

21 (6.2.M) Site Services Building

21.1 Functions, Basic Configuration, and Interfaces

21.1.1 Functions

The primary functions performed by the site services building are to house, support, provide a suitable environment, and to provide access to the components and systems which are located inside the building. These systems and functions include the centralized breathing air supply system, parts of the compressed air system, parts of the chilled water system (used for cooling), the water treatment plant for the production of demineralized water, distribution and treatment systems for steam and condensate, processing facilities for toxic, non-radioactive waste, processing facilities for non-toxic, non-radioactive waste, space for the steam plant, used to raise steam for process and heating use, and the non-active analytical chemistry laboratory. The building 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 Materials and Equipment

The site services building provides support and space for the equipment and operations which are assigned to this structure and include the following:

- potable and fire water service system
- demineralized water system
- hot water service system
- chilled water system
- low pressure steam distribution system
- compressed air system
- breathing air system
- non-active chemical laboratory
- processing of toxic and non-toxic, non-radioactive waste
- parts storage for operations

21.1.1.2 Protect Materials and Equipment from External Hazards

The building provides the resistance for anticipated wind, snow, and other environmental loads. The building also must resist seismic loads, consistent with the protection of health and safety of personnel.

21.1.1.3 Provide Required Services

The site services building provides internal distribution of services provided for 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 provides collection of rain water and floor drainage, which are discharged to site-wide disposal systems. It also provides 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.

21.1.1.4 Provide 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 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 foundation of the building shall be set below grade so that the finished floor level matches the grade level.

21.1.3 **Interfaces**

The site services building has interfaces with the following WBS elements:

- | WBS | Title |
|---------|--|
| • 2.6.O | Component Cooling System |
| • 2.6.P | Chilled Water Systems |
| • 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 |
| • 6.3.F | Non-radioactive Waste Systems |
| • 6.5.C | Potable & Fire Water |
| • 6.5.D | Sewerage (Sanitary & Industrial) |
| • 6.5.E | Steam/Condensate/Demineralized Water |
| • 6.6 | Gas Distribution and Compressors |
| • 6.8 | Plant Sampling Systems |

21.2 **Requirements**

21.2.1 **Design**

The requirements for the site services building are derived from the functions of the building. The requirements below are not complete as equipment designers continue to provide new interface information as the equipment designs evolve. However, the requirements identified are sufficient to develop the overall configuration and general design concept of the building.

21.2.1.1 General

The building shall accommodate the equipment and components for the following systems.

21.2.1.1.1 Potable and Fire Water Service System

This consists of an outdoor makeup basin, potable water treatment package, and various pumps, pipes, and valves. This system delivers water to all potable water use points in ITER, and is capable of pumping water from the potable water makeup basin to the fire water system. It also provides jockey pumps and/or accumulators to maintain pressure in the fire main system.

21.2.1.1.2 Demineralized Water Service System

This is used to remove suspended and dissolved impurities from water, so that it can be used for makeup to plant cooling systems, for makeup to the plant boiler, and for other uses which require high purity water. The system consists of: tanks, filters, regenerable ion exchangers, pipes, valves, and other equipment.

To prevent acids used for regeneration from spilling into drain systems, the demineralized water system must be surrounded by a low berm, sized to prevent uncontrolled release of fluid assuming a failure of the largest single tank. Acid-proof flooring should be used in this area.

21.2.1.1.3 Hot Water Service System

During some periods, space heating may be accomplished by the distribution of hot water, instead of low pressure steam. Equipment needed for this function includes steam or electric fired water heaters, pumps, tanks, piping, and valves.

21.2.1.1.4 Chilled Water Service System

Chilled water system provides water at about 6°C for use in HVAC and other ITER processes. The equipment consists of electric motor-driven chillers, heat exchangers, pumps, valves, tanks, and other system equipment.

21.2.1.1.5 Low Pressure Steam Service System

The auxiliary boiler systems will raise and distribute steam to all steam users in the plant (primarily HVAC and water detritiation system), and will collect, store, and treat returned condensate. The system will consist of packaged, oil or gas fired auxiliary boilers, tanks, pumps, pipes, valves, and other equipment. The fired boilers must be located in a separate annex to separate them from other fire hazards.

21.2.1.1.6 Compressed Air Service System

Provides oil-free air for instrumentation and control to a plant wide distribution system. Air is delivered at about 0.7 MPa. Space is provided for compressors, surge tanks, filters, piping, valves, and other system components. Parts of the compressed air system are located in other buildings, near major compressed air use systems.

21.2.1.1.7 Breathing Air System

Provides oil-free, filtered, fresh air for use with protective suits. Protective suits are

potentially required for entry to the tokamak cooling water system vault and repair cells within the hot cell building. This centralised supply system consists of compressors, surge tanks, filters, piping, valves, and other system components.

21.2.1.1.8 Processing of Toxic and Non-toxic Waste

For processing toxic and non-toxic (non-radioactive) waste and provide space for its temporary storage. The area is serviced by a lightweight overhead crane, and dust and dirt from these processes must be excluded from the other parts of the building.

21.2.1.1.9 Access, Maintenance, and Parts Storage Space

Space for normal maintenance and parts storage. Good access to all equipment within the building is needed. Parts storage and waste handling will involve transport of heavy objects by truck, hence large aisles and doors are needed as well.

21.2.1.1.10 Non-active Analytical Chemical Laboratory

For handling and analysing the non-radioactive samples used for control of cooling towers, water treatment plant, boiler, industrial sewage discharge, environmental samples, etc.

21.2.1.2 Seismic

The site services building is non-safety importance class (non-SIC) and shall withstand SL-0 seismic conditions with peak horizontal and vertical accelerations as specified in the PDS.

21.2.1.3 Structural

21.2.1.3.1 Component 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 Material Handling Devices

The buildings shall support the weight and forces of all lifted loads, including the lifting devices over the full range of their travel. Structural deflection under such loading shall 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.

21.2.1.4 Chemical

In areas where acid is used (the ion exchange processing and regeneration area), floors and the lower parts of the walls shall be covered with acid-resistant materials.

21.2.1.5 Electrical

21.2.1.5.1 Lighting

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

21.2.1.5.2 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. Service outlets will be provided approximately every 15 m along the north and south edges and centre of the building.

21.2.1.5.3 Grounding

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

21.2.1.5.4 Lightning Protection

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

21.2.1.6 Potable Water and Drainage

The building shall provide potable water and sanitary sewage systems for lavatories, and drinking fountains. Shower facilities will not be included in the building. Industrial sewage is also required in the processing and boiler areas.

21.2.1.7 HVAC Systems

Areas dedicated to full time worker occupation (offices, lavatories, shop, etc.) shall be equipped to maintain temperatures at $22 \pm 5^{\circ}\text{C}$. Relative humidity in these areas shall be maintained below 85% and particulate matter in the air will be filtered. The remainder of the site services building shall be equipped with roof-mounted exhaust ventilation fans that provides a minimum of 1 air change per hour. It shall also be equipped with distributed space heaters suitable to prevent the minimum temperature from going below 10°C .

21.2.1.8 Fire Protection

The building shall provide fire detection, alarm, and mitigation systems commensurate with

the occupancy and fire risk loading of the building.

21.2.1.9 Internal Communication

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

21.2.1.10 Access Control

The site services building does not contain any safety-related systems or equipment, nor any radiological exposure hazards. Furthermore, it is equipped with numerous truck doors. However, it shall be provided with worker access control on all entrances, and especially inside the building, in the toxic waste handling areas, the potable water treatment areas, the non-active chemical laboratory, the boiler, and parts storage areas. Access control shall consist of local barriers equipped with access control devices, and shall provide an inventory of all staff within the building (in case of emergency).

21.2.1.11 Materials

21.2.1.11.1 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.

21.2.1.11.2 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.M) -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

21.2.1.12 Cranes, Lifts and Materials Handling

The building shall provide one bridge crane with main hook capacity of 20 t, with coverage over large rotating machinery (such as chillers and air compressors) and parts storage areas; and a second crane with hook capacity of 5 t, over the waste handling areas. The crane shall provide 3 degrees of motion (x, y, z) and provide positional repeatability to 15 mm. Grade access at both ends and various points along the side of the building must be suitable for the entry and the operation of trucks and other mobile equipment. The building doors shall provide 4.2 m vertical clearance to allow conventional highway trucks to pass.

21.2.1.13 Instrumentation and Control

The site boiler system and other building support systems, including HVAC 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 site services building are derived from the requirements of systems which occupy the building, and 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 alarm and 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 site services building systems will 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.

21.2.3 **Surveillance and In-Service Inspection**

There are no surveillance and in-service inspection requirements for the building apart from 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.

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

21.2.4 **Quality Assurance (QA)**

There are no QA requirements for the site services building beyond those established by the uniform building code (or equivalent).

21.2.5 **Reliability Assurance**

There are no special reliability requirements for the site services building. 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.

21.2.5.1 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.

21.2.5.2 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 site services building shall 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.