21 (6.2.L.03) Electrical Load Centres (Outdoors Structures LC #5; 6&11; 7&8)

21.1 Functions, Basic Configuration, and Interfaces

21.1.1 Functions

The electrical load centres (LC) are dedicated to motor loads. Some of the load centres are in buildings, but LCs # 5; 6&11; and 7&8 are accommodated by light structures due to location. These structures are the objects of this DRG2 section. The primary functions performed by the structures 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 following sections describe the functions in more detail.

The following table shows the locations and characteristics of all the load centres (both in buildings or in the own structures).

Table 21 (6.2.L.03) -1 Electrical Load Centers

LC #	Site Location or Building #	Description	Ambient conditions
LC-1	36 AC Distribution Building	EL. 0.0 m Located on floor 1 of the building # 36 Class III room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80% Heat loads into the air
LC-2	33 Magnet Power Conversion Building	EL. 0.0 m Located on floor 1 of the building # 33. Class III room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-3	52 Cryoplant Compressor Building	EL. 0.0 m Buildings are used for PF coil fabrication as well as for the cryoplant Located on floor 1, west part of the building # 52. Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-4	71 Control Building	EL. – 6.0 m Located on underground floor 1, west middle part of the building # 71. Class III room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-5	LC-5 Load Center	EL. 0.0 m and 4.7 m Located west of the hot cell building #21 in a load center structure at ground and second levels. Class III room Class III – safety room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%

Table 21 (6.2.L.03) -1 Electrical Load Centers (cont'd)

LC #	Site Location or Building #	Description	Ambient conditions
LC-6	LC-6 Load Center	EL. 0.0 m and 4.7 m Combined with LC-11 and located north of the diagnostic building # 74 in a load center structure at ground level. Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-7	LC-7 Load Center	EL. 0.0 m Combined with LC-8 and located south of the diagnostic building # 74 in a load center structure at ground level. Class III room Class III – safety room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-8	LC-8 Load Center	EL. 0.0 m Combined with LC-7 and located south of the diagnostic building # 74 in a load center structure at ground level. Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-9	24 Personal Building	EL. 3.6 m. Located on floor 2, south part of the building # 24. Class III room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-10	14 Tritium Building	EL. 7.0 m Located on floor 2, south part of the building # 14. Class III room Class III – safety room Class III – safety room Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-11	LC-9 Load Center	EL. 0.0 m & 4.7 m Combined with LC-6 and located north of the diagnostic building # 74 in a load center structure at ground level. Class IV room	Temperature + 10 - 35°C Humidity ≤ 80%
LC-12	41 Emergency Power Supply Building	EL. 0.0 m Located on floor 1 of the building # 41. Class III – safety room Class III – safety room	Temperature + 10 - 35°C Humidity ≤ 80%

21.1.1.1 Protect Materials and Equipment from External Hazards

The structures provide resistance against anticipated wind, snow, and other environmental loads. The structures also must resist seismic loads, consistent with protection of health and safety of workers.

21.1.1.2 Provide Required Building Services

The load centres provide for the internal distribution of site services such as low voltage electricity for service and welding requirements, grounding (earthing) connections, and

instruments. They also provide for the collection of rain water, which is discharged to the site-wide run-off drainage system, and systems including access control, lighting, fire protection (detection, alarm, and mitigation), and communications. Design requirements for each of these aspects are described in section 21.2.

21.1.1.3 Provide Heating, Ventilation, and Air Conditioning (HVAC)

The structures must provide air quality sufficient to meet the requirements set by the systems and functions located within. Some of these systems and functions are safety importance classification and these requirements can be met by using conventional HVAC system equipment.

21.1.2 Basic Configuration

There are three LC structures, LC #5, LCs #6&11, and LCs #7&8. The LC structure (LC #5) is adjacent to the west wall of the hot cell building (21). The LC structure (LCs #6&11) is adjacent and north of, and the LC structure (LC #7&8) is adjacent and south of, the diagnostic building (74). Amenities must include a ventilation system, suitable for the equipment located in the structures, lighting and service power, fire protection, access control and roof drainage. The single-level structural design requires a simple foundation with a steel frame structure. The roof on each structure is structurally flat to provide a slope to drain points.

LC #5 and LCs #6&11 are two-story structures, while LCs #7&8 is a one-story structure. There are no large open or clear spans; it is a structural steel, column and beam configuration. Equipment is located at grade and on the roof. The foundation of the structures shall be set below grade so that the finished floor level matches the grade level.

21.1.3 Interfaces

The LC structures have interfaces with the following WBS elements:

WBS	Title
4.3	Steady State Electrical Power Distribution
4.5	CODAC
4.6.C	Access Control
6.1.A	Site General Layout
6.5	Liquid Distribution Systems
6.6	Gas Distribution Systems

21.2 Specific Requirements

21.2.1 Design Requirements

The requirements for the LC structures are derived from DRG1 and from the functions of the structures (section 21.1.1). The requirements below are not complete because equipment designers continue to provide new interface information. However, they identify all the requirements which control the overall configuration and general design concept of the structures.

21.2.1.1 General

21.2.1.1.1 Switching

The LC structures shall accommodate the switches and all other relevant components used to provide motor loads. Dry transformers associated with various power supply circuits are located in the structures.

21.2.1.1.2 Access and Maintenance Space

The structures must provide space for normal maintenance. Good access to all electrical equipment within the structures is needed. The structures shall have aisles and two doors for the movement of heavy objects.

21.2.1.2 Seismic

The LC #5 and LC #7&8 include safety importance class (SIC) components and the parts of LC structures which house SIC components shall withstand SL-2 seismic conditions with 0.2 g peak horizontal and vertical accelerations as specified in the PDS. The LC #6&11 include no SIC component and shall withstand SL-0 seismic conditions with 0.05 g peak horizontal and vertical accelerations as specified in the PDS.

21.2.1.3 Structural

21.2.1.3.1 Components Supported by the Structures

The structures shall support their own weight as well as the weight of all installed equipment.

21.2.1.3.2 Live Loads

The structures 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 Devices

The structures shall not be provided with bridge cranes or other lifting devices. Portable equipment will be used to move power conditioning equipment on the floor at grade.

21.2.1.3.4 Thermal Loads

The structures 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 structures 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 structures will withstand snow loading conditions of up to 150 kg/m^2.

21.2.1.4 Electrical

21.2.1.4.1 Lighting Service

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

21.2.1.4.3 Electrical Grounding

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

21.2.1.4.4 Lightning Protection System

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

21.2.1.5 Potable Water and Drainage

The structures shall not be provided with potable water. The structures shall have roof drains that connect to the yard drain system.

21.2.1.6 HVAC Systems

The structures do not contain any spaces which are normally worker occupied. The electrical bay in the structures shall be provided with HVAC equipment to protect equipment from freezing, and to limit peak air temperatures to < 40°C. The unducted air handling units will be augmented with roof-mounted fans to provide air refreshment at a rate of approximately 0.5 air changes per hour. The entire level of the structures are enclosed by lightweight covers, able to resist wind, snow loads and protect equipment from dirt and condensation. Conventional requirements are placed on the air change rate, dust, or humidity conditions.

21.2.1.7 Fire Protection

The structures shall provide fire detection, alarm, and mitigation systems commensurate with the occupancy and fire risk loading. The alarms will interface with the CODAC system, and their status will be available in the control building.

21.2.1.8 Internal Communication

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

21.2.1.9 Access Control

The structures and outdoor areas shall be subject to access control to prevent unauthorised entry and to prevent worker exposure to electrical power hazards. Access control will be accomplished with badges, or other identification, which must be read by, installed equipment 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.

21.2.1.10 Materials

21.2.1.10.1 Structural

There are no special requirements for construction materials. The foundations 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 roof structures will be flat, with built-up insulation material to provide 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 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.L.03) -2 IEC Relevant Material

IEC #	Technical Committee	Title
332 –1…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

21.2.2 Operation and Maintenance

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

21.2.2.1 Operation and Control of Building Services

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. Operation and control of building systems will be centralized in control panels located within the structures. Status of systems will be provided to the ITER CODAC system. However, no system will be directly controlled from the ITER main control room.

21.2.2.2 Maintenance of Building Services

There are no specific 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. 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.

21.2.3 Surveillance and In-Service Inspection

There are no surveillance and in-service inspection requirements for the structures apart from usual, annual, visual inspections of the structures 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 service equipment such as the fire detection, alarm, and mitigation systems.

21.2.4 Corrosion Protection and Control

The LC structures shall 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.

21.2.5 Quality Assurance (QA)

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

21.2.6 Reliability Assurance

There are no special reliability requirements for the LC structures. Support systems shall be designed to meet all functional requirements with the lowest overall lifetime cost, including the effects of unavailability and cost of maintenance and repair. HVAC components and equipment shall be designed, procured, and installed in accordance with industrial codes and standards. There are no additional reliability assurance requirements.

21.3 Codes and Standards

The LC structures 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" (or equivalent), shall also be employed.