

## 3.5 Miscellaneous Plant Systems

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The ITER plant has a number of miscellaneous systems that are required to support the operations of the plant, as categorised in Table 3.5-1.

**Table 3.5-1 Miscellaneous Plant Systems**

Category	System Name
<b>Personnel and Environmental</b>	
	Radiological and Environmental Monitoring
<b>Liquid Distribution</b>	
	Potable and Fire Protection Water
	Sewage (Sanitary & Industrial)
	Steam, Condensate, and Demineralized Water
<b>Gas Distribution</b>	
	Compressed Air
	Breathing Air
	Nitrogen, Helium and Other Special Gases
<b>Other</b>	
	Plant Sampling

### 3.5.1 Radiological and Environmental Monitoring Systems

#### 3.5.1.1 Functions

The radiological monitoring system is designed to monitor personnel, and plant areas, to protect people against exposure to ionising radiation.

The environmental monitoring system provides information suitable for monitoring compliance with environmental regulations applicable to the site.

### 3.5.1.2 Specific Functions

#### 3.5.1.2.1 *Radiological Monitoring System*

The radiological monitoring system for a generic site, according to present assumptions, provides the following specific functions:

- personnel dosimetry, for all radiation and contamination hazards appropriate for the radiation zones;
- dedicated radiation and contamination monitors, separate from others, which are located at strategic points in the ITER plant, and specified to remain functional during and after postulated accidents.

The latter are to provide an assessment of the conditions as part of an emergency preparedness program. In particular, air radiation monitoring is provided in all areas where tritium is handled, processed or stored. The tritium monitoring system in the plant gaseous exhaust is redundant and is designed to remain operable under accidents and loss of normal electrical power. It provides real-time indication of tritium releases. The sensitivity of the monitors enables the detection levels of tritium in air as low as  $10^{-6}$  Ci/m<sup>3</sup>.

#### 3.5.1.2.2 *Environmental Monitoring System*

The environmental monitoring system inside the generic ITER site provides a number of fixed environmental monitors, to monitor designated gaseous and aqueous pathways to the environment. These measure the following:

- airborne tritium (oxide and elemental);
- aqueous tritium oxide (tritiated water);
- airborne and aqueous neutron activation products;
- airborne beryllium;
- CO<sub>x</sub>, NO<sub>x</sub> emissions;
- hydrocarbon emissions;
- suspended solids;
- other hazardous/radioactive materials in the ITER plant.

The environmental monitoring system is designed to demonstrate that radiation and/or contamination releases to the environment are within the requirements established.

#### 3.5.1.2.3 *Testing Requirements*

All monitors have the capability of being tested in-situ. If the monitor has a circuit which actuates equipment or alarms, these functions have a bypass and “return-to-armed” capability such that unwanted alarms and actions during testing are avoided.

#### 3.5.1.2.4 *Operations/Maintenance Requirement*

Monitored data is transmitted to the CODAC system via a dedicated network.

## 3.5.2 **Liquid Distribution Systems**

The liquid distribution systems include:

- potable and fire protection water;
- sewage (sanitary & industrial);
- steam, condensate, and demineralized water.

### 3.5.2.1 Potable and Fire Protection Water

The potable water system distributes water suitable for human consumption, provided by the host to the site in quantities suitable for up to 1,000 persons. A reserve tank holds capacity for up to 3 days of normal use. About 10 per cent of the capacity is reserved for fire protection water. One day's usage is based on the widely used "rule of thumb" 380 ℓ/d/person. This translates to 380 m<sup>3</sup>/d, and a storage tank volume of 1,250 m<sup>3</sup>.

A distribution system for pressurised, plant-wide fire protection water distributes water supplied by the host to the site. The fire protection system provides the following specific functions:

- it provides a flow rate of 0.4 m<sup>3</sup>/s at a pressure of 1 MPa;
- it is configured as two independent feeds, so that water can be delivered at any point by at least two independent means - routing is such that leaks will not imperil systems important to safety;
- it is designed to withstand earthquake level SL-0.

The fire protection system is designed with sufficient redundancy to allow the maintenance of all active components without removal of the entire system from service, and without incapacitating the ability of the system to perform its function.

### 3.5.2.2 Sanitary and Industrial Sewage

The sanitary and industrial sewage system is designed to collect the sanitary and industrial drainage from the ITER plant and feed it to the sanitary and industrial sewage treatment system to be provided by the host. The industrial sewage system is designed to include coarse separators to provide a discharge quality satisfactory for the treatment system. However, should the host require additional treatment of filters, precipitators and/or ion exchange equipment in order to provide the necessary quality, those would have to be added outside the scope of the ITER plant design.

### 3.5.2.3 Steam, Condensate, and Demineralized Water

The steam and condensate system supplies and distributes saturated steam at 0.5 MPa, to components, systems and areas within the plant which require auxiliary or area heating, and collects and returns condensate to the steam-making equipment in the site services building. The steam condensate system uses carbon steel piping. Preliminary estimates of steam requirements are given in Table 3.5-3.

The demineralized water system supplies and distributes deionised water to be used directly for process purposes or as makeup to all other ITER closed cooling water loops. The deionised water system provides a maximum flow rate of 300 m<sup>3</sup>/d at pressures ranging from 0.2 to 1 MPa. The system is designed with stainless 304 steel.

**Table 3.5-3 Steam Load List (Preliminary)**

<b>Interfacing Systems</b>	<b>Required Heat kW(t)</b>	<b>Steam Flow kg/h</b>	<b>Remarks</b>
Tokamak Complex Buildings	4,576	7,075	HVAC use
Hot Cell Building	1,307	2,020	HVAC use
Radwaste Building	279	431	HVAC use
Personnel Building	43	67	HVAC use
Cryoplant Compressor Building	268	415	HVAC use
Cryoplant Cold Box Building	299	462	HVAC use
During PF Coil Fab. in Cryoplant Buildings	2,509	3,880	HVAC use
Magnet Power Supply Building	144	223	HVAC use
Magnet Power Conversion Building	331	511	HVAC use
Laydown, Assembly & RF Heating Building (and Tokamak Crane Hall)	534	826	HVAC use
NB Power Supply Building	8	12	HVAC use
Emergency Power Supply Building	102	158	HVAC use
Laboratory Office Building	298	460	HVAC use
Control Building	174	270	HVAC use
Site Services Building	335	517	HVAC use
Water Detritiation		3,150	Process use
Freeze Protection etc.		5,400	Equipment Protection
Distribution Loss ~ 10%		3,015	
<b>Total</b>	<b>12,133</b>	<b>30,424</b>	

### 3.5.3 Gas Distribution Systems

The gas distribution systems include:

- compressed air;
- breathing air;
- nitrogen, helium and other special gases.

#### 3.5.3.1 Compressed Air

The compressed air system is designed as a distributed system comprising compressors, receivers, dryers and other equipment needed to meet the air specifications for the specific equipment or personnel needs that it serves. An independent compressed air subsystem will be designed, if appropriate, for each of the following combinations of buildings:

- tokamak and tritium;
- hot cell, radwaste and personnel;
- cryoplant, emergency power supply;
- site services and control;
- magnet power supply.

The compressed air system satisfies the following specifications.

- the capacity of each independent subsystem is greater than 10 m<sup>3</sup>/min (STP) and less than 50 m<sup>3</sup>/min (STP).

- all subsystems which provide instrument air are designed to provide air with less than 10 ppm oil content.
- all subsystems are designed to provide high pressure (590 kPa to 865 kPa) and low pressure (270 kPa to 450 kPa) air.

The gas distribution system is designed such that all gas taps on the distribution system have check valves to isolate the tap from the distribution system if the gas pressure applied to the tap is greater than the distribution system pressure. This is to protect users' systems against overpressure.

#### 3.5.3.2 Breathing Air

The primary function performed by the breathing air system is to supply and distribute "breathing quality" compressed air to enable personnel wearing plastic suits or respirators to enter and work in contaminated or potentially contaminated areas of the ITER plant. With plastic suits, about 80 percent of the air is used for suit cooling with the balance used for respiration. Breathing air is also used by workers wearing respirators when entering enclosed work locations without adequate ventilation. The function is accomplished by compressors, air receivers, air dryers, air distribution, filters and other equipment needed to meet the requirements. The breathing air system is required to perform this function during normal plant operating and shut-down conditions.

An important feature for the function of the breathing air system is that it must not be connected in any way to the plant compressed air systems.

Breathing air is supplied on an entire ITER plant basis at a nominal pressure of 520 kPa(g). The single, centralized system of compressors with a distribution system is justified on an economic basis. The duplication of breathing air system components and controls is minimized. The breathing air system equipment is located in the site services building (Figure 3.6.1-1, building 61). The main distribution headers distribute breathing air to the complex of buildings which are the tokamak, hot cell, radwaste and tritium buildings. Each of these buildings is supplied by a separate distribution system from the main distribution header.

For access to areas that are too far away to connect into the distributed breathing air system, or for when the air compressors are not running, bottled breathing air is provided in addition to the plastic suits.

#### 3.5.3.3 Nitrogen, Helium and Other Special Gases

The primary function performed by this system is to provide nitrogen, helium and other gases for equipment and other plant needs.

Currently, all needs for special gases are small, such that a single central distribution system is not economical. Rather, the special gas system will consist of primarily "multi-bottle stations" located near the point of use. The stations have regulators and pressure monitors to assure safe and reliable delivery to the user. There is a large "multi-bottle" station adjacent to the tritium building, along the east wall.

For the very large volumes of helium in the cryoplant, dedicated storage tanks and distribution lines are provided by the cryoplant and the cryodistribution system.

### 3.5.4 Plant Sampling Systems

#### 3.5.4.1 Functions

The function of the plant sampling systems is to collect and evaluate the chemical and radiological attributes of key plant systems samples. The plant sampling system is designed to obtain samples for chemical and radiological analysis, so as to provide supporting operational information for the process systems of the ITER plant.

#### 3.5.4.2 Configuration

##### 3.5.4.2.1 *General*

Two separate laboratory analysis sub-systems, within the plant sampling system, are located in separate facilities to avoid cross contamination. The first sub-system, “hot” laboratory analysis, will be capable of handling radioactive samples in solid, liquid or gaseous form. The second sub-system, “cold” laboratory analysis will handle non-radioactive samples including potentially hazardous chemicals in solid, liquid or gaseous form.

Both sub-systems are designed to be available on demand such that no maintenance or operations activity will be delayed beyond the minimum practical sample processing time. Routine samples that may be safely contracted to outside laboratories will be routed to the off-site laboratories only if such action is cost effective.

##### 3.5.4.2.2 *Beryllium*

Special attention is required for the handling and the control of materials containing beryllium. Components with Be surfaces, such as blanket modules, will first be handled in the hot cell area during machine assembly. These Be-containing components will be received in the hot cell area and a temporary Be analysis laboratory will be set up close to the hot cell building, or in a separate area of the hot cell building, so as to avoid cross-contamination, to analyze samples from smears and from sample air filters to determine the presence of airborne Be. The permanent Be analysis function will be combined with the hot laboratory functions in the radwaste building once that portion of the radwaste facility is available.