

GENERAL SPECIFICATION

CIVIL WORKS

GS EP CIV 401

Minimum requirements for building design and construction

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1. Scope

This specification defines the minimum requirements for the design and construction of buildings and utilities located outside the restricted area according to the definition of the restricted area given in **GS EP SAF 221**: "Area within the boundaries of the installation, and hence under the control of Company, which is affected permanently by normal operation of the facility or exceptionally by the consequences of an emergency situation caused by a major failure".

When certain supplies and/or works may be of a particular nature, the Company reserves the right to modify or add to general specifications by using **particular specifications**.

Note: The present specification does not deal with gas for domestic use.

2. Reference documents

The reference documents listed below form an integral part of this General Specification.

- When local national standards, regulations and codes exist, their particular requirements and those of the standards or codes to which they refer shall be applied, supplementing or amending the provisions of this document.
- If there are no mandatory national regulations, then preference is given to:
 - Total General Specification
 - International regulations, standards and codes.

In case of lack of international norms and standards, national norms and standards (mainly American, British and French) listed hereafter shall be applied.

In all cases the system adopted shall be coherent, i.e. the various texts shall present no incompatibility and shall respect the same philosophy (French, British, US or European). In case of discrepancies between documents the most stringent shall apply in the same philosophy.

In all cases, Contractor shall inform the Company of any deviation required and justify the changes. Such deviation shall be approved by the Company.

The list of norms and standards provided in this document shall not be considered as exhaustive. The Contractor shall respect the secondary standards and regulations, which cover the works described in the present specification.

External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

Reference	Title
ASCE	Design of Blast Resistant Buildings in Petrochemical Facilities

Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

Reference	Title
GS EP CIV 202	Drainage and underground networks
GS EP CIV 301	Design of reinforced and prestressed concrete
GS EP CIV 402	Design and construction of oil field laboratory on production installations
GS EP CIV 405	Plumbing and sanitary for onshore and offshore installations
GS EP ELE 001	Electrical design criteria
GS EP ELE 031	Design of earthing and bonding systems
GS EP ELE 051	Design and installation of lightning protection
GS EP ELE 061	Minimum requirements for HV & LV cable sizing
GS EP ELE 081	Lighting
GS EP ELE 131	High Voltage switchgear and controlgear
GS EP ELE 133	G.I.S High voltage switchgear and controlgear
GS EP ELE 135	Low voltage switchgear assembly
GS EP ELE 137	Distribution boards
GS EP ELE 141	Power transformers
GS EP ELE 152	AC Uninterruptible Power Systems (UPS)
GS EP ELE 161	Electrical cables
GS EP HVA 100	HVAC Basis of design
GS EP MED 062	Hygiene in bases and living quarters
GS EP SAF 221	Safety rules for buildings
GS EP SAF 228	Liquid drainage
GS EP SAF 321	Fire pump stations and fire water mains
GS EP SAF 322	Fixed fire water systems
GS EP STR 901	Design rules and construction standards for ancillary structures of offshore installations
GS EP TEL 180	Engineering and installation of telecommunication network pre-cabling
GS EP TEL 410	Installation rules

3. Requirements for design

3.1 Mapping Requirements

The general layouts of the site, buildings and facilities shall be geo referenced using the Project Coordinate Reference System parameters provided by Company.

The following features shall be included on each charts, but not limited to:

- A title, a graphic scale (Bar scale) and Numeric scale, specify the drawing format for which the numeric scale is applicable, a legend
- The projected Company Coordinate System Grid, the geographic coordinate system ticks and Local Engineering Grid, when applicable
- A situation Map
- The reference of the source drawings
- Full Company Coordinate system parameters, transformation parameters between the Company Coordinate system and the Local Engineering Grid when applicable.

The native files shall be provided in AUTOCAD or MICROSTATION and PDF formats. The CAD files shall be georeferenced using the project coordinate system and structured thus:

- Separate layers for each feature type (contours lines, elevation roads, etc.)
- Continuous lines (e.g. contours lines) shall be drawn as continuous 2D or 3D polylines.

Contractor may also propose to provide data in GIS formats (as ESRI shapefile or Geodatabase).

3.2 Minimum dimension

Office's size shall be as standard as possible. Unless otherwise specified in particular specifications, the following dimensions apply 5 m long x 3.7 m wide for an office accommodating two employees with their standard office furniture. The design of the other rooms shall be based on the standard dimensions so that rooms can be formed of 2 x standard dimensions, 3 x standard dimensions etc. Meeting rooms, copying rooms, filling rooms, etc. shall have the possibility to be redefined to additional offices by using partition.

Unless otherwise specified in particular specifications, toilets shall be 1000 x 1500 mm (in offices, toilets shall be min. 900 x 1200 mm). Showers shall be 1000 x 2000 mm, divided into a wet area and a dry area.

Unless otherwise specified in particular specifications, workshop and warehouse buildings shall have a width of 15 m and a length of a multiple of 6 m.

Corridors when they are not used as means of egress shall have the minimum dimensions given in the **GS EP SAF 221** according to the classification of occupancy and the occupation load.

The minimum clear dimensions under **ceiling height** shall not be less than the minimum ceiling height of means of egress: 2.30 m. Unless otherwise specified, the following dimensions shall apply:

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Table 1 - Minimum ceiling height

	Industrial	This height shall depend on dimensions of equipment and handling space required
	Storage	This height shall depend on dimensions of equipment and handling space required
Computer room	Business	3 m min + 0.50 m mini between false ceiling, if any, and the roof framing members
Corridors	Business, Industrial, Lodging houses, Hotels	2.30 m min 2.50 m preferably
Electrical station	Industrial	2.30 m for Low and Medium Voltage* 200 + U(kV) cm, 250 cm mini for High Voltage*
Laboratory	Industrial	2.60 m (see GS EP CIV 402)
Office rooms	Business	2.50 m
Toilets	Business, Industrial, Lodging houses, Hotels	2.50 m

* See chapter 3.7 for the definitions of Low, Medium and High Voltage.

All height dimensions are to underside of ceiling or beams, whichever is the lower.

3.3 Building components

3.3.1 Floors

Floor of industrial and storage buildings such as workshop, warehouse shall be adapted to traffic, weight of component, etc.

For the installation of computers and other instrument or electrical equipment with cable connections at the bottom of the equipment, a special cavity floor shall be installed. Separate steel structures shall be provided to support electrical equipment and battery benches.

All floors exposed to weather, liquid spillage or washing-down operations shall be laid with adequate and effective drainage system.

The finished floor level shall be at least 150 mm above the pathway around the building.

3.3.2 Walls

3.3.2.1 External walls

External walls shall be designed to prevent condensation and to resist penetration of external moisture (due to rain or snow) into the inside of the building. If buildings are made of concrete blocks, the external surfaces shall be plastered and painted.

A damp-proof course shall be included in all walls over the full length at a minimum height of 150 mm above the finished grade level. Whenever necessary, termite barriers shall be provided in the construction.

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Industrial and storage buildings shall be made gas and water-tight when required.

Preventive measures shall be taken to avoid inflow of rain water or released flammable liquids. All openings for cables or piping shall be above groundwater level.

3.3.2.2 Interior walls and partitions

Floors, ceilings, windows, heating, ventilation, air-conditioning and electrical fittings shall be designed in such a way that partition walls can be built and demolished in future without undue damage to the building.

Partition walls installed in buildings shall be based on the standard module dimension specified in the particular specifications.

All plastered corners shall be protected against impact damage by an integral bullnose element.

A damp-proof course may be omitted for partition walls, if erected on the concrete floor, except for wash rooms and other wet rooms.

3.3.3 Roofs

3.3.3.1 Flat roofs

Roofs and curbs shall be made completely water-proof by any proprietary water-proofing treatment. The composite roof shall comply with criteria for thermal insulation and fire protection. Condensation shall be avoided. Where frequent roof traffic is expected, adequate walkways shall be provided.

In very dry (e.g. Middle East) areas, the roof shall be flat with run-off (nominal) slopes and surrounded by a curb. The build-up roofing felt shall be protected against direct sun radiation by means of a protective layer.

3.3.3.2 Pitched roofs

For pitched roofs, the plan shape shall be kept as simple as possible, without hips and valleys. The construction shall be such as to result in a completely water-proof roof.

Proper ventilation between roof and ceiling of laboratory buildings is required to prevent accumulation of vapours (toxic or inflammable).

In tropical areas, rainwater gutters and downspouts shall only be provided over entrances and other areas where people have to pass.

Under all outer roof lines without a roof gutter, adequate concrete gutter facilities shall be designed at floor level with concrete slabs on both sides to prevent erosion.

3.3.4 Doors

Doors shall comply with the required performance in terms of fire protection and explosion.

- **External** doors shall always open outwards and in the direction of the escape route.
- Weather stripping on **external** doors to maintain the climate inside the building and to exclude all dust and moisture infiltration.

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- All main entrances and all other entrances to buildings which are air conditioned and frequently used shall have airlocks with adequately separated doors to control the indoor temperature and to prevent sand accumulation in the case of desert conditions.
- If the dimensions of doors are unpractical for easy handling, a wicket door shall be provided for frequent passage of persons, i.e. in workshop doors.
- Where visibility is required, doors shall be glazed.
- Doors may be electrically operated but shall have a facility for quick disconnection of the electric driver after which easy manual opening shall be possible (balanced doors).
- In non-freezing areas, fire-fighting garages should not have doors in front of the fire-fighting vehicles. If doors are required for climatic reasons they shall be made of light material so that the fire truck can break them open in case the doors are locked during an emergency.
- Fixing of frames for doors to the building shall be such as to ensure solid, void-free, water-proof joints and shall be in accordance with the instructions of the Manufacturers of the door.
- Locks, handles, handle plates, barrel bolts, panic bolts, door stops, kick plates, and automatic door closers shall be provided as necessary. For doors to air locks, air conditioned rooms, pressurised rooms, main entrances to sanitary blocks, and for all fire-check doors, automatic door closers or self-closing doors shall be installed. For other external doors, door catchers shall be provided.
- Steel fittings for industrial buildings shall have a corrosion resistant finish.
- All fittings of the same kind shall be of one make and type.

3.3.4.1 Dimensions

The minimum clear width door opening shall be in accordance with **GS EP SAF 221**. Unless otherwise specified, the minimum dimensions shown below could be applied. All these dimensions shall be increased if required for installation of equipment in the buildings.

Table 2 - Minimum clear openings of external doors

Type	Applicability to the Company	Width x Height (mm)
Assembly	Conference or passenger rooms	Width = 5 mm to 10 mm/person Min 1120 x 2100
Hotels	Living quarters	Width = 5 mm to 10 mm/person Min 1120 x 2100
Lodging houses	Small living quarters	900 x 2100
Business	Offices, training rooms, ambulatory clinics	Width = 5 mm to 10 mm/person Min 1120 x 2100
Industrial	Processing facilities, workshops	Min 4000 x 4000 Large enough for the necessary equipment to pass through
Storage	Bulk oil storage, chemical storage, warehouses	Min 3000 x 3000 Large enough for the necessary equipment to pass through

When they are not used as means of egress the minimum dimensions for internal doors shown below shall apply. All these dimensions shall be increased if required for installation of equipment in the buildings.

Table 3 - Minimum clear openings of internal doors

Type	Applicability to the Company	Width x Height (mm)
Assembly	Conference or passenger rooms	1500 x 2100
Hotels	Living quarters	900 x 2100
Lodging houses	Small living quarters	900 x 2100
Business	Offices, training rooms, ambulatory clinics	900 x 2100
Industrial	Processing facilities, workshops	Min 4000 x 4000 Large enough for the necessary equipment to pass through
Storage	Bulk oil storage, chemical storage, warehouses	Min 3000 x 3000 Large enough for the necessary equipment to pass through

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3.3.5 Windows

Windows shall comply with the required performance in terms of fire protection and explosion.

- The number of windows and the sizes of the glass panes shall be restricted to the minimum required by local building authorities.
- Unless otherwise specified in particular specifications, the underside of all windows, where possible, should be min. 1000 mm above finished floor level.
- Unless otherwise specified, the maximum pane area should be 1 m² and the glass panes shall be fitted from the outside. All window openings shall be designed in such a way that only a minimum of different glass sizes is required.
- All **exterior** windows in heated and/or air-conditioned buildings shall be designed with weather-stripping as described for doors.
- Windows shall be designed to minimise heat gain and ultraviolet light transmission, this may be achieved by installation of sun protection devices and avoiding excessively glazed surfaces.
- Double glazing for large glazed areas is desirable. Hermetically-sealed double-glazing units shall be used when transparency needs to be combined with heat insulation.
- Where insect screens are required, they shall be easily removable and rustproof.
- When specifying special glazing, such as reflective mirror glass and heavily tinted glass, consideration shall be given to replacements and availability in the country in question.
- The fixing method shall ensure void-free and water-proof joints and shall be in accordance with the instructions of the Manufacturers of the glass and the compounds.

3.3.6 Changes in level

- All Changes in level shall be designed and located to meet the local fire authority requirements for means of egress in the case of fire. The proposed location shall be approved by the Company.
- Unless otherwise specified the specifications of **GS EP SAF 221** shall be applied. In addition, when the change of level is less than 53 cm, the ramp should be the preferred solution.

3.3.7 Dimensions for stairs

- Stairs shall be in accordance with **GS EP SAF 221** and **GS EP STR 901**.

3.3.8 Dimensions for ramps

- Ramps shall be in accordance with **GS EP SAF 221**.

3.3.9 Internal and external finishes

The **external** appearance of buildings shall be plain, yet in accordance with local customs and existing buildings (if applicable). Heat-reflecting, thermal insulating properties and low maintenance shall be the major considerations in the selection of all **exterior** finishes. The **external** finishes selected shall comply with the functional and imagery role play by the building.

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In order to facilitate easy maintenance of the building components: floors, roofs, ceiling and walls a minimum of different **internal** finishes shall be used in one building. The use of locally available material shall be considered.

The requirements for **interior** finishes shall comply with the classification established in the General Specification **GS EP SAF 221**.

Moisture-proof finishes shall be used in toilet rooms, bath facilities, kitchens and other areas exposed to humidity or water. Walls surrounding water closets, showers, bath tubs and urinals shall be finished with ceramic tiles, or specially designed sanitary partition walls.

3.4 Structure

Design shall guarantee the durability and performance of the structure under normal and extreme operational use and relevant maintenance.

3.4.1 Design documents

3.4.1.1 Calculation notes

Typical content of calculation note shall be the following:

- Table of contents
- List of revisions
- Purpose of the calculation note
- Sketches of the structure
- Assumptions
 - Loads
 - Load cases
 - Load combinations
 - Criteria to be complied with
- References to documents used (codes, standards, notes, etc.)
- General description of the calculation method, including formulas, sign, conventions, etc. When a computer software is used, the following additional information shall be provided:
 - Purpose of the software
 - Theoretical basis and calculation principles
 - Description of the model
 - Input data
 - Output results
 - Computer list attached as appendices to the notes (these list shall never constitute note by themselves).
- Stress or displacement calculations

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- Analysis of results
- Conclusions.

3.4.1.2 Drawings

Apart from all information necessary to build the structure, drawings shall include the following information:

- Unit used
- Co-ordinates system
- Type of concrete
- Concrete facing
- Construction tolerances
- Scales: scale shall range from 1/100 for general view (1/50 for reinforcement drawings) to 1/10 for details
- Construction joints
- Development and splicing length.

The drawings shall be accurate enough to completely define the works to be performed.

3.4.2 Design data

Structural design shall be based on the following data:

- Geotechnical data, the report shall contain sufficient description of field and laboratory investigation, subsurface conditions, typical test data, basic assumptions, recommendations, and final design.
- Material data, design shall be based on materials strengths which are available or obtainable on site. Common concrete compressive strength for structural members range from 20 to 40 MPa, measured either on cubic or cylindrical samples, as defined by the relevant code, reinforcing bars design is based on their yield strength, which is commonly taken between 240 and 500 MPa.
- Loading data. Unless otherwise specified, the loads detailed in the paragraphs below, applied on the structure shall be considered.
- Load combinations shall be made according to the relevant regulations/codes in use.

3.4.2.1 Dead Loads

The self weight of the various building elements comprising the structure shall be calculated, and used in the design. In case of lack of precise information, refer to **GS EP CIV 301**.

In office buildings or in other occupancies where partitions are likely to be subject to rearrangement or alteration, the minimum allowance for the weight of partitions shall be a uniform load equivalent of 1.00 kN/m².w.

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Dead load shall take into account the weight of building service equipment, including: plumbing, stacks, piping, heating and air conditioning equipment, electrical equipment, elevators, elevator machinery, flues, and similar fixed equipment.

3.4.2.2 Live Loads

The following minimum live loads shall be used.

Table 4 - Minimum live loads

	Type of building/room	Loads in kN/m ²
Business, Hotel, Lodging	Offices, first-aid buildings, guard houses, toilets, etc.	3
Assembly, Hotel, Lodging	Canteens, lunchrooms, training centres, corridors, stairs, halls	4
Business	Library (reading and stack), filling rooms	7
Industrial	Battery rooms, simulator room in training centre	10
Industrial	Mechanical, electrical, instrument workshop building (inclusive of covered area), workshop area in training centre, consumable store	20
Storage	Bulk store	40

If equipment has to be supported which would create a load exceeding those shown above, then the affected area shall be designed for the heavier load. The loads from equipment or machinery shall be derived from Manufacturer's data. If the equipment is a heavy rotating equipment, a detailed design and vibration analysis shall be made.

Live loads may also consist of concentrated and/or movable loads such as crane loads. Crane loads shall be assumed at their maximum values including lifting capacity as well as the maximum horizontal loads caused by braking or acceleration, the most unfavourable position of the crane or other moving loads shall be considered.

All possible loading conditions during erection and maintenance shall be taken into account. The loads of scaffolding, including the wind loads, due to erection and maintenance shall be taken into account for the design of the structure.

Temporary loads developed during tests, such as Hydrostatic Test, shall be considered in the design.

3.4.2.3 Environmental loads

3.4.2.3.1 Wind Loads

Wind loads shall be determined in accordance with the codes and standards in use. The design shall also include effects of pressure and suction. The wind can blow in any direction and the most unfavourable case shall be considered.

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A detailed design and vibration analysis shall be made if results of the wind-induced analysis indicate an unacceptable level of vibration. Detailed vibration analysis procedure shall be approved by the Company.

3.4.2.3.2 Snow/Sand/Water Loads

Where necessary, snow load/sand load shall be taken into account. The load shall be derived from local regulations or experience.

Load due to rainwater accumulation shall also be taken into account. The maximum rainwater accumulation load with the drains pipes or down spouts blocked shall be assessed.

3.4.2.3.3 Thermal Effect Loads

When thermal expansion results in friction between equipment and supports, the friction force shall be taken into account.

3.4.2.3.4 Earthquake Loads

The frequency of occurrence of earthquakes, their intensity and duration shall be derived from seismological data and/or accelerograms (i.e. recordings of actual ground accelerations during an earthquake), local regulations or as specified by the Company.

3.4.2.3.5 Differential Settlement Loads

The variability of the soil strata may result in differential settlement. The resulting bending moments shear and axial forces shall be considered.

3.4.2.3.6 Explosion and Impact Loads

Explosion and impact loads shall be included in the design, if required by the Company or local standards. See more in § 3.10.

3.4.3 Main structural components

3.4.3.1 Shallow foundations

Shallow foundations include strip, pad and raft foundation. This type of foundation is in most of cases suitable for buildings.

The center of the foundation shall be arranged vertically under the center of gravity of the loading. If this is not be possible, the effects on the structure of rotation and settlements shall be investigated.

The design of a strip or pad footing shall be performed according to one of the following methods: A strut-and-tie analysis in which the vertical load is transferred through the foundation to the soil by means of concrete struts or a beam-type analysis in which the effect of flexure and shear in the footing is investigated and reinforcement designed accordingly.

Regardless to the loads, the minimum width of a footing shall be no less than 40 cm.

When considering a structure founded on several footings lying on different types of foundation soil, attention shall be paid to the possibility of differential settlement. Measures shall be taken

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to minimise the settlements and the effect of these shall be considered in the design of the supported structure.

Foundations and structures subject to temperature effects shall be designed for any temperature difference that may occur.

3.4.3.2 Piles

Piles shall be designed to resist the effects of normal forces and flexure. The design of slender piles shall take into consideration the effects of lateral deflections.

As a minimum, piles shall be reinforced with 5 bars located in the corners of the concrete section, with ties to prevent longitudinal bars from buckling.

3.4.3.3 Beams

Beams are members resisting effects of flexure and shear. Design of beams shall also comply with the allowable deflection requirements.

Reinforcing bars shall be placed on the tension side, as close to extreme tension fiber as is compatible with proper corrosion protection of the steel.

The concrete cover shall enable the required fire resistance for the structure.

3.4.3.4 Slabs

Slabs are flat horizontal members supported on their edges. Design of one-way slabs shall take into consideration requirements for beams. Design of two-way slabs shall take advantage of bi-directional behaviour.

In any case, the slab shall be reinforced in both direction, either by using the required reinforcement given by calculation, or by placing a minimum amount of reinforcement, as required by the applicable code.

Other particular design requirements for Foundation piles, Shallow foundation, Slab on grad, Pedestals, Retaining walls, Foundation for machinery, Liquid retaining structures, Anchor bolts are detailed in [GS EP CIV 301](#).

3.5 HVAC and human comfort

Buildings require climatic conditioning, i.e. heating, ventilation and/or air conditioning (HVAC), to maintain the temperature, relative humidity, over-pressure and air quality within defined limits, in order to provide reliable operation of electronic equipment and acceptable human working conditions.

Careful attention shall be paid to the prevailing climatic conditions in various seasons, and records of all local climatic design data like air temperature, temperature differences, saline atmosphere, sand and dust storms, infiltration of sand in buildings, humidity, solar influence, wind, micro-climatic variations, etc. shall be used to arrive at a satisfactory design which ensures good conditions for equipment and personnel.

HVAC equipments are generally supplied by specialised manufacturers as package units or as single components. Refrigerating fluid shall be in compliance with Copenhagen and Montreal protocol (HCFC hydro chluro fluro carbon shall be forbidden and should be replaced by R134A)

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Sufficient space shall be reserved for positioning and maintenance of the HVAC equipment and other HVAC components: ducting and piping networks, pumps, electrical cabinets, etc.

3.5.1 Heating/cooling and humidificating

Indoor required conditions (Temperature/Humidity) during Winter and Summer are detailed in **GS EP HVA 100**. For a permanently manned room the indoor required conditions are comprises between:

- Winter Temperature/Humidity Design 18 to 22°C and 30% of humidity
- Summer Temperature/Humidity Design 20 to 24°C and 50 to 65% of humidity

Heating loads calculation (winter period) shall not take into account the heat gains from equipment.

For **cooling** loads calculation, sensible and latent heat gains must be taken into account in accordance with the last revision of the **GS EP HVA 100**:

For **cooling** loads calculation, heat gains from Lighting vary from 12 W/m² in corridor to 20 W/m² in conference room.

Inside living quarters, the temperature difference between two rooms (with comparable activity) where personnel can access without restriction shall not be greater than 5°C. And in a room, air temperature differential increase from floor (feet) up to head level shall be less than 5°C, and temperature differential between side-walls of a compartment less than 10°C.

The Over-design coefficient to apply on loads in heat gains and cooling gain calculation shall be 10%. The Contractor shall submit the "heating /cooling load" calculations to the Company.

When humidification is required, the humidifiers should be connected to the drinking water system. The water quality shall be checked with respect to the humidifiers.

3.5.2 Fresh air ventilation

Fresh air ventilation is required in order to:

- Provide a minimum fresh air intake quantity per unit of time
- Maintain an overpressure
- Compensate for specific exhaust.

Requirements for fresh air ventilation systems are:

- A positive flow from outdoors to indoors, and thereafter outdoors, shall be provided. The ventilation system shall be designed in such a way to prevent flammable/toxic gases and dusts from penetrating into buildings.
- Re-circulation of air is only permitted when the ventilation system is secured against absorption of returning air from clinics, kitchen, laboratories, lavatories and washing rooms. Ventilation outlets from clinics, kitchen, lavatories and washing rooms, etc. shall be channelled through separate ducts. Where air is re-circulated, adequate filters shall be installed.

The Fresh Air flow rates, Exhaust Air flow rates and Air Change volume is detailed in **GS EP HVA 100**.

For an Air Lock system, the minimum air change volumes shall be comprised between 40 and 60 volume of room/hour.

The inside of a room shall be slightly over-pressurised. Values of required over-pressure are given **GS EP HVA 100**, normal values are comprised between 30 and 50 Pa. The maximum leakage air flow rate shall be 35 m³/h/linear meter of joint for a door under a differential pressure of 30 Pa. For walls and partition, infiltration of 10⁻⁵ m³/m² of wall.

3.5.3 Insulation

Buildings requiring heating, air conditioning or ventilation shall have properly insulated roofs and walls. If the calculated U values are higher than the references U-values, the calculated U-values must be taken into account; otherwise the reference U-values shall be used.

Table 5 - Reference U-values

	Reference U-value In W/m ² /°C
External Walls	0.6
Roof	0.6
Floor	0.6
Doors	3.5
Windows	2.7
Partition/Internal walls	2.2

Insulation materials shall be rot and vermin resistant. Vapour barriers shall be specified to protect the construction elements and the insulation itself.

When the exact use may be subject to change, full thermal insulation shall be installed.

3.5.4 Control and alarming

HVAC control and alarming systems shall be **separate** systems.

HVAC control systems should at least include the following:

- Individual Temperature control:
 - For constantly manned rooms
 - For certain rooms which are less frequently used (e.g. meeting rooms)
 - For equipment rooms (e.g. electrical room, computer room).
- Individual Humidity control
 - For continuously manned rooms where the outside climate is so extreme that the humidity requirements are not reliably achieved without humidity control
 - For all rooms and buildings where vital electronic equipment is installed such as fire and gas detection and control equipment, telecommunications equipment (including CCTV).

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Other individual or non-individual controls including pressure, acoustic, pollution, enthalpy, gas control may be required by the Company and specified in particular specifications.

The Contractor shall submit details of control and alarming system to the Company for approval.

Performance of HVAC installation shall be checked. Results including the tolerance on measurement shall be in accordance with requested design values with no negative tolerance.

3.5.5 Hand over documents

The final documentation shall at least include:

- Engineering flow schemes
- Design criteria and data summary
- Layout and location drawings for each building
- Calculation sheets for ventilation rates, pressurisation, normal and abnormal cooling, heating load, etc.
- Control and alarm schemes
- Control panel drawings
- Electrical power supply and distribution drawings
- Hardware/software related drawings for control, alarm and shutdown functions
- Start-up, shutdown, trouble shooting and regular maintenance procedures
- Operating manuals
- Technical data books and spare parts listings
- Commissioning test reports.

The Contractor shall submit a listing of handover documents to the Company.

3.5.6 Noise abatement

3.5.6.1 Noise limits

Unless otherwise stipulated by local regulations, the maximum **global** surrounding noise limits shall be as per Appendix 5 of the **GS EP SAF 221**:

Maximum sound pressure levels, measured at any point of an occupied room, and due to HVAC equipment shall comply with these values.

Acoustic comfort is obtained by an acceptable ambient noise within the limits of 35 to 40 dB(A) with a maximum of 45 dB(A).

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3.5.7 Transmission

Transmission loss shall comply with the required level of acoustic comfort:

- Transmission loss between offices: Minimum rating of airborne sound insulation between office rooms, assuming closed doors, shall be -15 dB(A) for an acoustic pressure level of 50 dB(A).
- Transmission loss between indoors and outdoors: Minimum rating of airborne sound insulation of external wall against external noise, assuming closed windows shall be -45 dB(A) for an acoustic external pressure level of approximately 80 to 90 dB(A).

According to **GS EP SAF 221**, two rooms with very different noise levels should not be adjoining each-other.

3.6 Drainage, sewerage and water supply

3.6.1 Drainage and sewerage

3.6.1.1 Definition of the different systems

Except otherwise stated in the particular specifications, the following systems shall be of separative type (including downpipes):

- Water not polluted by hydrocarbons (rainwater, etc.)
- Rainwater from outside areas shall not enter the facilities limits and shall be collected and drained to discharge points selected according to the local facilities
- "Sanitary" water (wastewater from the buildings), normally return from potable water supply
- A dedicated domestic sewage system shall be installed on any permanently manned installation to collect and dispose of water from the accommodations and other domestic areas
- "Industrial" water or effluents
 - Water occasionally polluted by hydrocarbons
 - Water polluted by hydrocarbons
 - "Chemical" water
 - Effluents from hydrocarbon tank and their retention basins.

Definitions for these types of effluents are given in specification **GS EP CIV 202** and **GS EP SAF 228**. In any case, the selection of material shall be made according to the effluents chemical nature and temperature in the operating conditions (internal pressure, external loads, corrosion hazards), and to the installation, maintenance and repairing constraints. It shall be submitted to the Company for approval.

3.6.1.2 Design methodology and minimum dimensions

Rainwater drainage and sanitary water drainage shall be **distinct**.

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The design of the rainwater and sanitary water drainage systems requires:

- Calculation of the instantaneous flow to be discharged (see paragraphs below)
- Definition of the average slope of the network
- Calculation of the piping diameter by means of relevant formulas or charts
- Checking the compatibility between diameter and slope, as well as checking speed.

Regarding the sanitary water, particular specifications shall be precise if two distinct domestic sewage systems shall be considered: Kitchen and lavatories sewage.

3.6.1.2.1 Calculation of the instantaneous flow to be discharged - Rainwater drainage

Except otherwise stated in the particular specifications, the decennial rainfalls shall be taken into account. The curves: intensity = f (duration) shall be submitted to the Company for approval.

Regarding the superficial drainage (pavement without equipment and skids, for example), a flow of 3 l/m²/min shall be taken into account. However, if the design rainfall for the whole area has an intensity higher than 180 mm/h, the actual intensity shall be taken into account (not more than 4.5 l/m²/min).

The total contribution of the flow from a drained area shall be calculated according to the surface of this area, the rainfall intensity during the concentration time and the run-off coefficients corresponding to the soil nature of the catchment basin.

3.6.1.2.2 Calculation of the instantaneous flow to be discharged - Sewerage (Sanitary water drainage)

For an **isolated building**, the flow of foul water shall be computed by adding up individual flow from each piece of equipment and applying a simultaneous flow coefficient in case some pieces of equipment are not used simultaneously (see "Water Supply" paragraph).

For the **housing facilities** (of **family life bases**), the flow to be taken into account is the peak flow given by the formula:

$$Q_p = (2.4 \times q \times E_q \times N)/86400$$

In which:

- Q_p peak flow, in l/s
- q average daily flow to be discharged, in l/day.inhabitant (taken as 150 if no particular specification indicates a value)
- E_q equivalent number of inhabitants per dwelling (considering separately residents and employees)
- N number of dwellings served by the piping
- 2.4 peak coefficient

3.6.1.2.3 Minimum diameter/speed/slope

Table 6 - Minimum diameter/speed/slope

Rainwater system	Waste water system
- Calculations shall be performed according to the Bazin formula with a filling coefficient equal to 0.7. - Rainwater pipe systems: $D_{min} = 300$ mm. - Rainwater down pipes 1 cm^2 of down pipe drains/1 m^2 of roof area. V_{min} (full section) Low loaded rainwater = 0.9 m/s, Heavy loaded rainwater = 1.2 m/s. V_{max} (full section) = 4.0 m/s. - In case of a gravity rainwater system, minimum slope is 5/1000. For these minimum values, tolerance of installation is zero (non measurable).	- Diameters shall be established according to the Bazin formula for the water flow, taking a friction coefficient equal to 0.16 and a duct filling coefficient equal to 0.50 (ratio between height of water and internal diameter of the pipe). - Outside buildings, Main branches: $D_{min} = 200$ mm, Individual branches: $D_{min} = 150$ mm. - The flow speed at maximum flow rate shall be between 0.60 m/s and 3 m/s. The optimum speed is around 1.5 m/s. The minimum slope for these ducts inside inhabited buildings shall be 0.01 m per m. The minimum slope of the connection of these ducts from inside to outside the building shall be 0.03 m per m. Outside buildings, the minimum slope shall be 5/1000 for $\varnothing 150$ and $\varnothing 200$ mm diameters.

3.6.1.3 Installation

Internal downpipes, as for all other evacuation pipes, shall be permanently and solidly water and airtight. Rainwater downpipes and other drainpipes shall not pass through electrical equipment rooms or basements.

Suitable auxiliary equipment and installations shall be provided where required, to prevent foul liquids from flowing back into the buildings.

The systems shall be installed away from the intensive traffic areas. They shall thus be located under the sidewalks, parking areas, etc. The manholes shall be accessible by the vehicles, but parking shall be made impossible over their covers.

The soil cover over the pipes shall be 0.75 m minimum. In areas likely to be affected by frost, the external drain lines shall be laid at frost-free level. Special precautions shall be taken to protect pipes in case of an aggressive soil.

Pipes which cross roads and railways shall be mechanically protected (steel sheath for flexible piping, covering with concrete slabs, piping embedded in coarse concrete, etc.). A pipe shall never be installed under a foundation.

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Collectors for canteen and kitchen water shall include starch and grease separators. For laundry, foul water decanting basins shall be provided. They shall be set in a well-ventilated area, with access for vehicles and as close as possible to the equipment which they drain.

3.6.1.4 Connection to existing system

The Rainwater shall be discharged in the public property in conformity with the local regulations and with the Company's approval (see **GS EP SAF 228**).

The "sanitary" water may be sent to the public sewerage system, if exits, with the Company and the Local Authorities authorisations. Otherwise, it shall be sent into purifying equipment (mini purifying station, septic tank, etc.) before discharge in the system of water non-polluted by hydrocarbons.

3.6.2 Supply and distribution of hot and cold water

Any permanently manned installation shall be provided either with features ensuring the transportation to site and storage on-site of domestic water or with facilities for on-site production of domestic water.

Domestic water shall be provided in sufficient quantities to ensure all the physiological needs and normal hygiene for the occupancy load served. Unless otherwise specified, the default value of 200 litres by occupant served and by day shall be assumed.

3.6.2.1 Design requirements

Only drinking water shall be distributed in any permanently manned building. Piping system for drinking water must be in conformity with French or local regulations (the most restrictive) for transport of alimentary fluids.

Cold and hot water shall be distributed at appropriate temperatures, as far as possible + 15°C for cold water, + 60/65°C for hot water, and at as a constant pressure as possible.

- The supply pressure of the drinking water shall be between 3.5 bars and 1.50 bars, the extreme limits not exceeding 4 and 1 bar.
- As a general rule, the supply piping for each building shall have an initial pressure of 1 to 1.5 bars more than the highest tap pressure.
- The water circulation speed shall not exceed 1.50 m/s, and the minimum speed shall be about 0.8 m/s.
- Diameters for supply piping shall be calculated depending on the flow requirements, section lengths, distribution height and initial pressure. Section lengths shall be increased by 15% to account for accessories.

Outside buildings, the pipe diameter shall be at least 40 mm in the branched systems and 100 mm in the netted systems.

Should the pressure be difficult to maintain, elevated tanks, or preferably pressurized tanks with a capacity of $\frac{1}{4}$ to $\frac{3}{4}$ of daily consumption shall be installed. If, on the contrary, the pressure is too high (more than 3.5-4 bars) pressure regulators shall be installed at inlets into the buildings.

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The accommodation for male and female personnel shall be kept separate. Unless otherwise specified, the minimum number of fitments shall be as follows (All fitments of the same kind shall be of one uniform make and type):

- For offices, laboratories, training centres, canteens, etc., see table below.

Table 7 - Minimum number of fitments

Fitment	Male Personnel	Female Personnel
Wc	1 for 1-15 persons	1 for 1-12 persons
	2 for 16-40 persons	2 for 13-25 persons
	3 for 41-70 persons	3 for 26-40 persons
	4 for 71-100 persons	
Urinals	nil up to 2 persons	
	1 for 3-10 persons	
	2 for 11-20 persons	
	3 for 21-40 persons	
	4 for 41-100 persons	
Hand-wash basins	1 for 1-20 persons	1 for 1-15 persons
	2 for 21-40 persons	2 for 16-30 persons
	3 for 41-60 persons	3 for 31-45 persons
	4 for 61-80 etc.	4 for 46-60 etc.

Each toilet area in industrial and utility buildings, including canteens, shall have a tap with hose connection and floor drain.

3.6.2.2 Flow calculation

Flow calculations include:

- Basic supply flow for sanitary equipment as detailed in **GS EP CIV 405**
- Simultaneous flow theory.

Except otherwise stated within the particular specifications, the following simultaneous flow theory shall be used for sanitary equipment duct calculations. This is not applicable for tap flush equipment.

The total flow necessary for sanitary equipment shall be multiplied by a coefficient given by the following formula:

$$Y = 0.8/(X-1)^{0.5}$$

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Where:

Y = Probability of simultaneous flow coefficient

X = Number of pieces of equipment

However, it shall be necessary to distinguish the type of building or plant, to forecast the internal use of equipment at certain times of the day and to check that the installation which has been calculated from this general theory is adequate (living quarters for single people and families, offices, workshops, cloakrooms, etc.).

As far as tap flush equipment is concerned the following theories shall be used:

- In case tap flush is supplied by the same network as other equipment its input shall not be taken into account in the pipe diameter calculations.
- In case tap flush is supplied by an independent network, the following simultaneous flow theory shall be used:

Table 8 - Pieces of equipment operating simultaneously

No. of pieces of equipment installed	No. of pieces of equipment operating at the same time
3	1
4 to 12	2
13 to 24	3
25 to 49	4
More than 50	5

3.6.2.3 Installation

The minimum distance between the water pipes and the other networks shall be as follows:

- 0.50 m from the gas network (between external generants)
- 0.60 m from high-voltage electric cable
- 0.20 m from low-voltage electric cable
- 0.20 to 0.60 m from telecommunications cable
- 0.20 from drainage pipe.

The water pipes shall never be closer than 0.60 m from a fence or wall in order to allow the installation and operation of the branching valves.

The pipes shall be put in trenches with a cover that shall never be lower than 0.80 m for frost protection. It shall be of 1.00 m in temperate areas, 1.20 m in cold areas and 2 m in very cold areas (high mountains, etc.).

Outside trenches, cold water pipes shall be thermal insulated when certain conditions are met. Pipes exposed to frost shall be thermal insulated and have a minimum slope of 0.2% towards low points equipped with purge.

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In sunny regions pipes should never be exposed to the sun. Any tank on rooftop should be placed in the shade of light and ventilated shelters.

The main distribution network for each building should be equipped with a general shut-off valve and with a tap enabling fast draining of the installation. In case of a loop distribution, shut-off and drain valves shall enable isolation by sections.

It shall be mandatory that all flush, water heater, immersion heater, meter or special apparatus shall be equipped with individual shut-off valves. Collective sanitary equipment shall be isolated as a whole or by groups with shut-off valves.

Piping diameters shall be such that there shall be no interference between the different rooms and storeys.

3.6.2.4 Hot water production/distribution

Hot water production may be individual or collective.

It shall be produced by either:

- Storage water heater system
- Instantaneous water heater system operating on gas or electricity.

Unless otherwise specified the hot water requirements are as follow:

Table 9 - Hot water requirements in individual and collective production

	Individual production	Collective production
Bath	85/180 l	70 l
Washbasin	7/10 l	4 to 7 l
Bidet	5 l	5 l
Shower	20 l	20 l
Sink and simple tap	35 l	25 l
Washing up	65 l	50 l

In case of use of a storage system production, a capacity of the tank equal to 50% to 100% of the daily consumption of the overall equipment shall be provided. Heating delay shall be indicated. The "indirect" process (primary circuit between boiler and tank, and secondary circuit supplying the equipment) shall be the only system used.

Hot water network shall be of looped type. For small installation, gravity method shall be used and for large installations, pumps shall enable circulation (this latter system shall include parallel running pumps i.e. one spare with shut-off and non-return valves).

In horizontal hot water return piping, the theoretical speed, without tapping, should be at least 0.20 m/s.

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3.6.3 Fire water system

The particular specifications shall specify if the fire water system and the drinking water system form a unitary system or not. If it is not specified, these systems are separated.

With regard to the fire water system:

- In case of protection of an oil or gas installation, it shall be in conformity with the **GS EP SAF 321** and **GS EP SAF 322**.
- In the other cases (living bases, etc.), the flow shall be:
 - 60 m³/h during two hours, that is 17 l/s, if the system is connected with a so-called inexhaustible source.
 - 120 m³/h during two hours that is 33 l/s, in other cases.

For the fire water system, the starting pressure shall be about 10 bars, a pressure of 5 bars being preserved at the farthest/highest point.

In this case, the fire water circulation speed shall not exceed 3 m/s and the main collector shall have a minimum diameter of 150 mm. All networks shall be looped or, preferably, netted.

3.7 Electricity

3.7.1 Service conditions

3.7.1.1 Voltages and frequency

The voltages and frequency shall depend on the local existing systems.

Unless otherwise specified, switchboards auxiliary voltage shall be 230 VAC.

3.7.1.2 Neutral system

For High-voltage, the neutral system shall be imposed by the local Electricity Board.

For Low-voltage, if the neutral system is not imposed by the local Electricity Board it shall be preferably TNC-S. For small installations, the neutral system might be TT.

3.7.2 Power generation and main distribution

Power supply to the building shall be derived from the Local Electricity Board, either at HV or LV depending on load requirements.

Table 10 - Voltage definitions and characteristics

Terminology this document	Terminology French regulation	AC Volts	DC Volts
VLV	TBT	$U \leq 50$	$U \leq 120$
LV	BTA	$50 < U \leq 500$	$120 < U \leq 750$
MV	BTB	$500 < U \leq 1000$	$750 < U \leq 1500$
HV	HTA HTB	$1000 < U \leq 50000$ $U > 50000$	$1500 < U \leq 75000$ $U > 75000$

Electrical system shall be so designed as to allow future extension.

LV Power distribution shall be of radial type from the main LV switchboard. Main feeders shall supply distribution boards in dedicated areas (no mixing between different building levels or areas). As well, each distribution board shall supply final distribution boxes or cabinets dedicated for lighting and socket outlet circuits.

3.7.2.1 High voltage supply from local grid

3.7.2.1.1 Power distribution

The main HV switchboard shall be directly connected to the local grid.

The HV distribution network shall consist in one HV switchboard to which one or two HV/LV transformers shall be fed.

Refer to Diagram 1: One Line Diagram for HV supply from local grid

3.7.2.1.2 HV switchboard (HV - 3 Ph - 3 W)

HV switchboard shall refer to [GS EP ELE 131](#) and [GS EP ELE 133](#) with associated datasheet.

The HV switchgear shall be metal-enclosed and compartmentalised according to [GS EP ELE 001](#), fixed and indoor type (IP31 enclosure protection door closed/IP2X door open) with bare copper bus bar and equipped with incoming circuit breaker and one or two transformers outgoing circuits (fused switch combination).

The breaking technology for CB shall be either Vacuum or SF6. In case of use of vacuum technology, special care must be taken to limit switching over-voltages.

Incoming circuits and feeder outgoing circuits shall be pad-lockable.

Incomers protection shall be designed in accordance with the Local Electricity Board requirements.

Transformer protections shall be designed with at least overload, overcurrent, lockout relay and earth fault protection.

3.7.2.1.3 HV/LV transformer

HV/LV transformer shall refer to [GS EP ELE 141](#) with associated datasheet.

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It shall be cast resin encapsulated, dry-type, self-ventilated and suitable for indoor installation. Power rating shall be standardised, Delta/Zig-Zag, neutral brought out and solidly earthed. Transformer shall be supplied with over-temperature protection.

3.7.2.2 Low voltage supply from local grid

Incomers breaker shall be designed in accordance with the Local Electricity Board requirements. Refer to Diagram 2: One Line Diagram for LV supply from local grid.

3.7.3 Main switchboard

Main switchboard shall refer to **GS EP ELE 135** with associated datasheet.

The main switchboard shall be form 3b, FFF according to **GS EP ELE 001**, single busbar (bare copper), indoor type (enclosure protection: IP31 door closed/IP2X door open) and equipped with padlockable facilities (incoming and outgoing circuits).

Circuit-breakers supplying fire hazard areas shall be fitted with an earth fault protection device set at 300 mA.

Unless otherwise specified, motor starters, if any, shall consist on fuse-switch and contactor, of a limited number of different ratings. Motors electrical protections shall be designed with at least overload, overcurrent, and lockout relay.

3.7.4 Distribution board

Distribution board shall refer to **GS EP ELE 137** with associated datasheet.

Each distribution board shall be indoor type either stand alone or wall mounted cabinet (enclosure protection: IP31 door closed/IP2X door open), metal sheet enclosure, a set of copper bars, isolating screens and terminal protections to prevent contact to live parts. Incoming shall be a manual switch and outgoing shall be circuit breakers or mmCB (Moulded Miniature Circuit Breaker) with thermal overcurrent trip and instantaneous magnetic trip.

3.7.5 Final distribution cabinet

Final distribution cabinet shall be same as distribution board.

These cabinets shall be dedicated to lighting and socket outlets power supply.

Final distribution cabinet shall be indoor type and usually wall mounted type (enclosure protection: IP31 door closed/IP2X door open) with a set of copper bars, isolating screens and terminal protection to prevent contact to live parts. Incoming circuit shall be a manual Circuit - breaker and outgoing circuits shall be mmCB or ELCB's (Earth Leakage Circuit Breaker) in line with standard requirements.

Socket outlets outgoing circuits shall be fitted with an earth fault leakage relay set at 30 mA.

3.7.6 Spares

Spares shall refer to **GS EP ELE 001**.

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Unless otherwise specified, it shall be planned for the future extension inside main distribution board, distribution boards and final distribution boards:

- 10% of equipped spares
- Provision of 20% free space.

3.7.7 Buildings with Stand-by power supply

The Stand-by generating power plant shall consist on one or more LV Diesel generators.

Unless otherwise specified in the particular project specification, the generators rating shall be designed for the full load demand.

The Stand-by generating set will start automatically when a main failure occurs and shall be automatically switched off after the mains restoration.

A re-starting procedure for total black-out and power supply restoration shall be studied by the Contractor.

Generator neutral point shall be solidly earthed.

3.7.8 UPS systems

UPS system shall refer to **GS EP ELE 152** with associated datasheet.

UPS systems comprising battery charger, stationary batteries, inverter and by-pass transformer shall be used as required to provide un-interruptible supplies.

Batteries and all UPS systems shall be completely assembled and wired in free standing sheet steel cabinets suitable for indoor operation. Battery cubicle shall be properly ventilated (louvres) to avoid gas accumulation.

Battery autonomy shall be at least 10 minutes at rated load.

Sealed gas recombination type nickel-cadmium cells with a gas recombination rate equal to or greater than 95% in any charge mode shall be preferably used.

UPS distribution shall be through dedicated cabinets.

UPS socket outlets shall be dedicated and clearly identified.

3.7.9 Cables

3.7.9.1 General

Cables shall refer to **GS EP ELE 161** and **GS EP ELE 061**.

All electrical cables and wiring external to equipment shall be at least flame-retardant type. When required by the Project, halogen free cables shall be provided, Conductor can be either copper or aluminium.

HV cables will be single core or multi-core cable with XLPE insulation and radial field.

LV cables will be single core or multi-core cables with XLPE insulation, rated voltage 0.6/1 kV. LV cables with PVC insulation, rated voltage 450/750 V may be used for end-user circuits with low power requirements and control.

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3.7.9.2 Indoor

Cable shall be unarmoured and shall be installed above ground and mechanically protected where required (cable trays or ladders with cover, conduits, ducts, etc.).

3.7.9.3 Buried cables

Buried cables shall be galvanised steel armoured type with a PVC outer sheath. Cables shall be suitable to be directly buried without additional mechanical protection.

3.7.10 Lighting

Lighting shall refer to **GS EP ELE 081**.

3.7.10.1 Normal lighting

Lighting installations shall be designed to provide a suitable illumination level with regards to the room, building and area function and in line with the applicable standards.

Illumination level values to consider shall be in accordance with **GS EP ELE 081**.

Each room shall be fitted with one lighting switch as a minimum.

3.7.10.2 Emergency and exit lighting

Emergency lighting shall include exit lighting and general lighting in public areas, ensured by self contained type luminaires with independent rectifier, Ni-Cd accumulator battery and control system. luminaires shall be lit immediately when mains failure occurs. Battery autonomy shall be at least 1 ½ hour.

3.7.11 Earthing

Earthing shall refer to **GS EP ELE 031** and **GS EP ELE 051**.

The equipotential earth bonding system shall comprise internal loops and a general earth grid, connected at least in two opposite points.

The general earth grid and internal loops shall comprise class 2 bare copper conductors with a cross-sectional area calculated in accordance with **GS EP ELE 001**, and in no case less than 70 mm².

An equipotential general earth grid shall be installed for a group of buildings or houses. All the general earth grids shall be interconnected.

When there is a risk of corrosion (atmospheric or nature of soil), green/yellow insulated cable shall be used for earthing network. In that case, earthing rods might be required to lower the overall earthing network impedance within the requirements of **GS EP ELE 001**. Conductor cross-section shall be sized to sustain the greatest fault current.

The internal loops shall be connected at both ends of each building earth bars. All steel part of structure, plumbing and electrical equipment shall be earthed through these earth bars.

End-user electrical equipment, that is not class II rated, shall be earthed through a specific earthing conductor (green/yellow strips) which shall be connected to the final distribution box/cabinet earth bar or to one dedicated earth terminal. In TNS systems, the protective

conductor shall be included in the multi-core power cable and it may be separated from the power cable in other cases.

**Diagram 1 - One line diagram for high voltage supply from local grid
in accordance with **GS EP ELE 001** (appendix)**

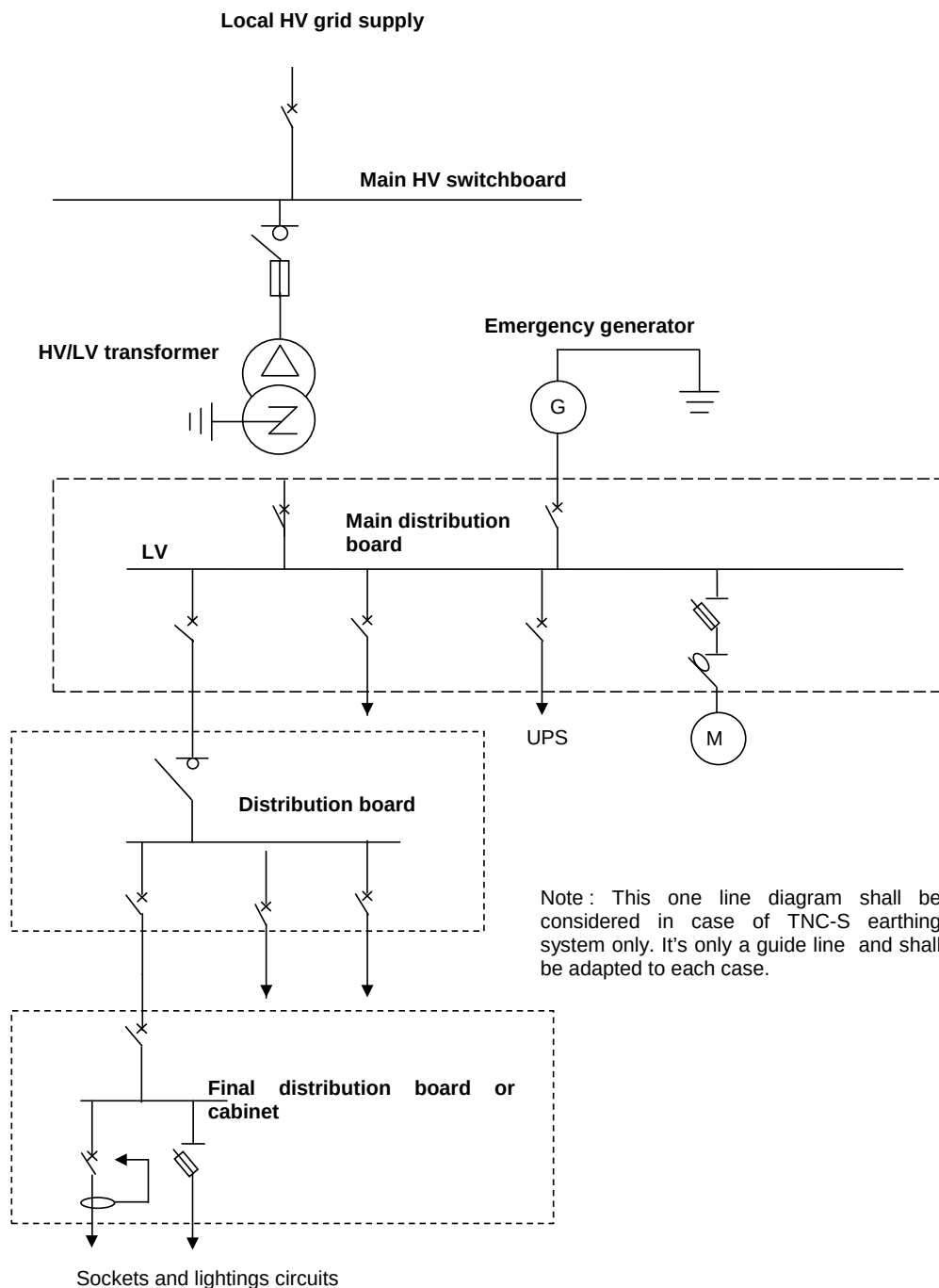
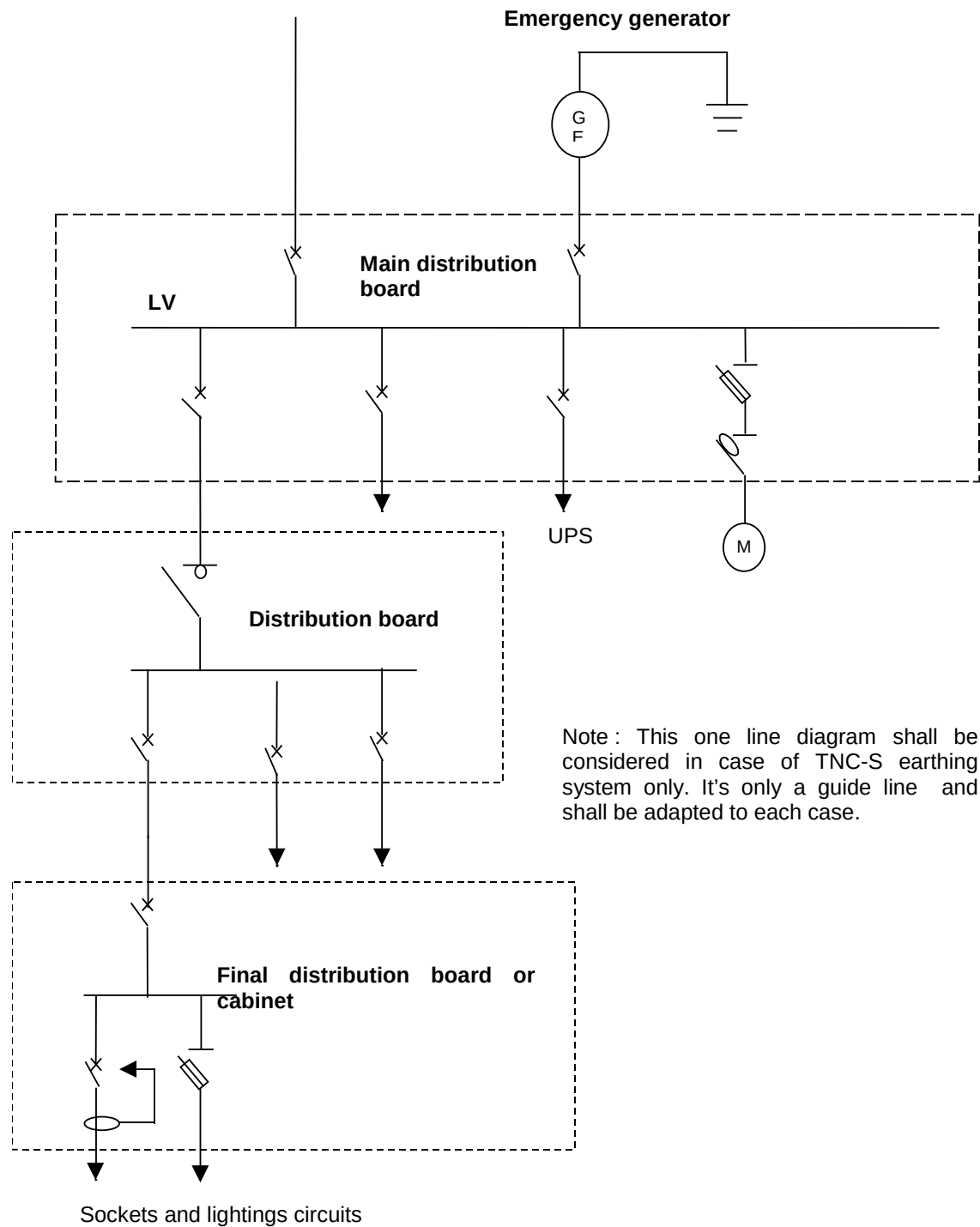


Diagram 2 - One line diagram for low voltage supply from local grid

Local LV grid supply



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3.8 Telecom

Telecommunication systems shall be installed in specific rooms separated from other facilities. The following sections deal with the different technical Telecom rooms, their environment (temperature, humidity ...) and the cable distribution.

The Telecommunication systems shall be in accordance with **GS EP TEL 180**.

3.8.1 Layout

Depending on the size of the building, technical rooms shall include:

- A Main Telecom Room (MTR). Room which contains the main Telecom equipments.
- General Distribution Room (GDR). Rooms connected from the Main Telecom Room through cables. This room might contain Telecom equipments
- Sub Distribution Room (SDR). Rooms connected from the General Distribution Frame through cables. Generally, the SDR distribute all the office RJ 45 sockets
- Operational room or Radio Operator room
- Separate rooms for maintenance, storage of spare parts and auxiliary equipment (power supplies, batteries, electrical boards, air conditioning equipment, etc.).

The following characteristics shall be respected:

- In order to avoid radio interference, all the technical rooms shall not be adjacent to rooms accommodating ventilation, heating, high power voltage or air conditioning
- The Main Telecom Room shall be made with reinforced concrete walls and shall be a blind room (no windows)
- The water pipes shall be avoided in all telecom technical rooms.

3.8.2 Design data

Technical rooms and their accesses shall be designed to allow for:

- Accessibility for equipment unloading (the minimum width of a door shall be 800 mm ...)
- To reduce as much as possible the length of coaxial cables and waveguides between cabinets or racks, as well as from cabinets or racks to aerials.

All of the technical rooms shall be in accordance with the **GS EP TEL 180's** requirements).

For the floor, lighting, ceiling, noise and colours specifications, refer to **GS EP TEL 410**.

Failure of air conditioning involves risks of overheating of telecommunications equipment: it is therefore imperative that an identical emergency system or fans to be provided.

Cable trays shall be installed in all technical rooms fixed on the non removable floor. Four types of cable trays shall be considered:

- Power cable tray
- Distribution cable tray

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- Feeder cable tray
- Mixing cable tray.

Feeders ceiling mounted cable trays may be installed to limit the distance between the Telecommunication tower and the radio equipment

3.8.3 Wires and cables

This specification deals with the four types of cables currently used for telecommunications, as per [GS EP TEL 410](#) and power cables as per [GS EP ELE 161](#).

Telecommunications cables shall meet the requirements of General Specification [GS EP ELE 161](#) when applicable and, in particular with regard to protection against environmental conditions and safety regulations in hazardous areas.

The precabling infrastructure (data and voice cables) shall meet the [GS EP TEL 180](#): except particular constraint, an average of 3 sockets RJ 45 per user shall be installed.

The technical room cable access shall be studied in order to prevent humidity infiltration, insects and animals entrance.

3.8.3.1 Cable routing

The installation of all types of cables shall be in compliance with [GS EP ELE 161](#), [GS EP CIV 202](#).

In addition, the following requirements shall be met:

- Telecommunication cables shall be routed in dedicated cable troughs. Telecommunication and instrument cables carrying signals at voltages lower than 65 V may be routed in the same trough or cable tray. Cable trough containing telecommunications cables shall be clearly marked
- Cable routing through hazardous areas should be avoided as far as possible
- It shall be strictly forbidden to route telecommunication cables through high fire risk areas (machine rooms, laundries, etc.) except for connecting communication terminals in those areas
- Runs should be made with a minimum of bends and offsets. The layout should enable easy access to cables for maintenance

When vital telecommunication equipment is connected to duplicated transmission lines for safety purposes, these lines shall be routed separately.

Refer to [GS EP TEL 180](#) and [GS EP TEL 410](#) for more details.

3.8.3.2 Protection

Cables shall be electrically and electromagnetically protected.

Outside buildings, calculation regarding segregation between telecommunication cables and electrical cables is not required if:

- Electricity line voltage is less than 20 kV

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- Length of lines in parallel do not exceed 10 km
- Separation between lines is more than 10 m.

The segregation between electrical and telecommunication buried lines shall never be less than:

- 0.50 m in the case of parallel runs; this spacing is recommended also in horizontal projection
- 0.20 m in the case of crossing.

Minimum spacing of 1 m is recommended wherever practicable.

Inside buildings:

Table 11 - Minimum spacing inside building

Electrical Power Cable Voltage (nominal)	Minimum Segregation
230 V	0.50 m
400 V	0.60 m
6,600 V	1.50 m

Details are given in [GS EP TEL 410](#).

3.8.3.3 Distribution

No joint or splice shall be accepted in the cable runs: cross connections shall be made in junction boxes. 50% spare terminals shall be provided in junction boxes.

In the case of telephone installations, the Contractor shall provide a main distribution frame. The main distribution frame shall provide 100% spare capacity.

Details are given in [GS EP TEL 180](#) and [GS EP TEL 410](#).

3.8.4 Energy

A specific energy closet shall be installed for the energy distribution in each technical room. This closet will provide UPS (Uninterruptible Power Supply) energy and stabilised energy. An individual breaker shall be installed for each rack.

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The UPS's sizing and 48 Volts shall be designed to ensure the following minimum requirements:

Table 12 - UPS minimum requirements

Equipment	Minimum energy autonomy required
PBX	6 hours
Radio equipment, microwave	6 hours
CCTV, Closed Circuit TeleVision monitoring system	6 hours
Satellite and WAN equipment (Fiber optics ...)	6 hours
Data equipment (router, switch ...)	6 hours
Entertainment Video equipment	2 hours
PAGA, Public Address and General Alarm system	1 hour 30 min at 20% load

3.8.5 Earthing

The plant, building or installation earthing system shall include a number of earthing networks.

Those required by telecommunication systems include:

- A telecommunication earthing network (clean earth)
- An instrumentation intrinsically safe earthing network
- An electrical earthing network (dirty-earth).

The telecommunication earthing shall be available for each technical room.

Details are given in [GS EP TEL 410](#).

Design of the MTR's earthing shall be subject to specific study carried out by a sub-Contractor specialized on those matters, approved by the Company.

3.8.6 Lightning

All the grounds shall be equipotential in order to minimize the lightning results.

The cable trays and the Distribution Frames shall be connected to the ground.

Lightning protectors shall be installed on outdoor communication cables (inter-building, local operator cables ...).

A specific study shall be done by a certified company the order to protect the complete installation to the lightning consequences.

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3.9 Safety to life

3.9.1 Fundamental requirements

According to the **GS EP SAF 221**, any building, new or old, designed for human occupancy shall meet, as a minimum, the following fundamental requirements:

- Buildings shall be provided with means of egress (the wording "escape" should be limited to buildings in the restricted area) to permit prompt exit:
 - The means of egress, by their kinds, numbers, locations, and capacities, shall be appropriate to the individual building
 - The means of egress shall be arranged and maintained free and unobstructed
 - Every exit shall be clearly visible and/or the route to reach every exit indicated without any risk of confusing the direction to go
 - Egress facilities shall be adequately and reliably illuminated
 - Two means of egress, as a minimum, shall be provided from any area where occupants can be trapped. They shall be arranged to minimise the possibility that both means might be rendered impassable by the same emergency condition.
- Buildings shall be provided with Fire protection features:
 - Design, construction and equipment shall preclude undue danger to occupants' safety during the period of time reasonably necessary to evacuate and/or to defend on place
 - Fire alarm facilities shall be provided where relevant
 - Vertical openings between floors shall be suitably enclosed or protected, to afford safety to occupants while using means of egress, and prevent fire or smoke spreading.

3.9.2 Classification of hazards

According to the **GS EP SAF 221**, the hazard of building contents is classified as low, ordinary or high.

3.9.3 Means of egress

Refer to **GS EP SAF 221**.

Internal stairways within the accommodation area shall be constructed of steel or reinforced concrete.

3.9.4 Passive fire protection features

Refer to **GS EP SAF 221** for:

- Minimum requirements for occupancy load served not exceeding 300 persons
- Fire resistance characteristics
- Requirements for compartments; interior finish, vertical openings, false flooring and ceiling, ventilation ducts ...

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3.9.5 Active fire protection

Refer to [GS EP SAF 221](#) for:

- Fire alert and emergency control
- Fire detection
- Active fire fighting (sprinkler, hose reel, portable extinguisher ...)
- Smoke control, smoke ventilation.

3.9.6 Special requirements for clinics, communication, catering, laundry, waste disposal

3.9.6.1 Clinics

Each permanently manned installation shall be provided with specific rooms, named clinics, in the clean and low-noise section of the living quarters. Requirements are given in [GS EP SAF 221](#) and in [GS EP MED 062](#).

3.9.6.2 Communication

Each permanently manned installation shall be provided with communications means, either for internal, alert or external use. Requirements are given in [GS EP SAF 221](#).

3.9.6.3 Catering

Requirements are given in [GS EP SAF 221](#).

3.9.6.4 Laundry

Requirements are given in [GS EP SAF 221](#).

3.9.6.5 Waste disposal

Requirements are given in [GS EP SAF 221](#).

3.10 Blast proof and blast resistant building

Any manned buildings or buildings containing critical equipment are to be designed against the blast overpressure. Requirements are given in [GS EP SAF 221](#) (§ 4.4) and depend on the building location (within or outside the restricted area). A Computational Fluid Dynamics (CFD) analysis shall be carrying out to assess the consequences of flammable gas release scenarios for buildings of the project.

Engineer will use [ASCE](#) to perform the design.

Unless specified in particular specifications, operating control buildings and power supply buildings in restricted areas shall be blast proof (see definition below). Buildings containing safety equipments in restricted areas, such as fire brigade, shall be blast resistant (see definition below).

Unless any project specifications, a free space of 30 m between blast or proof resistant building and dangerous area (gas cloud) is mandatory.

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3.10.1 Blast resistant building

A blast resistant building is designed to resist one time the maximum explosion event. The technical equipments in the building shall remain in activity after blast.

The remaining deformation of the building can be plastic deformation, which can require repairs for further use.

3.10.2 Blast proof building

A blast proof building is designed to resist several times the maximum explosion event, with no remaining deformation.

The behaviour of the building under blast must stay in elastic deformation.

3.10.3 Design of a blast resistant building

The following specifications shall be applied for a blast resistant building:

- Structure, roof and facades are made of concrete
- Windows are made of laminated safety glass.

Unless specified in particular specifications, the design of structure within restricted area shall take into account the following blast effects:

- Blast pressure on facades: 1400 hPa
- Blast pressure on roof: 750 hPa
- Time: 60 ms.

Multi-energy method shall be applied to take into account the free space in order to reduce the blast pressure.

The blast load is considered accidental. In the case of a blast resistant building, the structure can consider plastic deformation of materials.

3.10.4 Design of a blast proof building

The following specifications shall be applied for a blast proof building:

- Structure, roof and facades are made of concrete
- Windows are made of laminated safety glass with intermediate plastic sheet.

Unless specified in particular specifications, the design of structure within restricted area shall take into account the following blast effects:

- Blast pressure on facades: 1400 hPa
- Blast pressure on roof: 750 hPa
- Time: 60 ms.

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Multi-energy method shall be applied to take into account the free space in order to reduce the blast pressure.

The blast load is considered accidental. In the case of a blast proof building, the structure must remain in the elastic deformation of materials.

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