 1 to BS 6405 or equivalent approved. ""Review by Designer, in addition the chains must be electrically welded and the stud link chain complies with Grade 30 Class 1 to BS 6405 or equivalent approved.	Revision	N.A.	By lot delivered by supplier	Quality certificate	Review and approval by designer	Verification of compliance with Design requirements	PIC	JV PBO	JV PBO	

<div><div>SOLETANCHE BACHY</div><div>SOLETANCHE BACHY CIMAS</div></div> <div>CIPORT &amp; TECNAC</div>	TESTING AND MONITORING PLAN		
	30.jan.20	FTO-CAL-04	V1

PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

No.	NAME OF THE PROCESS / OPERATION DESCRIPTION	REFERENCE DOCUMENTS	CRITICAL FEATURE	PRODUCT	PROCESS	FEATURES			METHODS				RISKS		CLIENT'S INSPECTION POINTS	RESPONSIBLE		
						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESSMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		RESPONSIBLE		
																IMPLEMENTATION	DECISIÓN MAKING	
21	INSTALACIONES Y ACCESORIOS						Goma	Density ISO 2781 Max 1.20g / cc Polymer (rubber) ASTM D6370 Min 45% Carbon black ASTM D6370 Min 20% Ash ASTM D297 Max 5% Rubber fill ratio> 1.2	Revision	N.A.	By lot delivered by supplier	Quality certificate	Review and approval by designer	Verification of compliance with Design requirements	PIC	JV PBO	JV PBO	
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 15.8	PS	X		Bean' bollards with standard 'D' double horn base	200 tons of SWL	According to BS 6349: Parte 4: Cl. 10.2.6	Revision	N.A.	By lot delivered by supplier	Quality certificate	Review and approval by designer	Verification of compliance with Design requirements	PIC	JV PBO	JV PBO	
					X		Tightening torque in installation	According to manufacturer recommendations	Equipment Adjustment	Torque wrench	Each bolt adjusted	Bollard Installation Record	Review and approval by designer	Verification of compliance with Design requirements	PIC	JV PBO	JV PBO	
		BF1842-0400-1004 Volume IV - ER Part 2 - 2782019 numeral 15.14	PS	X		Crane Rails	British Steel CES 2: 1987 Crane Rails fabricado en acero conforme a BS 11	According with specifications	Revision	N.A	Per lot received	Quality certificate	Make an evaluation to select the most reliable suppliers	Laboratory tests on the material	N.A.			
			PP		X	Welding Rails	WPS procedure specification	N.A.	N.A.	N.A	One for each type of welding for pile connection	Procedure	Define the types of welding that will be required for rail welding	N.A.	PIC	JV PBO	JV PBO	
				UT Inspection			According with the WSP procedure specification	Measure	UT Equipment	Each Weld	Inspection report	Development of WPS procedure specification for the particular project	Welders are qualified according to WPS procedure specification	PIC	JV PBO	JV PBO		
				Dye penetrant test			According with the WSP procedure specification	Visual Inspection	Dye penetrant test equipment	Each Weld	Inspection report	Development of WPS procedure specification for the particular project	Welders are qualified according to WPS procedure specification	PIC	JV PBO	JV PBO		
			BS 6651.	PS		X	Rail installation	Level	H 5 mm of the level specified by the customer	Measure	Topography Equipment Tape measure	Per installed rail	Welding installation report	Ensure installation surface level	Topographic controls before and during installation	PIC	JV PBO	JV PBO
					Pending			2 mm in any length of 2 m.	Measure	Topography Equipment Tape measure	Per installed rail	Welding installation report	Ensure installation surface level	Topographic controls before and during installation	PIC	JV PBO	JV PBO	
		Rail line			less than 5 mm from the specified location and no more than 2 mm in any length of 2 m.			Measure	Topography Equipment Tape measure	Per installed rail	Welding installation report	Controls before installation	Topographic controls before and during installation	PIC	JV PBO	JV PBO		
		Caliber			± 5 mm			Measure	Tape measure	Random	Welding installation report	Controls before installation	Topographic controls before and during installation	PIC	JV PBO	JV PBO		
22	PAVIMENTO EN ADOQUIN	ASTM C418	PP	X		Sand Layer	Granulometry	According with ASTM C 418	Sampling	Laboratory Equipment	By Origin	Laboratory report	Make an evaluation to select the most reliable suppliers and sources	Laboratory tests on the material	PIC	JV PBO	JV PBO	
							Plastic Limit	NP	Sampling	Laboratory Equipment	By Origin	Laboratory report			PIC	JV PBO	JV PBO	
							Sand equivalent	Minimo 60%	Sampling	Laboratory Equipment	By Origin	Laboratory report			PIC	JV PBO	JV PBO	
		PP	X		Paving Stones	Breakage Module Test	Min. 5 MPa /promedio 5 especimenes Min. 4.2 MPa / Unidad	Sampling	Laboratory Equipment	Per production lot of maximum 10,000 units.	Laboratory report	Make an evaluation to select the most reliable suppliers and sources	Laboratory tests on the material	PIC	JV PBO	JV PBO		
						Absorption	promedio 5 elementos ≤ 5% Individual ≤ 7%	Sampling	Laboratory Equipment	Per production lot of maximum 10,000 units.	Laboratory report			PIC	JV PBO	JV PBO		
						Lenght of track	Average 5 elements <= 23 mm	Sampling	Laboratory Equipment	Per production lot of maximum 10,000 units.	Laboratory report			PIC	JV PBO	JV PBO		
23	ASPHALT PAVEMENT	ASTM 6114	PP	X		Stony Aggregates	Gradation Wear Degradation Mechanical strength Durability Cleaning Geometry Adhesiveness	According with ASTM 6114	Sampling	Laboratory Equipment	By Origin	Laboratory report	Make an evaluation to select the most reliable suppliers and sources	Laboratory tests on the material	PIC	JV PBO	JV PBO	
						Type of asphalt	Selection	According to ASTM 6114, it is chosen according to the climatic characteristics, type of layers and operating conditions of the pavement	Revision	Laboratory Equipment	By Origin	Quality certificate and laboratory report			PIC	JV PBO	JV PBO	



PROJECT:	Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1	UPDATED DATE:	
ACTIVITY:		REVISION:	

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						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION	DECISIÓN MAKING
24	SYSTEM AND ELECTRICAL INSTALLATIONS	BF1842-0400-1004 Volume IV - ER Part 3C - 2782019	PP		X	Factory Acceptance Pureba (FAT)	Visual inspection; • Verify integrity (reference to drawings); • Mechanical controls; • Control circuit control; • Signal verification and measurement; • High voltage test; • Insulation measurement; • Marks and signs; • Checking the presence of special, auxiliary tools, p. Ex.	Compliance with the requirements of each material and FAT SAT Test Protocol	Inspection and monitoring	Indicate in FAT / SAT Test Protocol	Random sample of each of the components	FAT Certificate	Development of FAT / SAT Protocols	Verify evidence compliance	PIC	JV PBO	JV PBO
			PP		X	Prueba de Aceptación en Sitio (SAT)	Visual inspection; • Control circuit control (including external connections); • Signal verification and measurement; • High voltage test; • Insulation measurement; • Contact resistance measurement on the contact surfaces of the screwed connections, such as the busbar sections; • Marks and signs; • Checking of special and auxiliary tools; • Interlocking test; • Phase sequence; • Configuration verification; • Test of protection devices (by means of current injection in the primary circuit).	Compliance with the requirements of each material and FAT SAT Test Protocol	Inspection and monitoring	Indicate in FAT / SAT Test Protocol	Random sample of each of the components	SAT certificate	Development of FAT / SAT Protocols	Verify evidence compliance	PIC	JV PBO	JV PBO
			PC		X	System Test	In test protocol	The system is shown to comply with the FAT / SAT specifications and protocol	Inspection and monitoring	Indicate in FAT / SAT Test Protocol	Whole System	Service test record	Development of FAT / SAT Protocols	Verify evidence compliance	PPC	JV PBO	JV PBO
			PC		X	Commissioning	In test protocol	The system is shown to comply with the FAT / SAT specifications and protocol	Inspection and monitoring	Indicate in FAT / SAT Test Protocol	Whole System	Service test record	Development of FAT / SAT Protocols	Verify evidence compliance	PPC	JV PBO	JV PBO
			PC		X	Performance Test	In test protocol	The system is shown to comply with the FAT / SAT specifications and protocol	Inspection and monitoring	Indicate in FAT / SAT Test Protocol	Whole System	Service test record	Development of FAT / SAT Protocols	Verify evidence compliance	PPC	JV PBO	JV PBO

• **SENSITIVE POINT (PS)**: Inspection point that may have an impact on the final result of the construction process but does not oblige to stop the activity, however its compliance or concession must be ensured by the decision maker.

• **CRITICAL POINT (PC)**: Inspection point that does not require to stop the subsequent activity, however the control must ensure compliance with the specification and / or tolerance established.




• **STOP POINT (PP)**: Inspection point that forces to stop the activity until the defined control has been executed and accepted according to the established specification and tolerance.

• **CUSTOMER INSPECTION POINT (PIC)**: Point from where customer inspection is required

• **CUSTOMER STOP POINT (PPC)**: Point from which release and / or approval by the client is required

	NAME	POSITION	SIGNATURE
PREPARED BY	EDGAR MATEUS	QUALITY ENGINEER	
REVIWED BY			
APPROVED BY			



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<div> EIPORT &amp; TECNAC</div>		30.jan.20			FTO-CAL-04				V1										
PROJECT:		Puerto Bolivar Port Expansion - EPC Container Terminal Development - Phase 1				UPDATED DATE:													
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						FEATURES	SPECIFICATIONS	TOLERANCE	ASSESMENTS TECHNIQUES / MEASURES	EQUIPMENT	SIZE AND SAMPLING FREQUENCY	REGISTER	PRELIMINARY ASSESMENTS	MITIGATION		IMPLEMENTATION		DECISIÓN MAKING	
EXCHANGE CONTROL						EXCHANGE CONTROL													
DATE		VARION		EXCHANGE		DATE		VERSION		EXCHANGE									
DD/MM/AAAA		0				DD/MM/AAAA		6											
DD/MM/AAAA		1				DD/MM/AAAA		7											
DD/MM/AAAA		2				DD/MM/AAAA		8											
DD/MM/AAAA		3				DD/MM/AAAA		9											
DD/MM/AAAA		4				DD/MM/AAAA		10											
DD/MM/AAAA		5				DD/MM/AAAA		11											