



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

GS ELE 211

**Electrical cabin for hazardous areas
Construction and equipment**

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1. Scope

The purpose of this specification is to define the minimum requirements for the design, the fabrication, testing, sea fastening, packing and transportation of an electrical cabin installed in hazardous areas.

The SUPPLIER shall make clear in his bid any deviation from this specification.

The omission from this specification of any item or items essential for the correct functioning of any part of specified equipment shall not absolve the SUPPLIER from supplying the equipment complete in every respect.

Should there be any technological difficulties or any conflict between this specification and the standards listed hereafter, the SUPPLIER shall request clarification before or at the time of quotation.

No deviation from the requirements of this specification are allowable unless itemised in the SUPPLIER's quotation and subsequently specifically agreed within the purchase order or purchase order supplement documents.

In case where the COMPANY's Standard Specifications have been amended by Project Specifications and are so noted, the Project Specifications will govern.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Standards

Reference	Title
IEC	Applicable IEC: Publications to electrical equipment and installation shall apply
EN 50-014	Electrical apparatus for potentially explosive atmosphere. General requirements
EN 50-015	Electrical apparatus for potentially explosive atmosphere. Oil immersion "o"
EN 50-016	Electrical apparatus for potentially explosive atmosphere. Pressurized apparatus "p"
EN 50-017	Electrical apparatus for potentially explosive atmosphere. Powder filling "q"
EN 50-018	Electrical apparatus for potentially explosive atmosphere. Flame proof enclosure "d"
EN 50-019	Electrical apparatus for potentially explosive atmosphere. Increased safety "e"
EN 50-020	Electrical apparatus for potentially explosive atmosphere. Intrinsically safe "i"

Reference	Title
EN 50-028	Electrical apparatus for potentially explosive atmosphere. Encapsulation "m"
EN 50-039	Electrical apparatus for potentially explosive atmosphere. Intrinsically safe (protection system) "i"

Professional Documents

All the HVAC systems shall comply with the requirements of the following standards at the date of tender:

Reference	Title
ASHRAE	American Society of Heating, Refrigerating and Air conditioning. Engineers handbooks and standards
OCMA	Oil Companies Materials Associations
AMCA	Air Moving and Air Conditioning Institute
ARI	Air Conditioning and Refrigeration Institute
AFI	American Filtering Institute
ADC	Air Diffusion Council
AGA	American Gas Association

In addition the cabin design shall be carried out in accordance with the following International Maritime Organisation standards.

Reference	Title
DOE	Guidance on Design and Construction of Offshore. Installation 1984 and amendments of September 1984 and April 1985
S.I. 289	Offshore Installation (construction and survey) regulation 1974
S.I. 611	Offshore Installation (fire fighting equipment) regulations 1978
NFPA	National Fire Protection Association
SOLAS	International Convention for safety of life at sea 1974 and amendments of November 1981 and June 1983

Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
	Hazardous area classification drawing General Lay out Electrical - One Line Diagram Cabin: general arrangement and preliminary dimensions

Note: This specification shall conform as a minimum to the current edition of the following in order of precedence:

- Project documents (drawings, particular specifications)
- Company standard specifications as listed in hereafter
- Applicable IEC publication
- CENELEC standards as listed above
- HVAC standards and International Maritime Organisation standards as listed above
- Applicable recognised standards (UTE, BS, VDC, etc.) where IEC publications have not yet been issued.

Total General Specifications

Reference	Title
GS COR 350	Corrosion External protection of offshore and related structures and equipment by painting
GS ELE 031	Electrical Design of earthing and bonding systems
GS ELE 079	Electrical apparatus for explosive gas atmospheres
GS ELE 081	Lighting
GS ELE 111	Induction motors
GS ELE 131	High voltage switchgear
GS ELE 135	Low voltage switchgear
GS ELE 141	Power transformers
GS ELE 151	DC uninterruptible power supply systems

Reference	Title
GS ELE 152	AC uninterruptible power supply (UPS) systems
GS ELE 161	Electrical cables
	Instrumentation
GS INS 102	Instrument symbols and identification
	Piping
GS PVV 101	List of piping document to be supplied
GS PVV 111	Piping design specification
GS PVV 112	Piping materials classes
GS PVV 116	Model review check list
GS PVV 142	Valves
	Safety
GS SAF 252	Design basis and rules for ventilation systems
GS SAF 312	Guidelines for selecting and installing fire and gas detection systems
	Structure
GS STR 101	Design of offshore jacket and subsea structures
GS STR 102	Design of offshore topsides structures
GS STR 201	Material for offshore steel structures
GS STR 301	Fabrication of offshore steel structures
GS STR 401	Load-out, transportation and installation of offshore steel structures
GS STR 901	Design rules and construction standards for ancillary structures of offshore installations
	Miscellaneous
GS CIV 406	Thermal and acoustic insulation

3. Environmental conditions

The cabin shall be designed in accordance with the data given in the “Environmental conditions particular specification”.

4. Cabin installation conditions

The cabin shall be designed in accordance with:

- The hazardous area classification drawing
- The Project "Climatic and Site conditions" particular specification.

5. Cabin, technical characteristics

5.1 Cabin, construction requirements

5.1.1 General

The cabin shall be minimum A60 SOLAS classification (roof, walls, floor and doors).

The cabin shall be air conditioned to limit temperature and humidity conditions.

The indoor equipment shall be protected by internal pressurization to suit the conditions of hazardous areas.

The cabin shall be designed to be lifted and transported in one piece, complete with all equipment.

The condenser of the air conditioning system shall be mounted on the roof of the cabin and dismantled for transport.

5.1.2 Structural works

5.1.2.1 Steel works

Structural steel material will be as per specification **GS STR 201**. Main framing and columns will be preferable square or rectangular tubes.

Walls will be made of steel sheets, 5 mm thick minimum.

Floor and roof will be made of steel sheets, 6 mm thick minimum.

All openings for doors, MCT, HVAC, etc., made in walls, floor, roof shall be framed to keep the structural integrity.

A safety ladder shall be provided to get access to the roof.

Removable hand rail shall be installed on the roof, for staff maintenance protection.

5.1.2.2 Lifting

The cabin shall be designed to be lifted complete with all equipment, in four points and to be supported as well as at the four opposite corners.

5.1.2.3 Padeyes and speeder frame

Padeyes shall be welded on top of columns at each corner of roof. They shall be calculated according to the contract specification and with a minimum slope of 60° to horizontal for the slings, if no speeder frame is used.

Four skidding padeyes (one at each corner) shall be welded at the base of the cabin structure for cabin skidding.

It is the SUPPLIER's responsibility to advise whether a speeder frame is required or not.

The SUPPLIER shall transmit to ENGINEER or COMPANY the padeyes and speeder frame (if any) calculation note.

The SUPPLIER shall define with accuracy the final as built weight of the cabin which is to be installed by lifting. The weight shall be determined by use of load cells, hydraulic jacking systems or alternative methods approved by ENGINEER or COMPANY.

5.1.3 Architectural works

5.1.3.1 Cabin dimensions

Refer to "Cabin general arrangement drawing".

5.1.3.2 Walls

Walls, roof, and floor of the electrical cabin shall be constructed from steel plate and designed to meet the A60 fire rating SOLAS classification.

Protection of external surface shall be approved by ENGINEER or COMPANY and shall incorporate paint work as defined in the specification.

Thermal insulation shall be provided in accordance with the HVAC specifications, and the environmental conditions specifications.

5.1.3.3 Doors

Doors shall be of marine type to withstand the severe marine and tropical conditions. The doors shall maintain the same fire integrity (A60 classification) as their adjacent walls.

Doors shall be equipped with anti-panic bars, rubber cushions and automatic closing system.

The airlock internal door shall be compatible with the partitioning (see 5.1.3.4).

Hardware and ironmongery shall be of good quality and stainless construction of heavy commercial standard. Adequate warning signs shall be fixed on the doors.

The minimum dimensions shall be as follows:

- Doors staff access: 2000 mm * 800 mm
- Doors material access: 2500 mm * 1000 mm
- Airlock internal doors: 2000 mm * 800 mm

5.1.3.4 Internal partitioning

If required in particular specification, the partitioning shall be as follows:

- The partitioning shall be selected from suitable proprietary systems. They shall provide a minimum of B15 rating
- Surface finishes shall be hard, non reflective tastefully patterned and in accordance the "painting" particular specification
- In battery room (if any) the surface finishes shall be acid resistant.



5.1.3.5 Floor and false floor

5.1.3.5.1 Floors

Floor of the electrical cabin shall be constructed from 6 mm steel plate, stiffened by IPE, and designed to meet the A60 fire rating SOLAS classification.

5.1.3.5.2 False floor

A 600 mm deep false floor shall be provided. The flooring beams shall be supported along the walls and distributed in accordance with the equipment bearings.

Flooring shall be composed of removable panels, approximately 40 mm thick, supported on adjustable jack. The distance between their support shall not exceed 1000 mm.

The panels shall be fire proof, class M1 as per Solar classification.

5.1.3.6 Ceiling

From false floor to ceiling, or floor to ceiling, there should be a clear height of:

- 2900 mm for switchroom or technical room
- 2500 mm for battery room (if any).

5.1.3.7 Roof

The roof shall be designed to support live loads, or equipment such as ventilation, and removable hand rails shall be located around the roof.

5.1.3.8 Penetrations

Service runs where these penetrate fire rated bulkheads or partitions shall be suitably to achieve the roof fire rating integrity.

5.1.4 Piping works

The present section is related to the piping work to be installed in the electrical cabin.

5.1.4.1 Materials

The materials shall be in accordance with the piping specifications listed section 2.

5.1.4.2 Supports and location

All supports shall be designed as dismantling type.

Piping works mounted on ceiling shall be avoided wherever possible.

Piping works running behind the inner walls or partition walls, shall be of good accessibility for maintenance, removable panels shall be foreseen if any.

5.2 Pressurization - Heating, ventilation and air conditioning system

5.2.1 Technical requirements

5.2.1.1 Design criteria

5.2.1.1.1 Internal conditions with continuous external conditions

- Dry bulb temperature: 23.5°C + 1.5°C
- Relative humidity 60% + 10 basic figure (final figure shall be in accordance with electrical and electronic material requirements)
- Maximum temperature gradient 4°C/hour (when HVAC is shutdown)
- Air distribution: the air velocity in occupied zone must not be greater than 0.25 m/s at 1 m level from floor.

5.2.1.1.2 Temperature differences between ambient and blow air

The differential values in temperature shall be never more than the following:

- High induction diffusers: 12°C
- Horizontal supply grids: 8°C
- High induction linear grids: 12°C

5.2.1.1.3 Air Renewal Rate

Fresh air flow ventilation rate shall be sufficient to satisfy not only air renewal specifications but also to maintain an ambient over pressure of 7/8 mm WG Pa (outdoor reference).

It should be capable to avoid outside air infiltration even when windy.

In any case, minimum air renewal rate shall be at least 1 vol./h.

5.2.1.1.4 Noise level for HVAC equipment

The noise level due to HVAC equipment running at the same time shall not exceed NC51 (noisy control).

5.2.1.1.5 Cooling load calculation

Heat gain calculation shall be in accordance with ASHRAE standards or to those of the Carrier manual.

U value taken into account shall be:

- External walls 0.5 w/m²°C (*)
- Roof 0.6 w/m²°C (*)
- Doors 3.5 w/m²°C (*)
- Floor 0.6 w/m²°C (*)

(*) These data shall be checked with those resulting from architectural design.

Internal heat gain for preliminary design shall be in the order of 700 w/m^2 of the floor. Heat gain lighting shall be about 20 w/m^2 .

5.2.1.1.6 Pressurization requirements

The volume of fresh air shall be capable to ensure the technical room over pressure as follows:

- Technical room: 7-8 mm WG (outdoor reference)
- Air lock: 3-4 mm WG (outdoor reference)

Closed door leakage to be taken into account shall be at least $35 \text{ m}^3/\text{h}$ per linear meter of door perimeter (at 8 mm WG differential pressure).

5.2.1.1.7 Wind pressure

Equipment shall be designed taking into account a wind speed as defined in the environmental conditions.

5.2.1.1.8 Airborne aerosol

Airborne marine aerosol presence shall be taken into account for HVAC equipment.

5.2.1.1.9 Filtration

Air filters shall be capable to ensure at least these output:

- Airborne air filter: efficiency = 98% at 6 microns of NaCl particles
- Return air filter: efficiency = 95% ASHRAE standard gravimetry.

5.2.1.1.10 HVAC equipment design criteria

The pressurization and air conditioning systems shall be sized in compliance with the following criteria:

- Doors air leakage (room door and air lock door) to be taken into account shall be at least $35 \text{ m}^3/\text{h}$ per linear meter of door perimeter at 8 mm WG over pressure (only one door shall be taken into account)
- Air inlet shall be sized at 2.5 m/s maximum face velocity on the basis of 45% free area, and an elbow shall be provided to limit the effects of wind pressure
- Over pressure dampers (pressure relief dampers) shall be sized at 2.8 m/sec (face area)
- Condenser coils shall be sized at 3.5 m/s through face area
- Direct expansion cooling coils shall be sized at 2.8 m/s through face area
- One way dampers on stand-by fan air losses with dampers closed shall be lower than 0.5% of the nominal air flow of the operating. Control system of HVAC equipment shall be able to work at the peak outdoor ambient temperature of 10°C above the rated temperature
- Fan motor speed shall be selected not to exceed 1500 rpm
- Ductwork shall be sized with a maximum air velocity of 6 m/s in main ducts and 3 m/s branch

- Minimum oversizing shall be at least: 15% of the nominal design requirements (cooling capacity and air flow)
- Maximum filter pressure loss shall be (at the nominal design conditions):
 - Fresh air: maximum 25 mm WG when fully dirty
 - Return air: maximum 15 mm WG when fully dirty and 5 mm WG clean.
- Refrigerant shall be R22
- Fan operating point shall be selected on a steep section of the fan curve in order to minimise variation in delivered air volume to be due to change in external wind pressure and/or filters pressure loss
- Flexible connections shall be of non combustible materials and reduced to a minimum.

5.2.1.1.11 Air distribution

Air shall be supplied from the ceiling and return shall be taken from the false floor.

5.2.1.1.12 Pressurization fans

Pressurization fans shall be provided with 100% stand-by unit, air flow escaping from air lock door and relief dampers.

5.2.1.1.13 Filters, exchangers, fans, ducts, etc.

All these equipment shall be capable of operating adequately with air flow and thermal cooling power of +15% to nominal design parameters.

5.2.2 Operation philosophy

5.2.2.1 HVAC operation

HVAC installations shall be automatic and capable of maintaining the required conditions. For each main equipment (condensers, pressurization, fans, package unit, etc.) an automatic/manual switch shall be provided; in manual position equipment may be controlled at request for checking or testing purposes.

All fans and air conditioning units shall be arranged for automatic change over on loss of air flow by fan speed air flow or pressure switch which provides inputs to indicate also fan running and fan tripped.

Operation of the heater batteries shall be inhibited until air flow is established as sensed by either one of the fan sensors.

Each air conditioning unit shall operate as follows:

- When supply fans are not in operation fresh air damper closes and compressor/condenser are stopped
- When only fresh air (Pressurization) fans are not in operation only return dampers are open

- For each air conditioner a dew point thermostat set at 13.5°C dry bulb and 12.5°C wet bulb (located at fan outlet) controls the compressor to maintain the required air supply and humidity conditions
- Evaporation temperature shall be between 4 and 6°C.

Ambient thermostat (on return air) controls the electric reheater to ensure ambient relative humidity and temperature. Upper limit safety device (thermostats and flow sensors) shall be provided.

For pressurization purposes only fresh air fan is required.

5.2.2.2 Fire and gas damper operation

The fire and gas system will have the capability to shutdown the complete HVAC system by isolating its power.

System also provide signals to the control system to indicate that all fire dampers have closed and also to indicate that all fire dampers are open.

To ensure fire extinguishing, all fire and gas automatic dampers of the technical room shall be automatically closed before CO₂ injection.

If gas sensors detect gas on fresh air inlet, all fire and automatic dampers are closed, the HVAC system shall stop to comply with fire and gas interface.

5.2.3 HVAC control system

The HVAC system shall be controlled from a programmable logic controller (PLC) interlocked with the main fire and gas detection system and shall have the same security functions as, but not limited to:

- Fire dampers operation (pneumatically operated)
- Rooms purge
- All drive fans and compressor operation
- Rooms pressurization and ventilation
- Emergency operation including the shutdown, manual purge and restart of the HVAC after an emergency situation
- Normal starting sequence of each system: a block diagram showing the HVAC control system shall be provided. Signals to/from other control system shall be detailed (type, e.g. digital in/out, analog in/out, hardwired links, serial links, etc.)
- Maintain of internal pressure control (Pressurization)
- Maintain temperature and humidity
- Air filter conditions (clean, dirty, etc.)
- All alarms
- Change-over to stand-by equipment
- All the running conditions: on, off, fault of each equipment
- All test and maintenance operations.

The automatic control system shall be designed, so that on failure of any drive equipment, automatic change-over to stand-by is made.

The application program functional analysis shall be supplied. The application program shall be:

- Properly structured
- Document throughout using comment boxes
- Developed using ladder logic.

5.2.4 HVAC equipment specifications

5.2.4.1 Refrigerant piping

Refrigerant piping shall be made of copper and shall be insulated with at least 25 mm thickness Armaflex, Prest-o-flex or similar air tight insulation.

All pressure test shall be completed and approved before application of insulation.

5.2.4.2 Direct Expansion split system unit

Compressors shall be of reciprocating hermetic or semi hermetic type for R22 (freon 22) refrigerant with housing made of 316L stainless steel painted.

Compressor shall be equipped with at least two steps capacity control (or hot-gas by-pass) to avoid start-stop problems (see Appendix 3).

In any case the system shall be selected to permit easy start-up after a long shutdown and with high indoor and outdoor temperature.

Evaporator fans shall be centrifugal with long life bearing (at least 30.000 hours without maintenance).

Air refrigerant exchangers shall be with copper tubes and fins.

Tubes and fins shall be electrotinned after manufacture. Face velocity shall be lower than 2.8 m/s. Evaporator coils shall have 10 fins/inch max.

Over capacity shall be at least 15%.

Direct expansion coil cooling control capacity shall be either by row control or face control.

Refrigerant circuit shall be equipped with low pressure switch, high pressure switch, gauge pressure control (low and high), dryers, filters, solenoid valves, etc. Condensate basin shall be made in stainless steel and insulated.

The EER (Energy, Efficiency Ratio) shall be at least 2.5 cooling kW per electrical kW.

Fans shall be driven by V. belts anti-static type. The capacity of all belts less one shall be 100% of the maximum motor capacity.

5.2.4.3 Air cooled condensers

Air condensers shall have copper tubes and fins electrotinned after fabrication.

The condensers shall be sized with a maximum face velocity of about 3.5 m/s and condenser coils shall have a maximum of 12 fins/inch.

Maximum condensing temperature shall be not more than 10-12°C max outdoor temperature.

Fans and motors shall be mounted in a frame isolated from casing by spring rubber vibration dampened with at least 92% efficiency.

Casing and fans shall be painted in accordance with relevant specification.

Fans and motors shall be suitable for operation in hazardous areas. A protective grid for fan and coil condenser shall be provided.

Casing thickness shall be at least 2.5 mm.

5.2.4.4 Pressurization fans

Fans and motors shall be suitable for operation in an hazardous area.

They shall be centrifugal (backward) or helico-centrifugal (mixed flow type).

Motors shall have a power margin capable to ensure 15% oversizing.

Maximum fan velocity shall be no more than:

- Backward curved type: 1700 rpm
- Helico-centrifugal type: 2950 rpm.

Fans shall be driven by V-belt anti-static type. The capacity of all belts less one shall be 100% of the maximum motor capacity.

5.2.4.5 Filters

Fresh air inlet shall be supplied with a rainhood protection.

Fresh air pre-filter shall be two stage tep. The first stage acts as a filter coalescer section. The second stage acts as separator section. The complete system assembly shall have an efficiency of 98% at 6 micron of NaCl particles. Units shall be selected to ensure a maximum static pressure of 25 mm WG when fully dirty.

Frame and filter cells shall be made from stainless steel.

Return air filters: maximum pressure loss shall be 5 mm WG when clean and 15 mm WG when dirty.

Efficiency shall be not less than 95% (ASHRAE standard gravimetry).

For each filter system a differential dial manometers shall be provided.

Type test certificates shall be supplied to check filter efficiency and pressure drop.

5.2.4.6 Ductwork

Ductwork shall be made in compliance with ASHRAE and SMACNA specifications and according to the thickness specified as follows:

- From 0 to 150 mm: 0.6 mm
- From 461 to 750 mm: 0.8 mm
- From 751 to 1200 mm: 1.0 mm
- From 1201 to 1500 mm: 1.5 mm.

Outside ducts shall be made in stainless steel AISI 316 SL.

Thickness shall be at least 1.5 mm and longitudinal joints shall be welded.



The duct tests shall be carried out for low velocity ducts except for a visual check on correct mounting.

All ducts shall be protected against corrosion by (inside and outside) painting in accordance with relevant specification.

Maximum air velocity shall be 6 m/s and/or 0.05 mm/m WG pressure loss for main ducts and 3 m/s for branch.

Outdoor ducts fresh air outdoor ducts shall not be insulated.

Indoor ducts: fresh air and supply air shall be insulated by means of 35 mm thick fibre glass and recovered by a vapour barrier.

The vapour barrier shall have a water vapour permeability of no more than 0.05 perm and shall comply with # 90A of the US National Fire Protection Association All joints shall be water tight.

Finally all these ducts shall receive a coating of fibre glass tissue and an epoxy resin paint to glaze the surface.

Caution shall be taken to ensure water tightness around supports, reinforcements, etc.

5.2.4.7 External grilles, louvres and relief dampers

These devices shall be fabricated from AISI 316L (or S16) stainless steel and painted in accordance with relevant specification.

Fresh air inlet shall be completed with moisture discharge.

Louvres shall be sized for a maximum face velocity of 2.5 m/s for inlet and 3.5 m/s for exhaust, on the basis of 45% free area.

90°C elbow or equivalent device shall be provided to limit wind pressure effects.

Oversizing shall be 15%.

Air losses for relief dampers shall be 2.5% of the nominal air flow at 20 mm WG differential pressure and face velocity about 2.8 m/s.

For gas dampers or one way damper leakage shall be no more than 0.5 of the minimal air flow at 20 mm WG differential pressure.

5.2.4.8 Fire and gas dampers

All fire and gas dampers shall be designed for a minimum fire rated A60 classification.

All dampers shall be of fail safe type with spring return operation from damper open to close position. The pneumatic actuator shall operate when supplied with compressed air via a universal solenoid valve.

Dampers shall be suitable for remote control. Each damper shall be fitted with two limit switches (one open and one closed position) to provide remote indication and shall be explosion proof type (Ex "d").

On receipt of a remote signal from the fire and gas system the solenoid operates the actuator to close the damper.

Each damper shall also be fitted with an approved pattern frangible bulb system set at 70°C + 3°C to close instrument air supply, venting the actuator.

Closing of fire and gas dampers shall be achieved within 2 sec of the bulb or solenoid valve action.

Casing and framework shall be of welded construction, fabricated from 3 mm thickness minimum AISI 316 stainless steel with 40 mm flanges for connection to ductwork.

Blades and spindles shall be also manufactured from AISI 316, 3 mm thickness stainless steel.

Bearings shall be of the sealed type life and without lubrication.

Fire insulation for A60 protection shall not be less than 75 mm thick mineral wool of density not less than 150 kg/m³.

All fire and gas dampers shall be fitted with side and edge seals to ensure that minimum air leakage through the damper blades and casing, with blades closed, shall not exceed 90 m³/h per m² at 10 mm WG differential pressure.

Each fire and gas damper shall offer a maximum pressure loss to air flow of 6 mm WG in the open position at system design velocity.

Stainless steel terminal boxes of the same material as the damper casing shall be Ex'e' and shall be mounted on the pneumatic actuator to avoid external cables.

All dampers shall be supplied with earthing box.

5.2.4.9 Electric reheater coils

Electric reheater coils shall be suitable for installation with a velocity (less than 4 m/s). Pressure drop on this coil shall not exceed 60 Pa at the nominal air flow.

The heating elements shall be of the fully sheated type operating at face temperature below 95°C.

Heating coil with more than 4 kW heating capacity shall be pre-wired for thyristor control.

Casing shall be made in stainless steel or carbon steel (same as for ducts) and shall be airtight.

The heater elements shall be of sheated black heat type, the tubular elements being supported within the casing.

The heating elements shall consist of wire with 80% nickel and 20% chromium in incolloy 800 tube packed with magnesium oxide.

The element bank shall be fitted with a removable terminal to facilitate maintenance and check. The terminal box shall be external to the air stream and shall have IP 55 enclosure.

Each heater shall also be fitted with manually reset safety cut-out controllers to insulate the electrical supply to the elements, when the surface temperature of the elements exceeds the normal operating temperature.

The reheaters shall be supplied complete with earthing box, a flow switch (or differential pressure switch) shall cut-off power if there is no air flow.

All heating elements shall be isolated from the frame inner supports with high temperature phenolic or approved equivalent insulators.

5.2.5 Control

Control shall be electric and/or pneumatic. All alarm and maintenance information shall be completely independent from controls. Alarm electrical interface shall be realised by switches (free of voltage).

When required status of the HVAC system shall be available at the VDU (installed in the control room) showing all main equipment e.g. fans, pumps, compressors, filters, dampers.

5.2.6 Accessibility

During design and installation, all necessary arrangements shall be made in order to facilitate dismantling and re-assembly of equipment, without hindrance to operation. The positioning and maintenance area of the different devices as well as control shall be studied so as to facilitate the work of maintenance people.

COMPANY reserves the right:

- To ask for any item removal to prove such accessibility
- To require any modification to improve the accessibility for routine maintenance.

5.3 Fire detection and extinguishing system

The equipment shall be in accordance with the following documents:

- The general specifications listed section 2
- The particular specification.

The equipment shall consist of:

5.3.1 Indoor

"n" smoke detectors located on the ceiling and inside the false floor, to make two separate loops.

One manual break glass CO₂ release.

The piping (ceiling and false floor).

One siren (buzzer).

5.3.2 Outdoor

One CO₂ skid equipped of two series of CO₂ bottles (one serie on duty, the other on stand by). The CO₂ skid shall be installed in a box adequately designed for weather protection and sun radiations (paint colour: red). Each unit shall be equipped as follows:

- One automatic bottles weighing and one CO₂ flow switch
- One CO₂ discharge pressure switch
- One mechanical CO₂ release.

One manual break glass (CO₂ release) installed near the main access door.

One pre-release CO₂ audible warning device installed near main access door.

One light box with two indicating lamps (green: normal operation, red: fire detection, and CO₂ release).

The box shall be installed near the main access door.

One manual/automatic selector switch (CO₂ release) installed near the main access door, to prevent the eventual CO₂ release whilst the cabin is manned.

Electrical cables for the fire extinguishing system shall be of fire resisting type as described in the electrical cables specification **GS ELE 161**.

5.4 Gas detection system

This equipment (if any) shall be in accordance with the gas detection particular specification.

The equipment shall consist of:

- “n” gas detectors
- 1 gas cabinet (part of fire cabinet)
- 1 visual alarm “gas detected”
- 1 “gas detection audible warning”.

5.5 Electrical equipment, description

5.5.1 Power transformers, switchboards, DC and AC UPS, batteries, and auxiliary panels cables, etc.

See “COMPANY Specifications listed in 3”.

5.5.2 Lighting circuits and sockets

5.5.2.1 Switchroom lighting (illumination level: 300 Lux)

Consists of:

- Industrial type fluorescent fittings supplied from the 230 V normal lighting panel and directly controlled from the circuit breaker
- Industrial type EExde lighting fittings supplied from the 230 V emergency lighting panel and directly controlled from the circuit breaker
- One emergency lighting, battery powered, permanently charged (autonomy 1h30 minimum). The lighting shall be installed above each door (with EXIT sign) and suitable for operation in a zone 1 hazardous area
- One portable lighting, battery powered with the rechargeable device supplied from a 230 V socket, permanently charged (autonomy: 4 h minimum). The lighting shall be suitable for operation in a zone 1 hazardous area.

5.5.2.2 Air lock lighting (illumination level: 100 Lux)

Consists of:

- Industrial type EExde lighting fittings supplied from the 230 V emergency lighting panel and directly controlled from the circuit breaker.

5.5.2.3 Out door lighting (illumination level: 100 Lux)

Consists of:

- “One” industrial type EExde lighting fittings supplied from the 230 V normal lighting panel and directly controlled from the circuit breaker. The lighting shall be installed above the main door access and suitable for operation in a zone 1 hazardous area.

5.5.2.4 Socket outlets

The following shall be installed:

- One “2* 16A + earth” - 230 V - AC - near the main door access
- One “2* 16A + earth” - 230 V - AC - at a suitable location
- One “3* 32A + earth” - 400 V - AC - near the main door access.

5.5.3 Cables

- Cables (power and control) for electrical apparatus (transformers, switchboards, motors panels, lighting, etc.) shall be in accordance with the COMPANY specification **GS ELE 161**
- Cables for the HVAC system (control) shall be in accordance with the particular project specification “Instrumentation cables”.

5.5.4 Safety equipment

Safety devices shall be grouped together on a rack fixed to the wall, and includes:

- One pair of gloves (in a box)
- One isolating stool. + rubber mat
- One isolating pole
- One voltage detector
- The resuscitations instructions and warning plates
- One portable earthing connections.

5.6 Telephone and public address

5.6.1 Telephone

One telephone set shall be installed near the main door access. The telephone set shall be suitable for operation in a zone 1 hazardous area.

5.6.2 Public address (when required)

The public address shall consist of one loud speaker. This speaker will be connected to the public address panel (out of scope).

5.7 Earthing system

The earthing system shall be in accordance with the “Design of earthing and bonding systems” **GS ELE 031** specification and the typical drawings.

The earthing shall consist of:

- One electrical earthing dispatcher installed in the false floor
- Two instrumentation earthing dispatcher (if any) installed in the false floor

- One electronic earthing dispatcher (if any) installed in the false floor
- All metallic parts, housings, enclosures, structures shall be connected to the electrical earthing dispatcher, other equipment shall be connected to the corresponding dispatcher.

6. Installation and connections

6.1 Switchboards, cabinets, panels and enclosures installation

Switchboards, cabinets, panels and electrical or instrumentation enclosures, shall be fixed on steel supports, welded to the cabin structure. Supports shall be sandblasted and painted in the same way as the rest of the cabin steelwork.

6.2 Cables installation and connections

6.2.1 General

Cables shall be in accordance with the **GS ELE 161**.

Cables interconnecting the equipment within the cabin will be of non armoured type.

Cables interconnecting the outdoor installed equipment shall be of armoured type, fitted outdoors with adequate mechanical protection.

Interconnecting and outgoing cables shall run on cable trays under the false floor.

Power cables shall be segregated from control/instrumentation cables in order to avoid interferences and electronic noise effects (minimum distance: 300 mm). In this respect, fire and gas detection equipment is particularly sensitive, therefore a particular attention shall be paid, to the wiring.

6.2.2 Cable trays and cables fixation

Inside the cabin, cable trays shall be made of hot dip galvanized, perforated steel plate.

Outdoor of the cabin (eg: roof), cable trays shall be made of perforated polyester plate, glass fibre reinforced (GRP), self extinguishing (M3) or aluminium 5754.

Fixation of cable trays shall be achieved by standard steel supports having a minimum thickness of 5 mm. These supports shall be welded to the structure, sandblasted and painted like the structure.

Cable trays shall be dimensioned with 20% spare capacity.

Changes in direction and shunting shall be done without interrupting the continuity of cable trays, and taking into account the minimum cable bending radius.

Elbows, tees, etc., shall be supplied in form of pre-fabricated components of the same material as the cable tray.

Cables shall be laid in a single layer. Two layers will be acceptable in case of control/instrumentation cables only.

Cables ties shall be made of corrosion proof materials. If parts are made of stainless, it shall be grade 304, with nylon coating.

Fixation of cables on cable trays shall be done as follows:

- Every 30 cm for vertical routings

- Every 1 m for horizontal routings, plus fixation points at direction changes
- At a distance of 20/30 cm of each connecting point
- In general, at all points, where lack of fixation may cause cable deterioration.

Individual cables or group of 2 maximum shall be placed in ducts, of same grade as the cable tray or in tubes, reinforced, fire resistant and mounted with open bends.

Individual cables shall be clamped every 30 cm.

Cables exposed to direct sunlight shall be protected by sunshades.

6.2.3 MCT'S (Multi Cables Transit)

MCT'S shall be provided and sized to accommodate all the cables (present and future), entering in the cabin.

MCT'S shall be provided with 20% spare.

MCT'S shall be of the same fire-rating than the wall (A60).

MTC'S shall be preferably mounted on the floor.

6.2.4 Cables marking

Cables marking shall be achieved by means of stainless steel tags, embossed or graved.

Tags shall be clamped to each cable, at both ends and at both side of MCT'S.

6.2.5 Cable glands

Cable gland shall be of a double seal armour clamping type, where a seal is made at both bedding and the outer sheath. Gland shall be ISO threaded.

Cable glands shall be certified suitable for use in the specified area.

Outdoor cable glands shall be provided with heat shrinkable sleeve.

Outdoor entries from the top of equipment are not permitted.

Cable glands shall be made of corrosion resistant material.

6.2.6 Cable connections

The following rules shall be observed:

- Lugs and terminations shall be crimped
- Control wires and power conductors shall be tagged
- Cable armours and shields shall be connected to relevant switchboard, cabinet, panel, etc., earth bar or terminal.

7. Engineering documents

7.1 Engineering services

The services will cover the detailed engineering of the cabin with all the associated components and works.

More specifically the engineering services shall include the following activities:

- Structural and architectural design of the cabin
- Complete study for cabin loading/unloading/sling calculations
- Detailed engineering of the pressurization and HVAC
- Detailed engineering of the fire and gas system
- Study of detailed equipment lay-out inside the cabin and outside contiguously to the cabin
- Study of all penetrations inside the cabin
- Electrical system study, including the detailed engineering of electrical switchboards, cabinets, panels and enclosures, covering both the electrical and dimensional aspects
- Electrical installation including cables routing inside and outside the contiguously the cabin
- Fault current calculation and study of selectivity of protections (coordination curves), with protective relays settings.

7.2 Engineering documents

The above mentioned engineering work will be materialized in form of the following documents.

Note: See particular specification for additional required documents.

7.2.1 Structure documents

- Cabin structural calculations
- Cabin structural detailed drawings
- Cabin architectural detailed drawings and specifications, showing:
 - Internal partitions
 - Access doors
 - False floor supporting structures
 - Equipment supporting frames.
- Cabin weight follow-up report
- Cabin loading/unloading/slides/spreader frame, calculation
- Cabin certificates (A60, Fire resistance, etc.)
- Equipment lay-out drawings in cabin with dimensions and weights
- Drawings showing penetrations inside the cabin (cables, pipe, HVAC, ducts).

7.2.2 Pressurization and HVAC documents

- HVAC detailed drawings and specification and data sheets
- Pressurization, HVAC, calculation note
- Trouble shooting diagram
- PID drawings

- Operating instruction manuals
- Maintenance instruction manuals.

7.2.3 Fire and gas system documents

Detailed drawings, specifications and documents as required in the particular specification.

7.2.4 Electrical documents

7.2.4.1 Studies (if required in the particular specification)

- General one line diagram
- Fault current calculation
- Protection selectivity study including selectivity and protective device settings
- Cable cross calculation
- Lighting calculation
- Battery sizing calculation.

7.2.4.2 Detailed drawings, specifications and documents (if required in the particular specification)

- Equipment dimensions lay out and installation drawings
- One line diagram (per equipment)
- Equipment (switchboard, cabinet, etc.) dimensions and installation drawings
- Equipment (switchboard, cabinet, etc.) data sheets
- Equipment (switchboard, cabinet, etc.) materials list
- Equipment (switchboard, cabinet, etc.) terminals
- Equipment (switchboard, cabinet, etc.) schematic and wiring diagrams
- Cabin, internal interconnecting diagram
- Cabin, internal cable list
- Cabin, external interconnecting diagram
- Cabin, external cable list
- Cabin, cable routing
- Cabin, earthing circuits, detailed drawings
- Cabin, lighting circuits, detailed drawings
- Cabin, MCT's location cables occupation drawings.

7.2.4.3 SUPPLIER book

Cabin SUPPLIER shall establish a final dossier called "SUPPLIER book" including:

- All "as manufactured" engineering documents listed hereabove (drawings, specifications, performances, MANUFACTURER documentations, certificates, calculation notes, tests records, etc.)
- The operational manual
- The maintenance manual
- The spare parts list.

The SUPPLIER book shall be delivered at the same time than the cabin.

8. Factory Acceptance Tests (FAT)

8.1 General

All the cabin components shall be subject to expediting and inspection by the COMPANY at the MANUFACTURER's works during manufacture.

The witnessing of inspection of any item shall be the prerogative of the COMPANY but does not relieve the SUPPLIER of his responsibility to comply with the specification.

The electrical cabin shall be factory tested and when stated in the purchase order commissioned offshore by the SUPPLIER. The intent of these tests is to carry out maximum commissioning of the cabin before it is taken offshore and to ensure that adequate records are made of all tests, so as to reduce the offshore commissioning requirement and also to highlight certain interface points, defects and design modifications which should be resolved before the units are required to be put into service offshore.

The SUPPLIER shall advise COMPANY/ENGINEER two weeks in advance at least in order that the COMPANY or his representative can witness the factory tests.

The SUPPLIER shall not carry out any testing without written consent from the COMPANY.

The SUPPLIER shall provide, at his own expenses, all appliances, instruments, labour and other facilities required for factory tests and shall perform the work as required by the COMPANY.

When specifically required, the MANUFACTURER representatives will be available for supervisory guidance for the testing and precommissioning of major items of equipment, although this in no way relieves the SUPPLIER from the responsibility of providing competent and suitably qualified testing and SUPPLIER engineers.

8.2 Acceptance tests

Acceptance tests must be performed by SUPPLIER in the presence of COMPANY inspectors, or his representative.

The factory acceptance tests shall include, but not limited to the following:

- Inspection of equipment and installation to check for mechanical integrity
- Inspection of equipment and installation to check for compliance with specifications, drawings, regulations and codes of practices

- Inspection of cables installation (supporting, fixing, tagging, connection, etc.)
- Inspection of switchboards, panels, etc., installation (supporting, fixing, tagging, connection, etc.)
- Inspection of earthing circuit (continuity and connections)
- Inspection of lighting circuits and illumination level checking
- HVAC functional tests:
 - Conformity with specifications and drawings
 - Functional tests
- Fire system functional tests:
 - Conformity with specifications and drawings
 - Functional tests (without CO₂ release)
- HV and LV cables:
 - Insulation tests
- HV and main LV switchboards tests:
 - Conformity with specifications and drawings
 - Protection relays test and calibration (secondary current injection)
 - Functional tests (closing, tripping and signalling circuits)
- Secondary LV switchboards and panels tests:
 - Conformity with specifications and drawings
 - Functional tests (relaying and signalling circuits)
- Battery chargers and 230 VAC UPS tests:
 - Conformity with specifications and drawings
 - Functional tests

The following test instruments shall be provided by the SUPPLIER and shall include:

- Direct reading anemometers
- Inclined gauge manometers with pressure ranges to suit fan duties
- Pito static tubes to suit ducts size
- Mercury in steel housing thermometers
- Dry and humidity recorders
- Tachometers
- Phonometers with frequency analyser
- Maghelic differential manometer for low and normal air pressure
- Heaters to simulate heat load if required



- PLC Programming console
- Insulation testers (LV and HV equipment) and multi-tester.

It should be understood that the activities specified above do not preclude the necessity for further inspection and testing, to suit individual features or MANUFACTURER's instructions.

SUPPLIER shall be responsible for taking all necessary safety precautions, replacing all sundries (e.g. fuses blow during testing) and keeping maintenance and preservation of the installation until taken over by the COMPANY.

8.3 Test reports

A draft test report shall be submitted to the COMPANY for approval two weeks before the beginning of factory tests.

Test reports shall specify in all cases:

- Theoretical values expected
- Permissible tolerance values
- Results of tests, including theses values leading to an initial rejection, where applicable.

These reports shall be incorporated into the contractual technical documentation, of which they form an integral part.

8.4 Qualification tests

SUPPLIER shall supply tests certificates of tests carried out in accordance with the required documents listed in the COMPANY specifications.

9. Spare parts

9.1 Commissioning and start-up spare parts

The SUPPLIER shall replace all damaged or broken material during construction and tests.

The SUPPLIER shall provide a list of spare parts to be supplied with the cabin, for the commissioning and start-up.

9.2 Two years spare part list for normal maintenance

The SUPPLIER shall supply with his bid a spare parts list for the maintenance of the electrical cabin on a two years basis.

10. Weighting

Before load-out the cabin SUPPLIER shall weight the complete cabin with all equipment installed. The load figure shall be given in a written report, including the co-ordinates of the center of gravity of the complete cabin.

Cabin weight follow-up shall also be established.



11. Sea fastening

The SUPPLIER shall provide sea fastening of equipment installed in the cabin or directly associated with the cabin (roof mounted equipment).

Sea fastening shall be achieved in compliance with instructions given by equipment manufacturers.

Sea fastening shall be submitted to COMPANY for approval.

All withdrawable and removable equipment, shall be shipped in sea worthy packed cases. This is also applicable to equipment that must be shipped separately (batteries, HVAC units, etc.).

Sufficient quantities of desiccant shall be placed in electrical switchboards, panels, etc., prior to sea transportation.

12. Limit of supply

Detailed limit of supply is given in the Appendix 1.

Appendix 1 Limit of supply

Legend: S - Supply C - Connection I – Installation

Equipment	Cabin SUPPLIER	Manufacturers			Engineer	Company
		Switchboards	Transformers	UPS		
Cabin structure and architecture	S - I					
False floor	S - I					
Pressurization HVAC						
Air cooled condensing unit	S - C - I					
Package direct expansion air conditioner	S - C - I					
Pressurization fans with filters and separators Ducts	S - C - I					
Fire and gas dampers, grilles, diffusers, overflow dampers	S - C - I					
Insulation for ducts and piping	S - I					
Gas and refrigerant piping	S - I					
Control instruments	S - C - I					
Utility air connection	S - C - I					
Accessories (thermoters, refrigerant, filters, dials manometers, etc.	S - I					
Control and power Cables	S - I - C					
Spare parts for commissioning and start up	S					
Fire system						
Fire detectors	S - I - C					
Smoke detectors	S - I - C					
CO ₂ skid	S - I - C					
CO ₂ release pushbutton	S - I - C					
CO ₂ mechanical release	S - I					
Fire control panel	S - I - C					
Cluster (signalling)	S - I - C					
Piping	S - I - C					
Control and power Cables	S - I - C					
Gas system						
Gas detectors	S - I - C					
Visual and acoustic alarm	S - I - C					
Gas control panel	S - I - C					
Control and power Cables	S - I - C					



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Appendix 1

Legend: S - Supply C - Connection I – Installation

Equipment	Cabin SUPPLIER	Manufacturers			Engineer	Company
		Switchboards	Transformers	UPS		
Electrical						
HV Switchboard	I - C	S				
LV Switchboards (400 V, 230 V)	I - C	S				
Marshalling cabinets	I - C	S				
Relaying cabinets	I - C	S				
Auxiliary distribution panels	I - C	S				
Lighting panel	I - C	S				
DC batteries chargers and distr. board and batteries	I - C			S		
AC UPS and distribution board	I - C			S		
HV/LV transformer	I - C		S			
LV/LV transformer	I - C		S			
Lighting and sockets	S - C - I					
Indoor cables	S - C - I					
Outdoor cables	S - C - I					
Indoor and outdoor cable trays	S - I					
MCT's	S - I					
Telephone and public address	S - C - I					
Safety equipment	S - I					
Earthing system	S - C - I					
Factory tests	X				X	X
Sea fastening	X					
Transport	X					
Ex WORKS						
FOB						
CIF						
On site assistance (commissioning and start-up) (upon request)	X	X		X	X	X
Company specifications						X
Engineering plant documents					X	



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Appendix 1

Legend: S - Supply C - Connection I – Installation

Equipment	Cabin SUPPLIER	Manufacturers			Engineer	Company
		Switchboards	Transformers	UPS		
Engineering cabin documents						
Structure	X					
HVAC	X					
Fire and gas	X					
Electrical	X	X	X	X		
SUPPLIER book	X					
Test procedures	X	X	X	X		
Test reports	X	X	X	X		

Appendix 2 List of approved equipment VENDORS

1 General

Priority shall be given to equipment that has already been produced in large series with however improvements in protection against corrosion and other details as specified to obtain reliability, long life and easy maintenance.

2 HVAC & instrumentation VENDOR list

Equipment	VENDOR
Compressors (hermetic or	Carrier semi hermetic)
Cooling coils	Carrier, Flakt
Condenser coils	Carrier, Flakt
Fans	Carrier, Howden Flakt, Woods
Fire and gas dampers	Colt, Flakt, OSV, TROX may dampers
Air filters	AAF
Air diffusers	Anemostat, Flakt
Sidewall grilles	Flakt, TROX Anemostat
Pressurization gauges	Maghelic DWAYER
Reheating coil	Flakt, Vulcan, OSV
Control	Sauter, Honeywell, Penn
PLC (Program logic controller)	Siemens, Simatic Product Range
Controllers/Recorders	FOXBORO BAILEY SEREG FISHER CONTROLS
Instrumentation cables	GORSE SILEC ALCATEL CABLE PIRELLI
Junction boxes	LEGRAND ATX STAHL
Corrosion monitoring System	INSTRUMENT & CONTROL / COSASCO FORAID DIMAPE
Telephon set	VENDOR shall be standardised with the rest of the plant
Public adress and loud speaker	VENDOR shall be standardised with the rest of the plant
Antenna mast	CGTI LECLERC
Control valves	FISHER CONTROLS MASONEILAN NELES



Equipment	VENDOR
Safety relief valves	FISHER CONTROLS SAPAG (ALSTHOM FLUIDES) SEDIM KEYSTONE (ANDERSON & GREEN WOOD)
On/off valves	FISHER CONTROLS MAPEGAZ (FLOW CONTROL) RSBD SARASIN (SEBIM) (ACTUATORS CAI/BETTIS)
Flow elements	BERGER DAR MECATHERMIC GASOS/DANIEL/PECO
Transmitters	
Flow transmitters	ECKARDT BAILLEY SEREG ROSEMOUNT
Level transmitters	OTIC FISHER & PORTER ROSEMOUNT BAILLEY SEREG
Pressure transmitters	ROSEMOUNT ECKARDT BAILLEY SEREG
Temperatures transmitters	ROSEMOUNT ECKARDT BAILLEY SEREG
Torque Tubes	ECKARDT FISHER CONTROL MASONEILAN
Level switches	MAGNETROL AUXITROL T. CAUVIN (PETROLE SERVICE) MIP
Level gauges	KLINGER AUXITROL T. CAUVIN (PETROLE SERVICE)
Pressure, Flow and Temperature Switches	GEORGIN
Pressure gauge	BOURDON ARM
Temperature elements (Thermowells)	BERGER DAR
Thermometers	ARM BERGER DAR

3 Electrical VENDOR list

Equipment	VENDOR
Cables	GORSE SILEC ALCATEL CABLES PIRELLI
Power and control junction boxes	LEGRAND ATX STAHL
Control stations	ABB LEGRAND ATX STAHL
Lighting fixtures and flood light	ABB LEGRAND ATX
Lighting junction boxes	LEGRAND ATX ABB STAHL
Cables trays and cable ladder	TEHALIT (GRP) CES (ALUMINIUM)
MCT'S	BRADBERG AFIMES ELCOM BEELF
Cable glands	LEGRAND ATX HAWKE PEPPERS
Socket outlet	LEGRAND ATX STAHL

4 Piping VENDOR list

Equipment	VENDOR
Above and equal to 2"	
Ball valves	IVC (FLOW CONTROL) MAPEGAZ THEVIGNOT (T. CAUVIN) TK Valves (except 2"x 1500 # which are not acceptable)
Cast steel valves	MALBRANQUE ALSTHOM FLUIDE SAPAG COYARD
Butterfly valves	AMRI KEYSTONE SEPAME
Check valves	FLOW CONTROL (CIPEG / MAPEGAZ) SEPAME DIMAPE
Filters Y (CS and SS)	T. CAUVIN SERVO DEFMAT SPIRAX SARCO



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Appendix 2

Equipment	VENDOR
Valves Cu-Ni/bronze	COYARD RONA T. CAUVIN
Less than 2"	
Ball vales	FLOW CONTROL (IVC / MAPEGAZ) THEVIGNOT (T. CAUVIN) TK Valves (except 2" x 1500 # which are not acceptable)
Forged valves	MALGRANQUE T. CAUVIN SACCP
Filters Y	Idem VENDORS for filters above and equal to 2"
Pipe CS	SPM TROUVAY CAUVIN CAPITAL TAD
Fittings - above 2"	SPM TROUVAY CAUVIN TRD
Forged fittings (CS) less than 2"	DELCORTE TROUVAY CAUVIN SPM
Flanges	MGI SPM TROUVAY CAUVIN
Pipe (stainless steel)	Idem Carbon Steel + CELLIER
Fittings (SS) - above 2"	Idem Carbon Steel + CELLIER
Fittings (SS) - less than 2"	Idem Carbon Steel + CELLIER
Flanges SS	Idem Carbon Steel + GILGRA
Pipe/Fitting/Flanges - Cu - Ni	TRD SANDWIK ACIER SPM TROUVAY CAUVIN
Pipe/Fitting/Flanges - GRP	SEPMA (T.C.) AMERON WAVIN
Gaskets	MECALLOY TROUVAY CAUVIN LE JOINT FRANCAIS



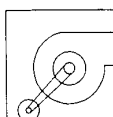
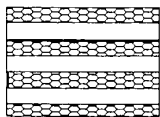
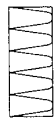
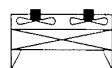
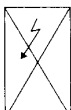
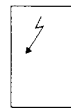
5 Fire and Gas

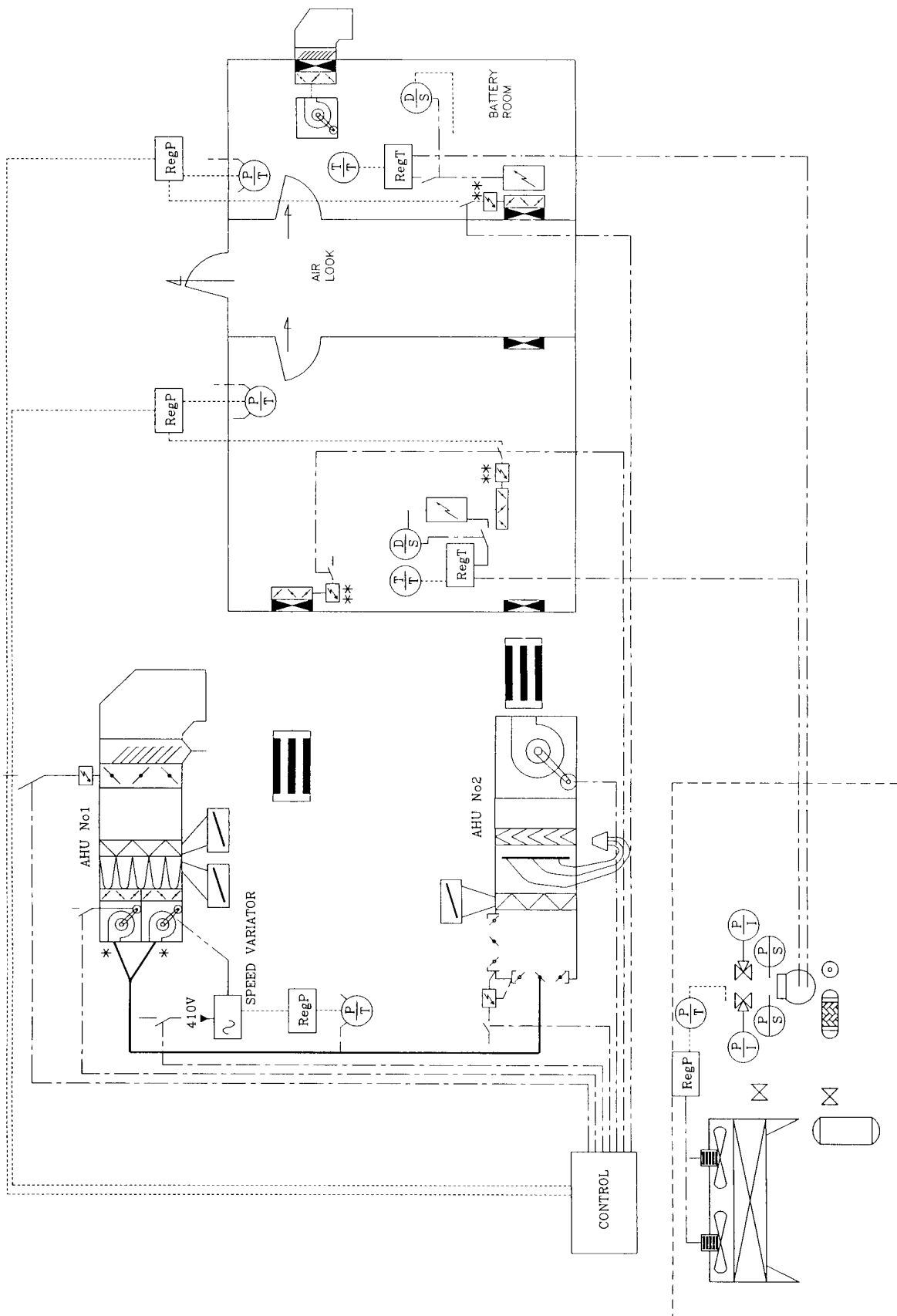
Equipment	VENDOR
Fire detection	AUTOMATISMES SICLI PROTEC FEU CERBERUS GUINARD GENERAL MONITORS
Gas detection	AUTOMATISMES SICLI PROTEC FEU CERBERUS GUINARD GENERAL MONITORS
Extinguishers (CO ₂ bottles)	SICLI PROTEC FEU

Appendix 3 HVAC typical

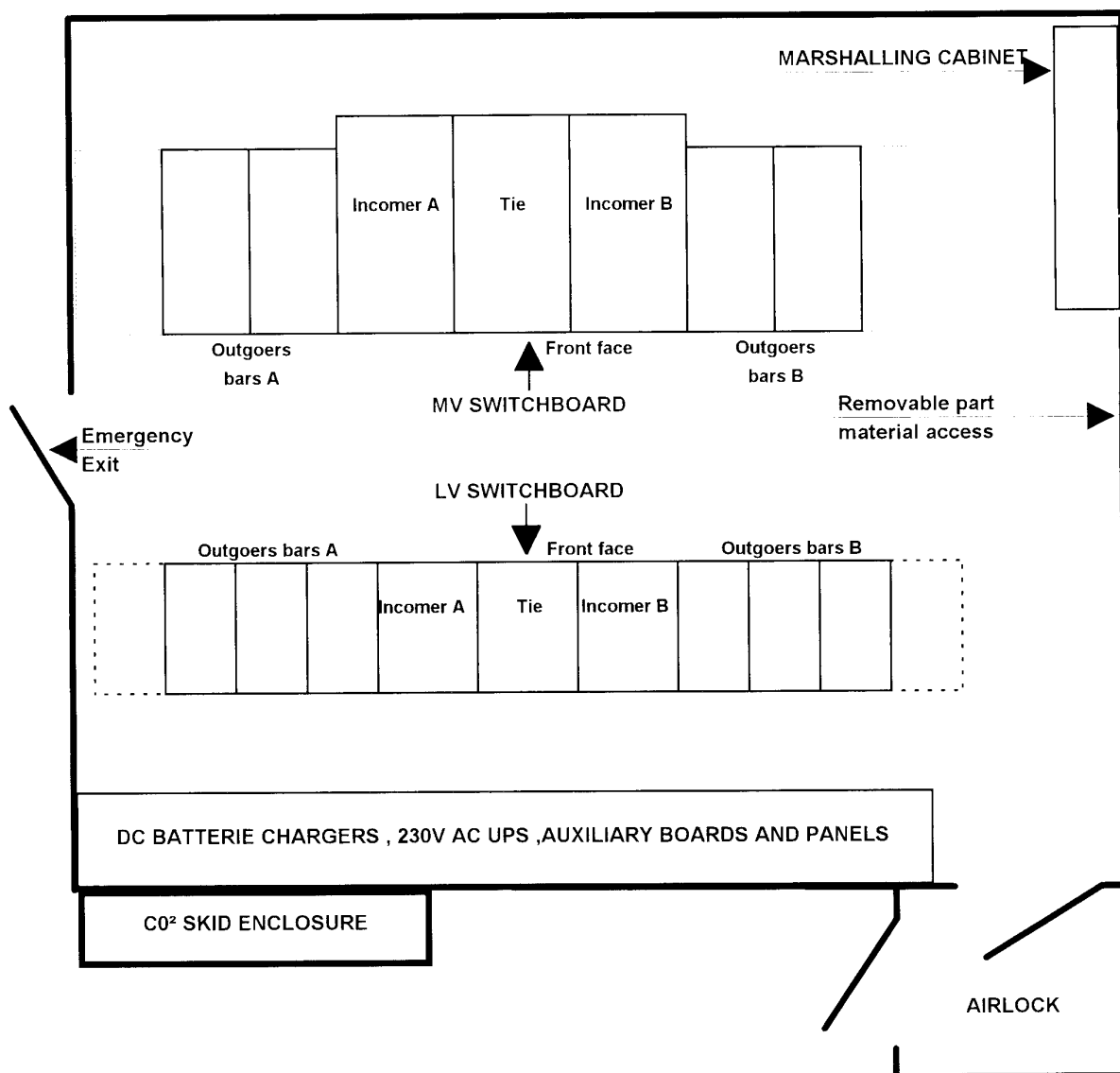
GENERAL NOTES :

- 1 - ALL OUTDOOR ELECTRICAL ITEMS WILL BE DESIGNED FOR DIV 1 : Ex"d" IIB-T3 OR Ex"e".
 - 2 - THE OPPORTUNITY TO PROVIDE SOUND ATTENUATOR AS WELL AS BUFFER TANK WILL DEPEND OF ACOUSTIC PERFORMANCE OR TECHNOLOGY OF THE SELECTED MATERIAL
 - 3 - IN CASE OF SHUT DOWN OR STAND-BY OF AIR HANDLING UNIT FAN, THE DAMPERS WILL BE IN CLOSED POSITION.
 - 4 - THE EXHAUST FAN WILL BE ENSLAVED TO THE AIR HANDLING UNIT FAN.
 - 5 - ALL THE FANS WILL DESIGN FOR ZONE 1- Ex"d" IIB-T3 OR Ex"e"
- * - FAN WITH VARIABLE SPEED DRIVE SYSTEM.
- ** - ALL AUTOMATIC DAMPERS WILL BE EQUIPPED OF A MECHANICAL STOPS IN ORDER TO ENSURE A MINIMUM AIR FLOW RATE (AIR FLOW RATE BLOWN - AIR FLOW RATE FOR THE OVERPRESSURE).

	COALESCER FILTER		FAN		
	ISOLATING OR BALANCING DAMPER		FIRE DAMPER		
	AIR PRE-FILTER		3 WAY VALVE		SOUND ATTENUATOR
	BAG FILTER		BALL VALVE		INCLINED P.G.
	CHILLED WATER COOLING COIL		BUTTERFLY VALVE		AUTOMATIC DAMPER
	DROPLET ELIMINATOR		FILTER		CONDENSER
	ELECTRIC HEATER		CIRCULATION PUMP		FILTER WITH SIGHT GLASS
			CHECK VALVE		EXPANSION DRUM WITH SAFETY VALVE
			LOUVRE		ELECTRICAL HEATER



Appendix 4 Cabin - Typical arrangement



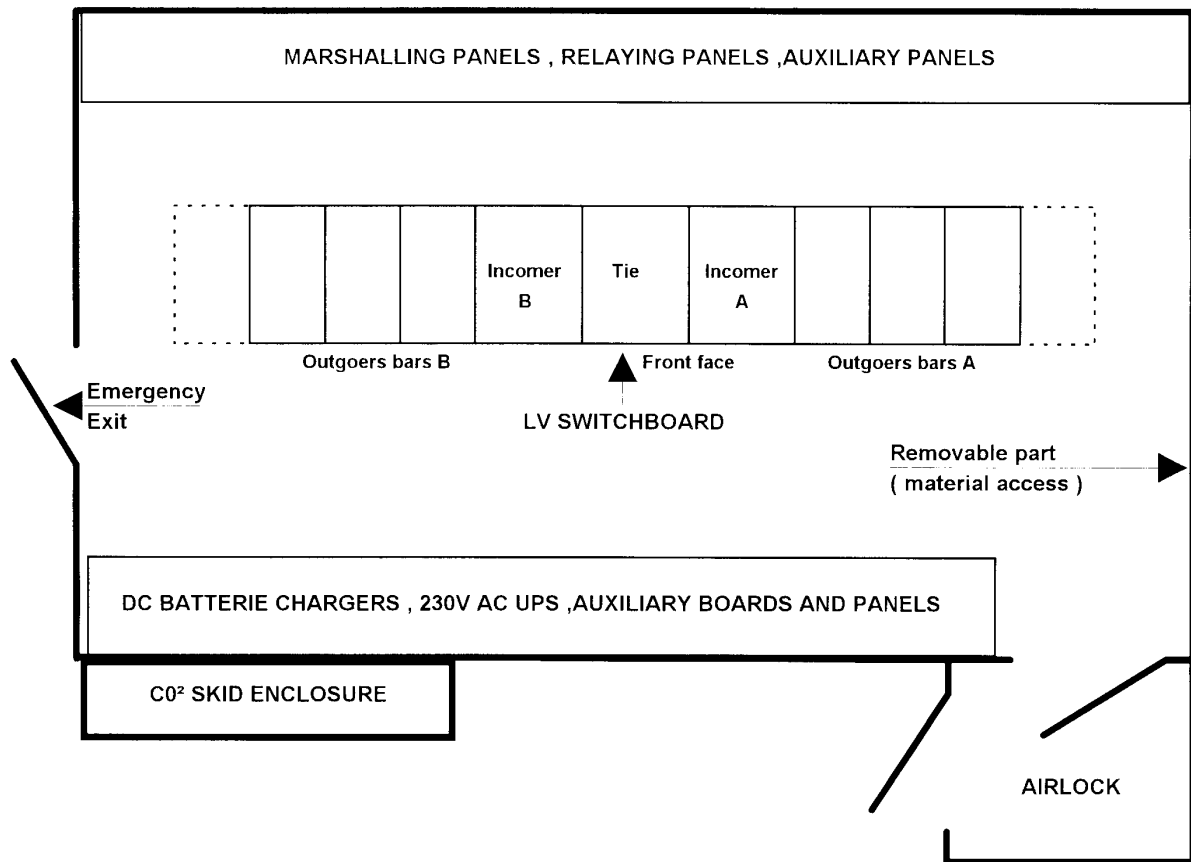
NOTE :

Space from wall to equipment : mini = 800mm
 Space from HV switchboard ,to LV switchboard : mini = 1700mm
 Space from LV switchboard ,to LV boards : mini = 800mm

LEGEND :

 Space for future equipment

Scale : ~ 1/50



NOTE :

Space from wall to equipment : mini = 800mm
 Space from LV switchboard ,to LV boards : mini = 800mm
 Space from LV switchboard , (front face) to other board : mini = 1500mm

LEGEND :

 Space for future

Scale : ~ 1/50