# 21 (6.2.E.02) Magnet Power Supply Switching Network Building

## 21.1 Functions, Basic Configuration, and Interfaces

### 21.1.1 Functions

The magnet power supply switching network (MPSSN) building provides space for busbar connections and is used to house poloidal field (PF) circuit protective equipment, including switchgear and dump resistors. The building houses other equipment, including dummy loads, and a water cooling supply system. The building includes office and restroom facilities for personnel support. The building also provides some general services such as HVAC, lighting, power, drainage, fluids, and lifting capability. The following sections describe the functions of the building in more detail.

21.1.1.1 Accommodate Equipment

The MPSSN building provides support and space for the major MPSSN equipment, and for the operation and maintenance of that equipment, as well as for the support services.

21.1.1.2 Protect from External Hazards

The building provides the resistance for anticipated wind, snow, and other environmental loads. The building also resists seismic loads, consistent with protection of health and safety of workers (UBC requirements - see section 21.2.1.2).

21.1.1.3 Provide Required Building Services

The MPSSN building provides internal distribution of services provided by the site such as potable water, steam, cooling fluids, low and medium-voltage electricity for service and welding requirements, grounding (earthing) connections, compressed air for services and instruments, and fire fighting water. It also provides collection of rain water and floor drainage, which are discharged to site-wide disposal systems. Self-contained building systems including access control, lighting, fire detection and alarms, and communications. Design requirements for each of these aspects are described in section 21.2.1.

21.1.1.4 Heating, Ventilation, and Air Conditioning (HVAC)

The building provides air quality sufficient to meet the requirements set by the systems and functions located within the building. All of these systems and functions are non-safety importance class (non-SIC); therefore these requirements can be met by using conventional HVAC (heat, ventilation and air conditioning) system equipment. The spaces dedicated to worker occupancy (offices, lavatories, break room, etc.) will be heated, cooled, and ventilated using requirements set for worker comfort.

### 21.1.2 Basic Configuration

The MPSSN building is a two-level structure. There are no large open or clear spans in the building, and it is a structural steel, column and beam configuration. Equipment is located at

grade, on a second floor, and on the roof. Large doors at grade, and on an intermediate floor (at + 7 m) allow the installation and removal of equipment using portable equipment. Equipment located on the roof (+ 14 m) will be placed using road cranes from grade, although horizontal movement at both internal levels will be accomplished using air pallets or similar devices. Roof level equipment is primarily HVAC. The foundation of the building shall be set below grade so that the finished floor level matches the grade level.

### 21.1.3 Interfaces

The MPSSN building has interfaces with the following WBS elements:

| WBS | Title |
|---|---|
| 2.6.O | Component cooling system |
| 2.6.P | Chilled water systems |
| 4.1 | Coil power supply and distribution |
| 4.3.C | Steady state electrical power distribution |
| 4.5 | CODAC |
| 4.6.C | Access control |
| 6.1.A | Site general layout |
| 6.2.S | Utility Tunnels & Site Improvements |
| 6.5.C | Potable & fire water |
| 6.5.D | Sewage (sanitary and industrial) |
| 6.5.E | Steam/condensate/demineralized water |
| 6.6.A | Compressed air |

## 21.2 Requirements

### 21.2.1 Design Requirements

The requirements for the MPSSN building are derived from the functions of the building. The primary functions performed by the building are to house, support, protect, provide a suitable environment, and to provide and control access to the equipment and processes, which are located inside the building. The requirements below are not complete because equipment designers continue to provide new interface information. However, the information identifies all the requirements which control the overall configuration and general design concept of the building.

21.2.1.1 General

21.2.1.1.1 Switching Network

The MPSSN building shall accommodate the switches, resistors and all other relevant components used to provide plasma initiation.

21.2.1.1.2 Quench Protection System

The MPSSN building shall accommodate the equipment for the superconductor quench protection system.

21.2.1.1.3 Water Cooling System

The building shall accommodate the equipment and a system for water cooling service. The water cooling system provides water for use in water-cooled busbars. The equipment consists of electric-motors-driven water, heat exchangers, pumps, valves, and other system equipment. The space required for this system, including maintenance, is approximately 240 $m^2$.

21.2.1.1.4 Access and Maintenance Space

The building shall provide space for normal maintenance. Good access to all equipment within the building is needed. Large aisles and doors are needed for the movement of large objects.

21.2.1.2 Seismic

The MPSSN building shall be non-SIC and shall withstand SL-0 seismic conditions with peak horizontal and vertical accelerations as specified in the PDS, or UBC and industrial health and safety requirements, which provide for a minimum of 0.05 g horizontal seismic force.

21.2.1.3 Structural

21.2.1.3.1 Components Support

The building shall support its own weight as well as the weight of all installed equipment in the building.

21.2.1.3.2 Live Loads

The structure shall support the weight and forces of all movable and active equipment, systems, and structures located on the slabs.

21.2.1.3.3 Lifting and Materials Handling

The buildings shall support the weight and forces of all lifted loads, including the lifting devices over the full range of their travel, as well as the loads from fork lifts, trolleys, etc. Structural deflection under such loading must be consistent with the required precision of the lifting devices.

21.2.1.3.4 Thermal Loads

The structure shall either resist stress induced by expansion and contraction due to changes between the as-built temperature and the maximum expected structure temperature excursions, or allow movement through the use of expansion joints.

21.2.1.3.5 Wind Loads

The MPSSN building shall withstand horizontal wind conditions of up to 140 km/h defined at

10 m above grade.

21.2.1.3.6 Snow Loads

The MPSSN building shall withstand snow loading conditions of up to 300 kg/m$^2$.

21.2.1.4 Electrical

21.2.1.4.1 Lighting Service

The MPSSN building shall be equipped with normal and emergency lighting. Lighting standards to be applied will be similar to those used for industrial process plants.

21.2.1.4.2 Electrical Service

The building shall provide low-voltage (~ 100 - 230 V and ~ 400 V welding power) electrical service to all areas of the building where needs for this service are anticipated.

21.2.1.4.3 Grounding

The MPSSN building shall have an electrical grounding grid placed with connections to the grounding grid of the plant-wide network and with robust grounding terminals at electrical service power outlet locations inside the building.

21.2.1.4.4 Lightning Protection

The building shall have lightning protection systems with connection to specified grounding terminals.

21.2.1.5 Potable Water and Drainage

The building shall provide potable water and drainage systems for lavatories and drinking fountains.

21.2.1.6 HVAC

21.2.1.6.1 HVAC for Electrical Equipment Areas

The large electrical bays in the MPSSN building shall be provided with HVAC equipment to protect water-cooled equipment and busbars from freezing, and to limit peak air temperatures to 40°C.

The entire building is enclosed by a lightweight cover, able to resist wind and snow loads and protect resistors from dirt and condensation. Each resistor is enclosed in a shroud, which provides air ducting for forced-air cooling. This cooling system shall use ambient air from the interior of the building, and exhausts air from the resistors to the space above the roof. The flow in this system must be adequate to cool the resistors to ambient temperatures within 6 hours. Conventional requirements are placed on the air change rate, dust, and humidity conditions.

#### 21.2.1.6.2 HVAC for Personnel Areas

Spaces in the MPSSN building which are normally worker occupied (offices, lavatories, shop, etc.) shall be served with a ducted recirculating system capable of providing two to three air changes per hour, and maintaining temperature and humidity within human comfort zones. Fresh air shall be added to recirculation systems at a rate equal to about 30% of the recirculation rate to maintain a positive relative pressure. Fresh air shall be filtered and heated or cooled to match zone conditions.

### 21.2.1.7 Fire Protection

The MPSSN building shall provide fire detection, alarm, and mitigation systems commensurate with the occupancy and fire risk loading of the building.

### 21.2.1.8 Internal Communication

The building shall provide an internal communication system, including a distribution of telephone connections, public address system, and appropriate warning systems (plant emergency, crane movement, fire, etc.). Telephone access points will be provided with noise shields where necessary.

### 21.2.1.9 Access Control

The MPSSN building shall provide access control to prevent unauthorised entry and to prevent worker exposure to electrical and RF power hazards. Access control shall be accomplished with badges, or other identification, which must be read by, installed equipment to allow doors to be opened. The system shall provide for automatic tracking of the individuals and total number of workers within each controlled space. In addition, some areas shall be fenced or otherwise controlled within the auxiliary buildings. Interior barriers will be locked and door status alarmed.

### 21.2.1.10 Materials

#### 21.2.1.10.1 Structural

There are no special requirements for construction materials. The building foundation will be a cast-in-place reinforced concrete mat, locally thickened to provide stiffness and point load bearing, and the superstructure will be prefabricated structural steel. Siding and roofing will be metallic, with integral insulation where appropriate. The building roof structure will be flat, with built-up insulation material to provide local slopes to drainage points.

#### 21.2.1.10.2 Electrical

All cables will be made with copper and should have appropriate insulation level according to the nominal voltage of equipment to be supplied. Cable insulation should meet the following requirements:

- insulation material XLPE preferred, PVC not accepted;
- max. permissible temperature of conductor:
  - continuous 90°C,
  - under short circuit conditions 250°C;
- acid gas content zero halogen, according to IEC-754;
- fire retardancy according to IEC-332-3

**Table 21 (6.2.E.02) -1 IEC Relevant Material**

| IEC # | Technical Committee | Title |
|---|---|---|
| 332-1 to 3 | SC 20C | Test on electric cables under fire conditions |
| 728 | SC 12G | Cable distribution systems |
| 754 | SC 20C | Tests on gases involved during combustion of electric cables |
| 840 | SC 20A | Test on electric cables 30 kV to 150 kV |

21.2.1.11 Cranes, Lifts and Materials Handling

The MPSSN building will not be provided with bridge cranes. Floor-supported moving aids (e.g. air cushion pallets) and temporary rigging will accomplish installation and maintenance relocation of heavy equipment in these buildings. The building shall provide one travelling hoist with a hook capacity of 5 t, for lifting the equipment to the 2$^{nd}$ floor. Grade access at both ends and various points along the side of the building shall be suitable for the entry and operation of trucks and other mobile equipment. The building doors shall provide 4.2 m vertical clearance to allow conventional highway trucks to pass.

21.2.1.12 Instrumentation and Control

Building systems, including HVAC, access control, and any other subsystems which have actively controlled components, shall comply with ITER plant standards for control and communication protocols, and shall provide appropriate interfaces to the CODAC system.

### 21.2.2 Operation and Maintenance

The operations and maintenance (O&M) requirements for the MPSSN building are derived from DRG1, from the systems which occupy the building, and from the functions of the building.

21.2.2.1 Operation and Control of Building Services

Building service systems shall incorporate instrumentation and control to manage system operation. Manual control over lighting, power distribution, large doors, and fluid supply is expected to be adequate. Manual control with safety interlocks will be provided for building cranes and lifting devices. Automatic controls with manual override capability will be installed for the operation of HVAC and fire suppression systems. Operation and control of

building systems will be centralized in building control panels located within the building. Status of building support systems will be provided to the CODAC system. However, no MPSSN building system shall be directly controlled from the main control room.

21.2.2.2 Maintenance of Building Services

There are no specific building system maintenance requirements apart from periodic inspection and repair or system correction during or after these inspection periods. Operation of most systems may be interrupted for maintenance activities. However, HVAC systems shall include sufficient installed redundancy that at least 50% of normal service can be maintained while one unit is removed from service for maintenance.

### 21.2.3 Surveillance and In-Service Inspection

There are no surveillance and in-service inspection requirements for the MPSSN building apart from the usual, annual, visual inspections of the building for noting the status of the overall condition, and for monitoring for any deterioration. In addition, there may be legal inspections for some of the building service equipment such as lifts, and the fire detection, alarm, and suppression systems.

### 21.2.4 Corrosion Protection and Control

The MPSSN building shall be painted and provided with passive corrosion protection features (galvanizing) where appropriate to ensure that the design life of the structure is at least 30 years, the expected combination of ITER construction and operating periods.

### 21.2.5 Quality Assurance (QA)

There are no quality assurance requirements for the MPSSN building beyond those established by the uniform building code (or equivalent) and the ITER QA manual.

### 21.2.6 Reliability Assurance

There are no special reliability assurance requirements for the MPSSN building structure. Building systems shall be designed to meet all functional requirements with the lowest overall lifetime cost, including effects of unavailability and cost of maintenance and repair.

21.2.6.1 HVAC Components and Equipment

HVAC components and equipment shall be designed, procured, and installed in accordance with industrial codes and standards. No additional reliability assurance requirements are applied.

21.2.6.2 Lifting Equipment

Cranes and lifting devices shall comply with classification system, design practices, and safety factors established by the crane manufacturers associations of America (CMAA), or equivalent. The usage of the site services building cranes will be "class D - heavy service use".

## 21.3 Codes and Standards

The MPSSN building will be designed in accordance with the 1994 uniform building code (or equivalent). Good engineering practice, as expressed in the "Ninth Edition of the American Institute of Steel Construction (AISC) Manual of Steel Construction", shall also be employed.