

21 (6.2.G.01) Low Level Radwaste Bulding

21.1 Functions, Basic Configuration and Interfaces

21.1.1 Functions

The main functions of the radwaste building are the following:

- house and support the systems, provide adequate space
- provide a suitable environment for the system and workers
- provide confinement boundary of tritium, activated materials
- shield radiation

21.1.1.1 House and Support the Systems, Provide Adequate Space

The building provides support and space for components and also provides space for access and maintenance. The equipment in the building consists mostly of tanks, filters, demineralizers, pumps, and piping needed to store, process, and monitor potentially contaminated water. The major systems in the radwaste building are shown in Table 6.2.G.01-1.

Table 21 (6.2.G.01) -1 Major Systems installed in the Radwaste Building

Low-Level Waste Processing System	Low-Level Liquid Waste Processing System
	Low-Level Solid Waste Processing System
Materials Handling	

21.1.1.2 Suitable Environment for the System and Personnel

For a suitable environment, the following systems must be installed;

- materials handling system
- lighting, service power, and welding power
- fire detection, alarm, and suppression
- service fluid distribution system
- drainage systems
- grounding system
- heating, ventilation, and air-conditioning (HVAC) system
- access control and personnel escape system
- communication system

The materials handling system includes overhead crane located in the truck bay. The building shall be firmly connected to the site grounding grid. As the radwaste building will contain radioactive materials, access control is necessary. The other systems are usual for industrial buildings.

21.1.1.3 Confinement Boundary

All rooms in the building are related to the low-level waste processing system (LLWPS) that handles both liquids and solids contaminated with tritium and with other radioactive materials. Due to the possible release of these materials, all rooms in the radwaste building

are classified as green zone rooms (rooms with the potential for surface contamination). Thus, HVAC must provide confinement of the sources, to keep exposure to workers and the public within regulatory limits. The required confinement functions can be provided by assigning suitable leak tightness to the radwaste building boundaries, and maintaining the HVAC pressure gradients and exhaust stream monitoring. The vent detritiation system (VDS) in the hot cell building is connected to the radwaste building in the case of a tritium release accident.

21.1.1.4 Radiation Shielding

The amount of radioactive material in several rooms may be higher than normal for zone B. Thus, these rooms are assigned as zone C, and the walls and slabs to separate these rooms from zone B shall provide sufficient thickness. The exterior walls shall also provide a shielding function to reduce the exposure to the in-site workers and the public. During the movement of a cask with in-vessel component into the hot cell building, the radiation level is high such that the wall on the west shall be thick enough to mitigate the radiation to allowable level.

21.1.2 **Basic Configuration**

The radwaste building is a two-story building (with basement) and is adjacent to the hot cell building and connected to the hot cell building by a corridor which is used to transport canisters containing radwaste from the tokamak building or the hot cell, into the radwaste building. Most of the tanks are in the basement, and processing rooms are on the first floor. A local operations room is located on the second floor. The truck bay is on the grade elevation as a single story structure, but with the ceiling at the same level as the rest of the radwaste building.

21.1.3 **Interfaces**

The radwaste building has interfaces with the following WBS elements:

WBS	Title
2.6.P	Chilled Water Systems
3.2.F	Atmosphere Detritiation
4.3.C	Steady-State Electrical Power Distribution
4.5.A	CODAC
4.6	Interlocks System
6.1.A	Site General Layout
6.2.A	Tokamak Buildings
6.2.B	Hot Cell Building
6.2.G.02	Personnel Building
6.2.S	Utility Tunnels & Site Improvements
6.3.D	Low Level Waste Processing
6.4	Radiological and Environmental Monitoring
6.5	Liquid Distribution, including Water
6.6	Gas Distribution and Compressors
6.8	Plant Sampling Systems

21.2 Specific System Internal Requirements

21.2.1 Design

The requirements for the radwaste building are derived from the functions of the building. The requirements identified below are not complete as some equipment is still being developed. However, all the requirements which control the overall configuration and general design concept of the building have been identified.

21.2.1.1 General

21.2.1.1.1 Low-Level Liquid Waste Processing System

The building shall accommodate the low-level liquid waste processing system and provide the space for its operation. The system consists of three treatment chains, dirty waste water stream, clean waste water stream and soapy waste stream. Each stream includes treatment equipment and tanks.

21.2.1.1.2 Low-Level Solid Waste Processing System

The building shall provide space for the low-level solid waste processing system and provide the space for its operation.

21.2.1.1.3 Truck Bay

The building shall provide space for a truck bay to transport the dry waste. The truck bay shall also be used for a contractor waste treatment system. The building shall provide spaces for their operation.

21.2.1.1.4 Hot Laboratory

The building shall accommodate a hot laboratory.

21.2.1.1.5 Control Room

The building shall provide space for a local control room.

21.2.1.2 Seismic

The radwaste building is not safety importance class (SIC) but shall withstand SL-2 seismic conditions with peak horizontal and vertical accelerations as specified in the DRG1. The radwaste building HVAC systems which provide tritium control and confinement functions (i.e. maintain negative pressure) shall be classified SIC. The building shall be considered to have withstood these conditions if no damage occurs to SIC components that would impair their safety function.

21.2.1.3 Structural

21.2.1.3.1 Dead Loads and Equipment Load

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

21.2.1.3.2 Live Loads supported by the Walls and Slabs

The structure shall support the weight and forces of all movable and active components, systems, and structures supported by walls or slabs.

21.2.1.3.3 Lifting/Transporting Devices and Their Loads carried on Support Structures

The structure shall support the weight and forces of all lifted loads, including the lifting devices themselves, 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 External Hazard Loads

The structure shall resist the force exerted by seismic activity, wind, snow and soil and ground water pressure.

21.2.1.4 Nuclear

The radwaste building shall have a separate HVAC system and other appropriate controls to prevent the spread of radioactivity. Local shielding will be provided as needed.

21.2.1.5 Electrical

21.2.1.5.1 Building Lighting Service

The building shall provide appropriate permanently installed electrical lighting.

21.2.1.5.2 Building Electrical Service

The building shall provide low-voltage electrical service to all areas of the building where needs for this service are anticipated.

21.2.1.5.3 Building Electrical Grounding Grid

The building shall have an electrical grounding grid with firm 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

21.2.1.6.1 Potable Water and Sanitary Drainage

Potable water shall be supplied to the hot laboratory and the HVAC system. However, worker ingestion shall not be allowed.

21.2.1.6.2 Roof Drains

The radwaste building shall have roof drains that connect to the yard drain system.

21.2.1.6.3 Floor Drains

Floor drains within contamination control areas (i.e. all of the radwaste building) shall always connect to the low level radwaste systems.

21.2.1.7 Heating, Ventilation and Air Conditioning (HVAC)

All areas within the radwaste building shall be equipped with HVAC systems. Any areas which are assigned a confinement function shall be equipped with vent air decontamination capability to maintain negative room pressure in the relevant contaminated areas. The atmospheric decontamination capability for such areas shall be installed in the hot cell building.

21.2.1.7.1 HVAC Pressure Gradients

The building shall be constructed such that HVAC pressure gradients in the airflow system are in the opposite direction of the contamination gradients of the areas associated with the building. The HVAC system shall consist of the systems given in Table 21 (6.2.G.01)-1.

Table 21 (6.2.G.01) -2 Classification of HVAC

Group	Group 1	Group 2
Ventilation	HVAC	HVAC
Surface contamination zone	Green	Green
Exposure zone	B	B
ADS/VDS operation	Backup	Backup
Pressure, mbar gauge	- 1	~ 0

21.2.1.7.2 Temperature, Humidity, Particulates, Gaseous Contaminants

The radwaste 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. HVAC systems may include local air coolers if required for the heat removal for the equipment and for a significant residual heat from activated components. All areas should have temperatures in the range of 10°C and 35°C, and relative humidity in the range of 40% and 60%.

21.2.1.7.3 HVAC Subsystem Independence

The radwaste building HVAC systems shall be designed as independent subsystems for each of the major process areas, to limit the possibility of transfer of contamination between areas.

21.2.1.7.4 Leak Tightness

Areas which are possible to be contaminated shall have a maximum in-leakage of less than 100 vol%/day under negative pressure design conditions.

21.2.1.8 Fire Protection

The radwaste building shall provide passive and active fire detection, alarm, and suppression systems commensurate with the occupancy and fire risk loading of the building.

21.2.1.9 Instrumentation and Control

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.

21.2.1.10 Internal Communications

The building shall provide the necessary cabling and equipment to link specified locations in the building with plant communications networks such as telephones, local area computer network, CCTV, public address, etc.

21.2.1.11 Access Control

The building shall provide a system to control access to all rooms and spaces within the building. The system must be capable of allowing and recording single person ingress and egress with discrete signals to the central control room. The access control shall include an audio-visual alarm to warn of potential hazards or the need for evacuation. The alarm shall be activated automatically by zone breach or manually by push-button. Personnel monitoring and radiation protection procedures shall be used whenever workers cross zone designation boundaries. In addition, worker entry and exit from areas within normally accessible areas (A and B exposure zones) shall be monitored to assure appropriate responses to building evacuation events. The access control system must interface with the area radiation monitoring system to prevent re-entry into any area where alarms have been actuated by high radiation. The access control shall be provided with the necessary equipment to control worker access and to interface with the plant access control system.

21.2.1.12 Materials

21.2.1.12.1 Structural

All structural materials shall conform to usual building practice, the American concrete institute, and the uniform building codes.

21.2.1.12.2 Electrical

All cables will be made with copper and should have the 15 kV, 6 kV and 0.6 kV rated insulation voltage for 11 kV. 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.G.01) -3 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

21.2.1.13 Cranes, Lifts and Materials Handling

The building shall provide two overhead bridge cranes in the truck bay. The cranes will be sized according to the largest objects to be transported.

21.2.2 Operation and Maintenance

The operations and maintenance (O&M) requirements for the radwaste building are derived from the functions of the building.

21.2.2.1 Operation and Control of Building Services

Building 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 shall be provided for building cranes and lifting devices. Building systems with no safety or radiation control function (compressed air distribution, grounding, etc.) will be equipped with appropriate instrumentation and control to operate in a 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, none of these radwaste building systems will be directly controlled from the ITER main control room.

Fire protections systems shall be equipped with automatic controls with manual override capability. These systems will initiate alarms and signals which shall report the system status to the central control room. However, these systems will not be controlled directly from the ITER main control room.

Access control, floor drainage, and HVAC systems perform functions that are directly related to worker safety and release of radioactive material to the environment. These systems shall be equipped with instrumentation and control to enable active control from the main control room. When authorised, devices will also be operable from building control panels in the radwaste building. Door status indicators will be provided, and integrated with the control system for HVAC, so that different HVAC operating modes can be accommodated as required. The access control system will interface with remote handling transport systems, to assure that no workers are in unsafe locations when hazardous operations are initiated.

21.2.2.2 Maintenance of Building Services

There are no specific building system maintenance requirements. Operation of most systems will be interrupted for maintenance activities.

21.2.2.3 Specific Maintenance for Structures

The radwaste building materials which may be degraded by corrosion shall have prevention and control measures incorporated that shall be maintained over the life of the project including decontamination and decommissioning.

21.2.3 Surveillance and In-service Inspection

There are no surveillance and in-service inspection requirements for the radwaste 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 cranes and fire detection, alarm, and suppression systems, and the confinement of radioactive materials. Leak rates for various rooms will be continuously monitored and evaluated through the development and analysis of HVAC performance data.

21.2.4 Quality Assurance (QA)

The radwaste building shall be designed and constructed in compliance with the ITER QA program. The building is not SIC but seismic class, and shall be designed and constructed in accordance with “American Concrete Institute (ACI)-349” (or equivalent) and all the quality assurance and inspections contained therein, plus any additional requirements specified by the ITER QA program.

21.2.5 Reliability

21.2.5.1 Confinement Boundary Components and Equipment

Status of all boundary closure devices shall be instrumented. The radwaste building shall be designed to also support periodic functional testing at full or partial design pressure of confinement boundaries, per ASME section 11 (or equivalent). Functional testing shall include time to achieve closure, leak rate at pressure, and other parameters important to safety analyses.

21.2.5.2 HVAC Components and Equipment

HVAC systems shall be designed with sufficiently redundant installed components (filters, air handling units, and depression fans) to achieve all safety requirements and to allow continuing operation during maintenance. Reliability of these systems will be assured by continuous monitoring, control panel alarm response and a program of preventative maintenance.

21.2.5.3 Lifting Equipment

The radwaste building overhead crane and hoists are not redundant, and their reliability shall be assured only by specification, good design practice, and appropriate maintenance. Cranes shall be rated for continuous duty and shall be subject to continuous preventative maintenance programs. Lifting beams, slings, and other lifting aids will be subject to industry rules for periodic inspection, testing, and certification, similar to rules for instrument calibration.

21.3 Codes and Standards

The radwaste building, and all seismic class reinforced concrete structures will be built in accordance with the "American Concrete Institute (ACI) - 349 code" (or equivalent). Further, it 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.