Utilities

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In January 1988, the Japan Atomic Energy Research Institute(JAERI) and the Institute of Physical and Chemical Research(RIKEN) concluded the "Agreement on Cooperation for Research and Development of Large Scale Synchrotron Radiation Facility (SPring-8)" and in October 1988 formed the SPring-8 Project Team in order to further promote closely their cooperation in the R&Ds on SPring-8.

In June 1989, the Science and Technology Agency of the Japanese Government (STA) selected Harima Science Garden City, Hyogo Prefecture as the SPring-8 site. The Harima Science Garden City is located in the inland, a southwestern part of Hyogo Prefecture, which are hills at the elevation of 250 to 350 meters extending over three counties and three towns (Shingu-cho, Kamigori-cho and Mikazuki-cho). This City is newly developed and has the area of approximately 2000 hectares.

The SPring-8 site has been developed according to the master plan determined through concrete negotiations with the Public Enterprises Agency, Hyogo Prefectural Government, based on the plot plan of SPring-8 prepared by the SPring-8 Project Team. The site has an area of approximately 141 hectares and the flat area is about 78 hectares. The site is divided into several zones according to altitude; e.g., an injector system area, a storage ring area, a medium-long beamline area, an area for the future facilities, and a management and welfare area. For construction work of the facility between JAERI and RIKEN, JAERI is in principle responsible for all of the work except for that related to the storage ring building.

In September 1990, the "SPring-8 Harima Administrative Office" was established in the Harima Science Garden City, then the concrete discussion was initiated on construction, fire fighting, and public utilities such as electricity, water supply, drainage and gas. The orders for construction of the beam transportation line (from the synchrotron to the storage ring), trunk roads, rainwater drainpipe canal, and main pipes (for electricity, water supply and drainage, extinguishment and gas) were placed, adjusting the consistency with the new city development plan including the compliance with the urban design guideline by Public Enterprises Agency, Hyogo Prefectural Government (hereinafter, called ADG); "A City Growing up with Time, in the Woods" is the theme for building the town.

In May 1992, the construction started fullfledgedly at the site, and in October of 1992 the "SPring-8 Construction Office" was set up at the site in order to proceed with the construction smoothly and still exists now. With the large supplementary budgets for fiscal 1993 and 1995, the construction work reached its peak at the end of fiscal 1994, and the entire facilities are to be completed in fiscal 1997.

Injector System Building and Infrastructure

Injector System Building

The injector system consists of an 140-meter linac (which accelerates electrons emitted from an electron gun to the energy of 1 GeV), a synchrotron (an oval-shaped accelerator with a circumference of 396 meters which accelerates the electrons from the linac to 8 GeV and injects them into the storage ring) and its annexed components.

The injector system building consists of a tunnel-shaped structure (herein-after, called a tunnel, which stores the linac and the synchrotron) and a building in which their annexed components are installed. The entire injector system building has a shape of "d" in plane, the straight-line portion is the linac building and the remaining portion forming a ring is the synchrotron building. The area surrounded by the ring of "d" is raised with fill to be almost at the same ground level as the storage ring building for easy access to relevant rooms such as an local control room.

The tunnel is made of reinforced concrete from the viewpoint of radiation shielding capability. The thickness of the shielding is 4 meters at maximum in the linac building and approximately 1.3 meters in the synchrotron

building, of which inside cross section is 3.8 meters in width and 3.5 meters in height. The total length of this building is 600 meters.

A very firm ground at the site enables the installation of the tunnel on the ground surface and facilitates the expansion of the facility in the future. For the portion of tunnel exposed to the outdoor air, an external insulation method is employed to restrain structural transformation by the temperature change due to weather. The other buildings are mainly steel-frame buildings, where steel sandwich panels are employed to reduce the air-conditioning load and to unify the architectural designs.

The total length of the tunnel for the accelerators including the storage ring is approximately 2,400 meters. The accuracy of the relative position among these buildings is less than ±25 millimeters. The reference points for installing the linac and synchrotron were set up with a precision of ±2 millimeters

Electrical Facility

Electric power comes in an electricity room of the heat source building through two high voltage lines of 6.6KV (for commercial and emergency) from the second substation for extra-high voltage, and is supplied by groups of transformers with the each capacity of 2.3 MVA installed in this room. The trunk systems consist of an experimental board system, an air-conditioning and ventilating system and two high pressure refrigeration systems.

There are six earth points for class -1 grounding with deep burial method. One of them is for the body of the linac and the synchrotron; a copper ground bus is installed along approximately 750 meters in the tunnel and the klystron room to obtain lower impedance .

An uninterruptible power system is installed at a common building to back up the power supply for the injector system control at an interruption of commercial power supply. Startup and shutdown, state monitoring of the power receiving/transforming equipments and monitoring of the power supply system for the building are performed by a central monitoring panel in the control equipment room.

General Facilities

As for air-conditioning of the injector system building, there are many units of air-conditioners with cold water coils and electric heaters, packaged air-conditioners with air-cooled heat pumps and exclusive fan-coil units for air-cooling. They are appropriately operated according to the indoor conditions.

The exclusive fan-coil units are installed in order that each of them can deal with a local heat load generated accelerator components because the indoor temperature conditions are very tight for the accelerator as a combination of precision electrical components though the heat generation from them are so large. In addition, an exhaust system is installed in the tunnel portion according to the "Radiation Injury Prevention Law," and a waste water tank is installed in the drainage system.

Extra-High Voltage Transforming Stations

Extra-High Voltage Switchyard

The power of 77 KV, 3 phases and 60Hz is received through an underground cable system with two lines of a main and a spare from the Technopolis Substation of Kansai Electric Power Company. They are transmitted to the extra-high voltage first substation and the extra-high voltage second substation respectively through an underground cable system with one line.

Extra-High Voltage First and Second Substations

The first substation transforms the power to 6.6 KV by transformers (20MVA x 3 units) to supply it mainly to four transforming systems in the storage ring building and the equipments of the water supply system building.

The second substation transforms the power to 6.6 KV by transformers (25MVA, 6MVA, 5MVA) to supply it for the injector system building and the drainage treatment facility. At both substations, phase condensers for power-factor improvement and auxiliary high voltage

feeder boards are equipped.

Emergency Electric Power Generation System

The emergency electric power is connected to the loads such as uninterruptible power systems, emergency lighting for each building and extinguishment equipments.

This system is a gas turbine generator of 2,000 KVA and can build up the voltage within 40 seconds after the loss of power in commercial lines. The load capacity which can be put into this system for once is up to 1,800KVA at maximum and loads are automatically put into at two-second intervals in the sequence of urgency.

Other Buildings

A water-receiving tank, a pump room, a power source room and a monitoring panel for the extra-high voltage switchyard are installed in the water supply system building. The outward appearance is made with the design modifying a shape of the tunnel (ratchet shape) for taking out synchrotron radiation as the building is located close to the main gate and visitors would easily get their own image of SPring-8.

A house for security guard at the main gate is utilized as a place for guiding general visitors and for waiting for people. The plane of the building is round, and its outward appearance looks symbolic of SPring-8 by taking in sun light through a curtain wall made of transparent glass and contrasting it with the water supply system building.

The building of the experimental drainage treatment system is also used as a preliminary depository for solid wastes.

Other Facilities

The water is separated into tap water and water for industrial use. It is supplied from the Nishi-harima Kogen Water Supply of the Nishi-harima Kogen Business Entity for Water and Sewage Service. The water is received at the water-receiving tanks in the water supply system building and is distributed to each facility by a pump pressurizing method. The planned maximum water supply is approximately 3,000 cubic meters per day.

The drainage contains rainwater, waste water (including blow down water of cooling towers) and experimental drain. Among these, the experimental drain is treated at the harm removal facility with treatment capability of 250 cubic meters per day (flocculation + sand filtration + activated charcoal adsorption), then it is discharged with the waste water and finally treated at the Nishi-harima Kogen Purification Center.

In addition to the extinguishment equipments of each building, 40-cubic-meter water tanks for extinguishing fire and outdoor fire hydrants are distributed at the key points of the site. Town gas is supplied from the satellite base of Osaka Gas to be constructed in the north side of the SPring-8 site. Gas meters and governors are installed in the water supply system building. The gas is mainly used for air-conditioning of the storage ring building.

Development of the Surroundings

The landscape design of Harima Science Garden City is carried out based on the ADG. Likewise, in SPring-8, planting at the development areas and development of roadside trees along the trunk road are in progress, referring to the ADG Landscape Improvement and Planting Plan.

Storage Ring Building and Infrastructure

Storage Ring Building

The storage ring is a facility, which stores the electrons injected through the underground tunnel with the accelerated energy of 8 GeV by the injector system in the circular orbit with a circumference of 1,436 meters, and performs various experiments by utilizing the synchrotron radiation. Klystrons which feed power for compensating the energy loss by

radiation of electrons are arranged at four points.

The storage ring building takes the shape of a doughnut leaving the summit of Mt. Miharakuriyama 350 meters above sea level in its center. Its installations are arrayed in the sequence of experiment preparation rooms, an experimental hall, an area for accelerator storage and a passage for maintenance, from the outer circumference side. In addition, respectively at four points of the internal circumference side there are buildings which store klystron devices and the systems related to power source, air-conditioning and machine-cooling (cooling for the storage ring and experimental facilities).

The main structure is as following. The system of electromagnets along the electron orbit is enclosed by the tunnel of reinforced concrete with a thickness of one meter from the viewpoint of shielding effectiveness. The tunnel is covered with a steel-frame protective covering. Its diameter is approximately 450 meters and its height is approximately 11 meters, and the total floor space is approximately 73,000 square meters.

The storage ring tunnel is closely fixed on solid rocks and is built as an independent structure irrelevant to the other buildings by making an expansion in order to avoid the effects such as vibration and transformation from the other parts as much as possible because a position of radiation light at a target station could be much enlarged even by a slight vibration.

In the storage ring tunnel, the temperature is controlled by air-conditioning. The insulating materials are used in the roofs and walls to reduce the air-conditioning load because a slight transformation of component due to temperature change could cause a trouble.

Electrical Facilities

There are electricity rooms at four points in the ring building, each of which is supplied with the power of 6.6 KV from the extra-high voltage first substation. The power of 6.6 KV is decreased to 400V, 200V or 100V according to the usage, then it is supplied to each load. The electric systems of each electricity room are divided into the machine related ones and the building related ones; the former means power sources for the accelerator and experiments and the latter for utilities such as lighting and air-conditioning.

Remote monitoring and operation of power source systems, air-conditioning systems and other utility systems and monitoring fire alarms are conducted by a CRT of the central monitoring room.

As a measures for the interruption of commercial power supply, batteries for emergency lighting and operating a circuit breaker, and a CVCF device with built-in batteries for central monitoring devices and computers are prepared.

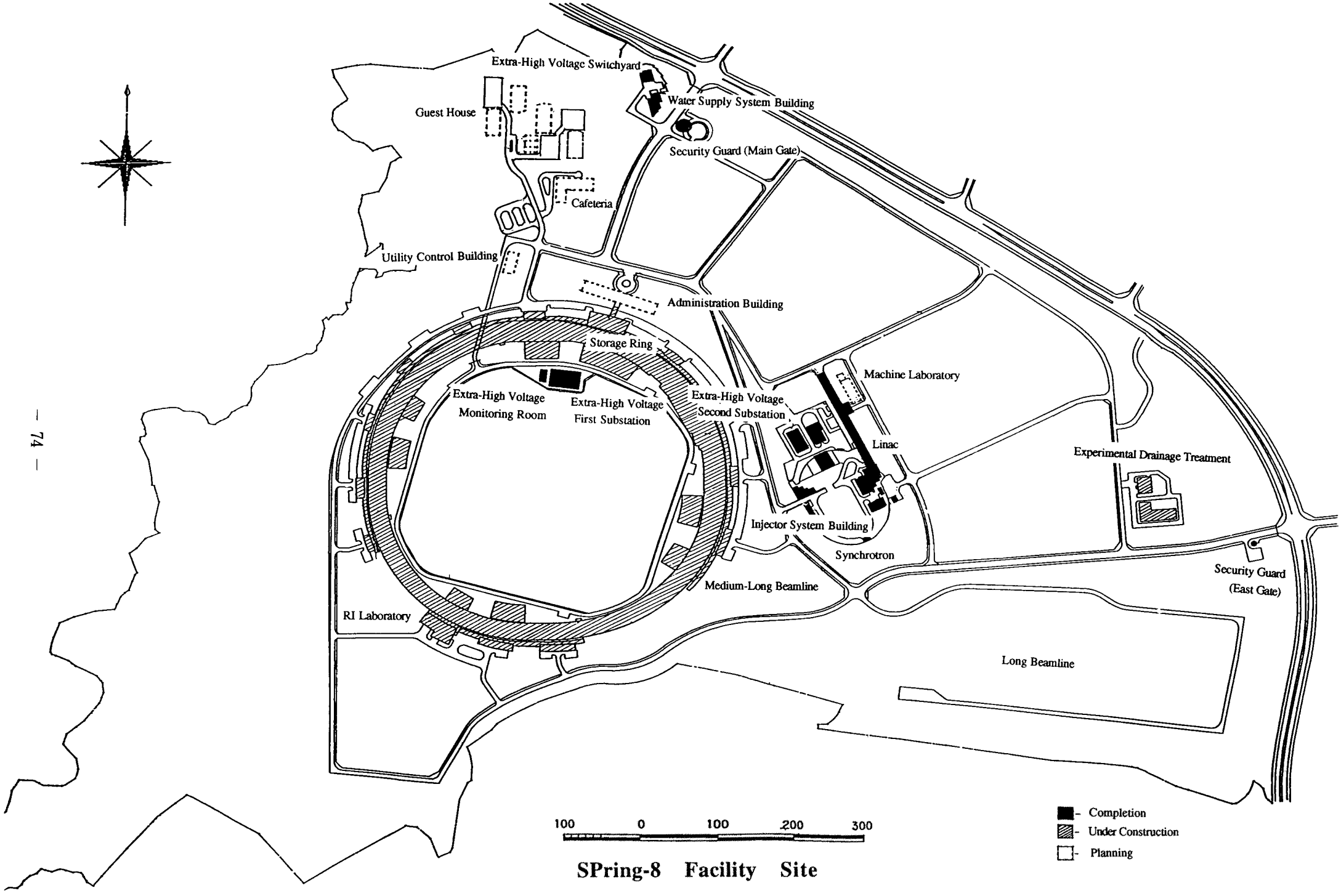
General Facilities

As the storage ring building is extending over a circumference of 1,436 meters, the heat source equipments are divided into four systems from A to D. In order to meet 24-hour continuous running of the machine-related components, each system consists of the following components installed in consideration of possible failure.

- Cold and hot water generator with burning gas 150 USRT × 2 units
- Heat pump using air heat source 265 USRT × 2 units
- Heat pump using water heat with heat recovery 105 USRT × 2 units

The temperature conditions of the storage ring tunnel are strictly decided to be 27 ± 1 °C with 50 % humidity throughout a year, so the temperature is controlled by 370 units of fan coils and 8 units of air-conditioners treating outdoor air.

The storage ring tunnel is designated as a radiation control area, so the exhaust air is treated by sealed exchange filter units under negative pressure .



SPring-8 Facility Site