21 (6.2.J.01) Cryoplant Compressor Building and Poloidal Field Coil Fabrication Building #2

21.A PF Coil Fabrication Building #2

21.A1 Functions, Basic Configuration, and Interfaces

21.A1.1 Functions

The poloidal field (PF) coil fabrication building #2 is dedicated to industrial manufacturing processes associated with the on-site construction of PF coils 1, 2, 5, and 6. Large circular PF coils are required, ranging in finished diameter from 12 m to 18 m, and weighing up to 255 t. The building provides some general services such as HVAC, lighting, power, drainage, fluids, and lifting capability. The primary functions performed by the building are to house, support, protect, provide a suitable environment, and to provide and control access to the materials, equipment and processes, which are located inside the building.

The following sections describe the functions of the building in more detail.

21.A1.1.1 Accommodate Materials and Equipment

The PF coil fabrication building #2 provides support and space for the equipment and operations which are assigned to this structure and include the following:

- Potable and fire water service
- Hot water service
- Chilled water
- Low pressure steam distribution
- Compressed air
- Breathing air
- Electrical load distribution
- Parts storage for operations

21.A1.1.2 Protect Materials and Equipment from External Hazards

The building provides the resistance for anticipated wind, snow, and other environmental loads. The building also provides protection against extremes in temperature and humidity as dictated by the fabrication process and worker health and safety. The building isolates the materials, equipment and coils from dirt, debris, and other contaminants, which may be present at the construction site that could interfere with fabrication or degrade the finished coil. The building also must resist seismic loads (UBC requirements).

21.A1.1.3 Provide Building Services

The PF coil fabrication building #2 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, alarms and mitigation systems, and

communications. Design requirements for each of these aspects are described in section 21.A2.1.

21.A1.1.4 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 equipment.

During assembly of the PF coils, the building atmospheric environment has to be maintained within specifications for the coils. The PF coil fabrication building HVAC systems provide heat, ventilation, and cooling to all building areas except the mechanical equipment room. These systems maintain a relative positive pressure within the building to minimise inleakage and associated dust.

The fabrication building provides the storage of the last two finished PF coils. The finished PF coils except the last two coils shall be stored in the tokamak building, or in a protected environment outside the buildings.

21.A1.2 Basic Configuration

The PF coil fabrication building is a single level structure with a space for mechanical and electrical services. The building footprint is sufficient to provide for simultaneous fabrication of one large coil and one small coil. Each coil will occupy 5 equivalent diameters, plus space for conductor laydown and spooling for a three-in-hand winding operation, although the module assembly station for the smaller coil will be inside the space allocated for the large coil. The height of the building is controlled by the height of the winding operation plus room for pancake and module handling tools, crane, and roof truss depth. The foundation of the building is set below grade so that the finished floor level matches the paved grade level at the entrances to the building.

The tools, jigs, and winding fixtures needed for the largest coil determine the space requirements for the building. The heaviest module determines the crane capacity. The manufacturing process involves the application of epoxy insulating and bonding materials, vacuum impregnation steps, and preparation of conductor joints. The process requires cleanliness, lighting, and environmental control, which are similar to aircraft manufacture.

The building includes space for an electrical load distribution center, which is part of the plant steady-state electrical power distribution system. Personnel areas such as offices, lavatories, change facilities, and other worker support functions will be provided using temporary buildings.

The large, open bay in the building will be equipped with wall- or ceiling-mounted, un-ducted air handling units. These air handling units will be augmented with bi-directional, roof-mounted fans.

The worker-occupied region will be served with a ducted system capable of providing two to three air changes per hour, and maintaining temperature and humidity within human comfort zones. Air exchanges are consistent with the building occupancy and internal processes

HVAC system connections to site steam and chilled water services.

After the coil fabrication campaign, the PF coil fabrication building will be converted to the cryoplant compressor building.

21.A1.3 Interfaces

The PF coil fabrication building # 2 has interfaces with the following WBS elements:

WBS	Title
1.1 - 1.3	Magnet 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
6.5.C	Potable & Fire Water
6.5.D	Sewage (Sanitary & Industrial)
6.5.E	Steam/Condensate/Demineralized Water
6.6.A	Compressed Air
6.6.C	Nitrogen, Helium, etc.

21.A2 Requirements

21.A2.1 Design

The requirements for the PF coil fabrication building #2 are derived from the systems within the building and from the functions of the building, as in section 21.A1.1. The primary functions performed by the building are to house, support, protect, provide a suitable environment and to provide and control access to the materials, 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, these requirements shall control the overall configuration and general design concept of the building.

21.A2.1.1 General

21.A2.1.1.1 PF and Correction Coils

The building shall accommodate the fabrication materials and the finished PF and correction coils which will be fabricated in this building.

21.A2.1.1.2 Systems and Components for Coil Fabrication

The building shall accommodate the equipment and systems which are used to fabricate the PF and correction coils. For example, layer winding system, inspection system, insulation system, and so on.

21.A2.1.1.3 Coil Transporter

The building shall accommodate the coil transporter to move the coils from the building in which they are fabricated to the laydown, assembly and RF heating building. The transportation of all coils will be accomplished with the conductors in a horizontal orientation using multi-wheeled carriers. Carriers will be used throughout the site to handle heavy loads.

21.A2.1.1.4 Electrical Load Distribution

The electrical load distribution centre (LC-3) shall provide power to the PF coil fabrication buildings #1; #2 and the local utility tunnel. Approximately 120 m^2 are required for LC-3.

21.A2.1.1.5 Access, Maintenance, and Parts Storage Space

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

21.A2.1.2 Seismic

The PF coil fabrication building #2 shall be non-SIC and shall withstand SL-0 seismic conditions with peak horizontal and vertical accelerations as specified in the PDS.

21.A2.1.3 Structural

21.A2.1.3.1 Components Support

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

21.A2.1.3.2 Live Loads

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

21.A2.1.3.3 Lifting, Materials 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.A2.1.3.4 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.A2.1.3.5 Wind Loads

The PF coil fabrication building #2 shall withstand horizontal wind conditions of up to 140

km/h defined at 10 m above grade.

21.A2.1.3.6 Snow Loads

The PF coil fabrication building #2 shall withstand snow loading conditions of up to 300 kg/m^2.

21.A2.1.4 Construction

After the coil fabrication campaign, the PF coil fabrication building will be converted to the cryoplant compressor building.

21.A2.1.5 Assembly

Apart from the requirement to produce the PF and correction coils coils for assembly, and to provide a path for delivery of them to the assembly staging area, there are no further assembly requirements.

21.A2.1.6 Electrical

21.A2.1.6.1 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.A2.1.6.2 Electrical Services

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.A2.1.6.3 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.A2.1.6.4 Lightning Protection

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

21.A2.1.7 Potable Water and Drainage

The building shall provide potable water and sanitary drainage systems for drinking fountains. Offices, lavatories and shower facilities will not be included in the building, but will be provided by the use of temporary support buildings (trailers).

21.A2.1.8 HVAC

The PF coil manufacturing building shall provide temperature control to 23 ± 3°C from 0 to 3 m above the building floor, low humidity (40% max), and control of dust. These conditions will not need to persist when the large doors are opened. The HVAC system should recirculate air to provide at least 3 air changes per hour. Fresh air will be added to the building to maintain a positive relative pressure. Intake air will be filtered, dehumidified, and heated or cooled to match building conditions. At least two HVAC trains shall be provided to ensure that conditions can be maintained during maintenance activities on HVAC components.

Areas dedicated to full time worker occupation (offices, shop, etc.) shall be equipped to maintain temperatures at 22 ± 5°C. Relative humidity in these areas shall be maintained below 85% and particulate matter will be filtered.

The remainder of the PF coil fabrication building #2 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.A2.1.9 Fire Protection

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

21.A2.1.10 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.A2.1.11 Access Control

The PF coil fabrication building #2 will not contain any safety-related systems or equipment, nor any radiological exposure hazards. Entry conditions are not affected by the operating state of the tokamak or any other plant systems. Furthermore, it will be equipped with truck doors. However, it shall be provided with worker access control on all entrances. 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.A2.1.12 Materials

21.A2.1.12.1 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.A2.1.12.2 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.J.01) -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.A2.1.13 Cranes, Lifts and Materials Handling

The building shall provide one bridge crane with main hook capacity of 40 t, and one 5 t bridge sub-crane, with coverage adequate to serve the entire coil fabrication area and parts storage 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 of trucks and other mobile heavy-load-carrying equipment. The building doors shall provide 10 m vertical clearance to allow conventional highway trucks to pass.

21.A2.1.14 Instrumentation and Control

Building 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.A2.2 Operation and Maintenance

The operations and maintenance (O&M) requirements for the PF coil fabrication building #2 are derived from the systems which occupy the building, and the functions of the building.

21.A2.2.1 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 the HVAC and the fire detection, alarm, and suppression systems. Operation and control of building systems will be centralised in building control panels located within the building. The status of the building systems will be provided to the CODAC system. However, no PF coil fabrication building #2 systems will be directly controlled from the main control room.

21.A2.2.2 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.A2.3 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 PF coil fabrication building #2 shall be painted and provided with passive corrosion protection features (galvanising) 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.A2.4 Quality Assurance (QA)

There are no QA requirements for the PF coil fabrication building #2 beyond those established by the uniform building code (or equivalent).

21.A2.5 Reliability Assurance

There are no special reliability assurance requirements for the PF coil fabrication building #2 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.A2.5.1 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.A2.5.2 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 PF coil fabrication building #2 cranes will be "class D - heavy service use".

21.A3 Codes and Standards

The PF coil fabrication building #2 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.

21.B Cryoplant Compressor Building

21.B1 Functions, Basic Configuration, and Interfaces

21.B1.1 Functions

After the coil fabrication campaign, the PF coil fabrication building will be converted to the cryoplant compressor building.

The cryoplant compressor building provides space for the compressor parts of the ITER cryoplant. Many compressor units must be grouped together and operated in parallel to provide the necessary gas flow. Individual compressors are expected to be electric motor-driven rotary screw units, each consuming several thousand horsepower. The number, size, noise, and vibration associated with the compressors has resulted in a decision to isolate them in a dedicated building. The streams of helium and nitrogen are supplied to these cold boxes from the cryoplant coldbox building. Outdoor equipment: He gas heaters for the final stage of warm up.

The building includes space for an electrical load distribution centre, which is part of the plant steady-state electrical power distribution system. 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.B1.1.1 Accommodate Materials and Equipment

The cryoplant compressor 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
- Chilled Water System
- Low Pressure Steam Distribution System
- Compressed Air System
- Breathing Air System
- Electrical Load Distribution System
- Parts Storage for Operations

21.B1.1.2 Protect Materials and Equipment from External Hazards

The building provides the resistance for anticipated wind, snow, and other environmental loads. The building also provides protection against extremes in temperature and humidity as dictated by the fabrication process and worker health and safety. The building isolates the materials, equipment and coils from dirt, debris, and other contaminants, which may be present at the construction site that could interfere with fabrication or degrade the finished coil. The building also resists seismic loads (UBC requirements – section 21.B2.1.2).

21.B1.1.3 Provide Building Services

The cryoplant compressor 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 protection, and communications. Design requirements for each of these aspects are described in section 21.B2.1.

21.B1.1.4 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-SIC, therefore these requirements can be met by using conventional HVAC equipment. The cryoplant compressor building HVAC systems service all building areas. The large, open bays in the building will be equipped with wall- or ceiling-mounted, un-ducted air handling units. These air handling units will be augmented with bi-directional roof mounted fans. Air exchanges are consistent with the building occupancy and internal processes. The HVAC system connects to site steam and chilled water services.

21.B1.2 Basic Configuration

The cryoplant compressor building is a single level structure with clear span. the building provides space for process equipment and is serviced by an overhead main 40 t bridge crane and a 5 t bridge sub-crane, suitable for servicing and assembly and disassembly of the helium coldboxes. To maintain stability, the crane columns are built-up with an effective width of 2.5 m, resulting in 40 m between crane rails. The maximum hook height for the crane is 18 m. The north aisle is used for interior truck access and routing of services, both overhead and in a below-grade utility trench. Large doors are provided at the east end of the building.

The space for mechanical and electrical services, parts storage, and other worker support function will be provides at the west end of the building. Additional cryoplant equipment, helium gas heaters for the final stage of warm-up are located outdoors.

The foundation of the building is set below grade so that the finished floor level matches the paved grade level at the entrances to the building.

21.B1.3 Interfaces

The cryoplant compressor building has interfaces with the following WBS elements:

WBS	Title
2.6.O	Component Cooling System
2.6.P	Chilled Water Systems
3.4	Cryoplant and Cryodistribution
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 & Industrial)
6.5.E	Steam /Condensate/Demineralized Water
6.6.A	Compressed Air
6.6.C	Nitrogen, Helium, etc.

21.B2 Requirements

21.B2.1 Design

The requirements for the cryoplant compressor building are derived from the systems within the building, and from the functions of the building. The requirements below are not complete because equipment designers continue to provide new interface information. However, these requirements shall control the overall configuration and general design concept of the building.

21.B2.1.1 General

21.B2.1.1.1 Compressor System

The cryoplant compressor building shall accommodate the equipment and systems for the compressor portion of the liquid helium refrigeration and (LN_2) supply system.

21.B2.1.1.2 Helium Purification System

The building shall accommodate the equipment and system for helium purification.

21.B2.1.1.3 Helium Gas Dryer

The building shall accommodate a set of helium gas dryers of LHe plant and 80K He loop.

21.B2.1.1.4 Nitrogen Gas Dryer

The cryoplant compressor building shall provide space for set of nitrogen gas dryers.

21.B2.1.1.5 Access, Maintenance, and Parts Storage Space

The building shall provide space for normal maintenance and parts storage and good access to all equipment within the building. The building shall provide large aisles and doors for the transport of parts in the building.

21.B2.1.1.6 Outdoor area

He gas heaters for the final stage of warm-up shall be located outdoors.

21.B2.1.1.7 Electrical Load Distribution Centre

The electrical load distribution centre (LC-3, approximately 120 m^2) will provide power to the cryoplant buildings and the local utility tunnel.

21.B2.1.2 Seismic

The cryoplant compressor building shall be 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.B2.1.3 Structural

21.B2.1.3.1 Component Support

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

21.B2.1.3.2 Live Loads

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

21.B2.1.3.3 Lifting, 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.B2.1.3.4 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.B2.1.3.5 Wind Loads

The cryoplant compressor building shall withstand horizontal wind conditions of up to 140 km/h defined at 10 m above grade.

21.B2.1.3.6 Snow Loads

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

21.B2.1.4 Construction

After the coil fabrication campaign, the PF coil fabrication building will be converted to the cryoplant compressor building.

21.B2.1.5 Electrical

21.B2.1.5.1 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.B2.1.5.2 Electrical Services

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.B2.1.5.3 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.B2.1.5.4 Lightning Protection

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

21.B2.1.6 Potable Water and Drainage

The building shall provide potable water and drainage systems for drinking fountains. Offices, lavatories and shower facilities will not be included in the building, but will be provided by the use of temporary support buildings (trailers).

21.B2.1.7 HVAC

The cryoplant compressor building shall be equipped with ceiling-mounted, unducted air handling units, able to heat or cool the building over a range suitable for the processes contained in the building. These unducted air handling units shall be augmented with bi-directional roof-mounted fans to provide air refreshment at a rate of approximately 0.5 air changes per hour. Additional temporary clean zones will be established during the disassembly of delicate machinery such as turbo-expanders. This activity will take place in the maintenance laydown area and be restricted to a local region for the device under maintenance.

The remainder of the cryoplant compressor building will be equipped with roof-mounted exhaust ventilation fans that provide 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.B2.1.8 Fire Protection

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

21.B2.1.9 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.B2.1.10 Access Control

The cryoplant compressor building will not contain any safety related systems or equipment, nor any radiological exposure hazards. The building will provide access control to prevent unauthorized entry 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 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. In addition, some areas will be fenced or otherwise controlled within the cryoplant building. Interior barriers will be locked and door status alarmed.

21.B2.1.11 Materials

21.B2.1.11.1 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. The building roof structure will be flat, with built-up insulation material to provide local slopes to drainage points.

21.B2.1.11.2 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.J.01) -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.B2.1.12 Cranes, Lifts and Materials Handling

The building will provide a bridge crane with main hook capacity of 40 t and a 5 ton bridge sub-crane, with coverage adequate to serve the entire compressor and parts storage areas. 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 10 m vertical clearance to allow conventional highway trucks to pass.

21.B2.1.13 Instrumentation and Control

Building 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.B2.2 Operation and Maintenance

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

21.B2.2.1 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 detection, alarm, and suppression systems. Operation and control of building systems will be centralised in building control panels located within the building. Status of building systems will be provided to the CODAC system. However, no cryoplant compressor building systems will be directly controlled from the ITER main control room.

21.B2.2.2 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.B2.3 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 cryoplant compressor building shall be painted and provided with passive corrosion protection features (galvanising) 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.B2.4 Quality Assurance (QA)

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

21.B2.5 Reliability Assurance

There are no reliability assurance requirements for the cryoplant compressor building structure. Building support 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.B2.5.1 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.B2.5.2 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 cryoplant compressor building cranes will be "class D - heavy service use".

21.B3 Codes and Standards

The cryoplant compressor 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.