

## 21 (6.2.E.05) Alternating Current Distribution Building

### 21.1 Functions, Basic Configuration and Interfaces

#### 21.1.1 Functions

The main functions of the AC distribution building are the following;

- 1) House and support the systems, and provide space for both operations and maintenance.
- 2) Provide a suitable environment for the system and workers inside.

##### 21.1.1.1 House and Support the Systems, and Provide Space

The AC distribution building provides space for the systems located within the building, and enough strength to support the systems. The AC distribution building resists external hazards, including seismic events, extreme weather (hurricanes, tornadoes, rainfall, snow, etc. as specified in the PDS) in order to prevent failure of the systems.

The building provides services, such as power supply, cooling water, etc. Thus, cables and pipes have to be installed in the AC distribution building, to be connected to the site infrastructure.

The major systems to be installed in the AC distribution building are shown in Table 21 (6.2.E.5) -1.

**Table 21 (6.2.E.5) -1 Major Systems installed in the AC Distribution Building**

AC Distribution System	Switchgear
	Control Room
	Reactive Power Compensation (RPC) Controllers
	DC Battery

##### 21.1.1.2 Provide a Suitable Environment

For a suitable environment for the systems, equipment, and workers, the following systems must be provided;

- lighting, service power
- fire detection, alarm, and suppression
- service fluid distribution system
- drainage systems
- grounding system
- heating, ventilation, and air conditioning (HVAC) system
- communication system

Many of these systems are commonly found in buildings, but there are some special features of the plant that generate some uncommon requirements;

- a robust grounding system
- an access control system

The other systems are those usually installed large industrial buildings.

## 21.1.2 Basic Configuration

The AC distribution building is a two-level structure. It should be a reinforced concrete building because the DC battery room requires the strength of massive and strong walls to resist a potential hydrogen explosion. Heavy equipment should be located at grade.

## 21.1.3 Interfaces

The building has interfaces with the following WBS elements:

WBS	Title
2.6.O	Component Cooling System
2.6.P	Chilled Water System
4.3.A	Steady-State HV Substation
4.3.C	Steady-State Electrical Power Distribution
4.5	CODAC
4.6	Interlocks System
6.1.A	Site General Layout
6.2.S	Utility Tunnels & Site Improvements
6.5	Liquid Distribution, Including Water

## 21.2 Requirements

### 21.2.1 Design

The requirements for the AC distribution building are derived from the DRG1 and section 21.1.1, above. The requirements listed below are not complete as some equipment is still being designed. However, these requirements are sufficient for the overall configuration and the general conceptual design of the building.

#### 21.2.1.1 General

##### 21.2.1.1.1 3.3 kV Shedding Switchgear

The building shall accommodate the 3.3 kV shedding switchgear.

##### 21.2.1.1.2 AC Distribution Board

The building shall accommodate an AC distribution board.

##### 21.2.1.1.3 DC Battery System

The building shall accommodate the DC battery system, surrounded by strong walls and slabs with a designed weak point to accommodate the potential pressure burst from a hydrogen explosion that might result from the accumulation of H<sub>2</sub> gas from batteries. A separate ventilation system should be provided for the DC battery room.

#### 21.2.1.1.4 RPC Controllers

The building shall accommodate the RPC controllers.

#### 21.2.1.1.5 SSEPN Control Room

The building shall accommodate the SSEPN control room.

#### 21.2.1.1.6 Pulsed Power Supply (PPS) AC Distribution Control Room

The building shall accommodate the PPS AC distribution control room.

#### 21.2.1.1.7 Pulsed Power Supply (PPS) Switchgear

The building shall accommodate the PPS switchgear.

#### 21.2.1.2 Seismic

The building is not safety importance class (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 Dead Loads and Equipment Loads

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

##### 21.2.1.3.2 Live Loads

The building shall support the weight and forces of all movable and active components, systems, and structures located on the slabs or walls of the building.

##### 21.2.1.3.3 External Hazard Loads

The structure shall resist the forces exerted by seismic activity, wind, snow and soil and ground water pressure, as defined in the PDS.

#### 21.2.1.4 Testing

The building shall be constructed to appropriate codes and standards, which will include requirements for construction and commissioning testing of materials, welding, piping systems, electrical systems, and other building components. In addition to construction-related inspection and testing, the AC distribution building shall be designed to accommodate functional testing of the building systems such as fire detection, alarm, and mitigation systems.

### 21.2.1.5 Electrical

#### 21.2.1.5.1 Building Lighting Service

The building shall be provided with appropriate, permanently-installed, electrical lighting fixtures which shall include an emergency lighting circuit.

#### 21.2.1.5.2 Building Electrical Service

The building shall distribute low voltage power for services and welding to points within the buildings.

#### 21.2.1.5.3 Building Electrical Grounding

The building shall have an electrical grounding grid with connections to the plant-wide grounding grid network, and shall have robust grounding terminals at specified locations inside the building.

#### 21.2.1.5.4 Lightning Protection System

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

### 21.2.1.6 Potable Water and Drainage

The building shall provide potable water and sanitary drainage systems for lavatories, kitchen facilities, and drinking fountains. The building shall have roof drains that connect to the yard drain system.

### 21.2.1.7 HVAC

The building HVAC systems shall provide air quality (temperature, humidity, purity, freshness) sufficient to meet the requirements of the workers and equipment located in the building. Battery rooms will be equipped as necessary with dedicated systems to prevent the buildup of hydrogen or other flammable gasses.

### 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. The alarm system shall interface with the CODAC system, and fire status shall be displayed in the control 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 building will not contain any radiological exposure hazards. However, it shall provide access control to prevent unauthorised entry to the building (or to individual control centres and equipment halls), and to prevent worker exposure to electrical and other hazards. Access control will be accomplished through the use of badges or other identification which must be inserted into readers to allow doors to be opened. The system will provide for automatic tracking of the individuals and total number of workers within each controlled space.

### 21.2.1.11 Materials

#### 21.2.1.11.1 Structural

The building shall be constructed with structural steel and reinforced concrete as required in the codes specified in section 21.3.

#### 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.E.5) -2 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 Material Handling

The building shall provide hoist crane, the capacity of which shall be 10 t, for the switchgear maintenance activity.

### 21.2.1.13 Instrumentation and Control

Building systems 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 AC distribution building are derived from the DRG1 and the functions of the building (see section 21.1.1).

### 21.2.2.1 Operation and Control of Building Services

Building services shall incorporate appropriate instrumentation and control subsystems to manage system operation. Manual control over lighting, power distribution, and fluid supply is expected to be adequate. Manual control with safety interlocks will be provided for the crane. Building systems with no safety or radiation control function (compressed air distribution, industrial drainage, grounding, etc.) will be equipped with appropriate instrumentation and control to operate in stand-alone mode. Operation and control of these building systems will be centralised in building control panels located within the building. Status of these building systems will be provided to the CODAC system. However, the AC distribution building support systems will not be directly controlled from the main control room.

Fire protection, alarm, and suppression systems in the AC distribution building will be equipped with automatic controls with manual override capability. These systems will initiate alarms and signals used by CODAC, and will report status to CODAC, but these systems will not be controlled directly 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. The HVAC systems will include sufficient installed redundancy so that at least 50% of normal service can be maintained while one unit is removed from service for maintenance.

### 21.2.2.3 Specific Maintenance Requirements for Structures

The buildings materials which may be degraded by corrosion shall have prevention and control measures which may be maintained over the life of the project including decommissioning and dismantling.

## 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 or hoists, and the fire detection, alarm, and

mitigation systems.

#### **21.2.4 Quality Assurance (QA)**

There are no quality assurance requirements for the AC distribution building beyond those established by the uniform building code (or equivalent).

#### **21.2.5 Reliability Assurance**

There are no reliability assurance requirements for the AC distribution 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.

### **21.3 Codes and Standards**

The AC distribution building shall be designed and constructed in accordance with the uniform building code (or equivalent) and American concrete institute (ACI) - 318 (or equivalent).