Utility Management

1. Introduction

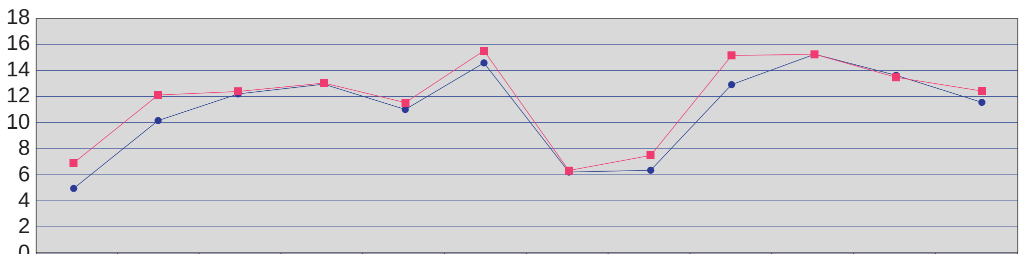
The Facilities and Utilities Division (henceforth 'the Division') supports synchrotron radiation application research by ensuring safe operation of the SPring-8 facilities and maintaining their stable and reliable operation. The Division is mainly engaged in maintaining operation of the utilities, machine cooling system and related facilities as well as in controlling waste, chemical substances, etc. The utilities include systems for supplying electric power, water and gas, air-conditioning system, fire-extinguishing system, broadcasting system, telephone network system and buildings in the complex. The machine cooling system includes the cooling systems of the types of Linac (Linear Accelerator), synchrotron, storage ring (SR) and frontend. The Division maintains and controls all the other facilities associated with SPring-8 such as the experimental sewage treatment facility, radioactive isotopes treatment facility and cafeteria. The Division is also entrusted with operation and maintenance of the utility facilities and machine cooling systems of New SUBARU (Synchrotron Radiation Facility) constructed by the government of Hyogo Prefecture.

In 1999, the Division improved the machine cooling system and fire-extinguishing system, implemented the frontend cooling system installation works, carried out preparatory works for accepting a Russian-made superconducting wiggler, and developed a mechanism for waste control, while systematically managing the operation and maintenance of the facilities under its control. For rationalization of its duties, the Division worked on three projects for software improvement: a study on a system expansion of the chemicals management program, a preliminary research for the drawing management program system and the introduction of cost integration software for construction works named "RAIDEN". In terms of safety, the Division reviewed the state of facility management under the instruction of the President, in the wake of the JCO criticality accident. As part of its international cooperation activities, the Division held a technical meeting with the delegates of the Shanghai National Synchrotron Radiation Center (SSRC) and the Synchrotron Radiation Research Center of Taiwan (SRRC).

2. Electricity, Water and Gas

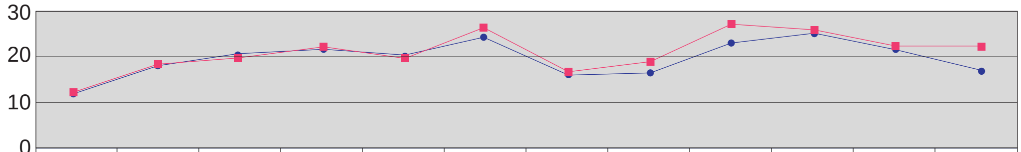
The total electricity consumption in 1999 was 141 GW•h, 7% up from 132 GW•h in the previous year. This increase mainly comes from the approx. 3% increase in the operating hours of the SR accelerators and the launch of full-scale research activities at the Structural Biology Experimental Facility, etc. Fig. 1 shows the electricity consumption in 1999 as compared with the previous year. The electricity consumption declined in summer because the operation of the accelerators was suspended for system inspection and upgrading. It should also be noted that electric power companies ask its major customers to restrain their operation and reduce their huge power consumption in summer, when the national electricity demand reaches its peak. The SPring-8 operation plan is in line with this request, and we were able to restrain our operation relatively easily. Owing to the reduction in our power consumption, coupled with the discount rate offered to the users who responded to the request, we managed to save electricity charges.

The total water consumption in 1999 was 253 km^3, approx. 8% up from the previous year. Approx. 86% of this was for industrial use; mainly used in the machine cooling system and cooling towers of the air-conditioning system. The increase in industrial water consumption mainly comes from an approx. 70% increase over the previous year at the Structural Biology Experimental Facility and approx. 25% increase at the Storage Ring Facility. As will be explained below, the total sewage discharge showed no marked increase from the previous year. The increase in industrial water consumption, therefore, may be considered mainly due to water evaporation from the cooling towers. Fig. 2 shows the water consumption in 1999 as compared with the previous year.



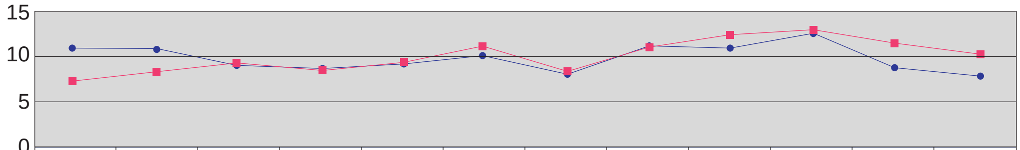
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998's	5.13	10.105	12.387	13.097	11.063	14.596	6.148	6.322	12.832	15.342	13.441	11.51
1999's	6.884	12.044	12.512	13.175	11.679	15.33	5.943	7.463	15.192	15.343	13.124	12.51

Fig. 1. Consumption of Electricity (GWh/Month)



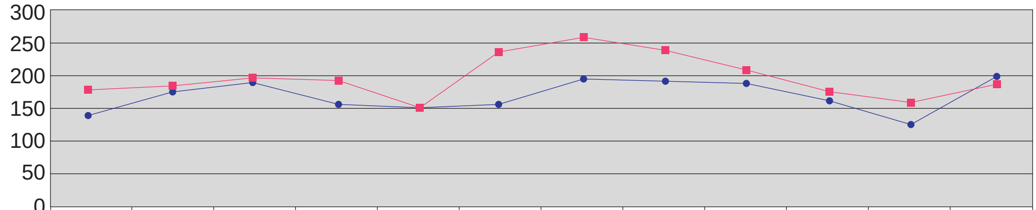
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998's	12.492	18.047	20.655	21.414	20.542	24.086	15.88	16.198	23.128	24.346	21.638	16.686
1999's	12.696	18.659	19.989	22.566	19.707	26.408	16.555	18.76	26.888	25.661	22.838	22.49

Fig. 2. Consumption of Water (Km³/Month)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998's	10.898	10.693	8.924	8.678	9.65	10.223	9.17	11.238	10.77	12.013	8.902	7.452
1999's	7.315	8.388	9.107	8.434	9.818	11.115	8.789	11.08	12.175	12.383	10.906	10.072

Fig. 3. Consumption of Sewage (Km³/Month)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998's	139.396	177.113	185.933	158.319	148.956	154.097	195.509	193.072	182.077	160.155	126.284	198.459
1999's	177.712	187.102	194.246	190.0861	147.788	232.667	258.714	234.047	210.493	176.988	161.188	178.897

Fig. 4. Town Gas of Consumption (Km³/Month)

The total amount of sewage discharge in 1999 was 120 km³, showing a little less than 1% increase from the previous year. Fig. 3 shows the amount in 1999 as compared with the previous year. The amount of sewage was approx. half the amount of water consumption because the remaining half evaporated from the cooling towers. The experimental sewage discharged in the process of research activities is specially controlled, separate from household sewage. The chemicals and the water used for cleaning chemical containers up to twice are not drained but stored and handed over as specially controlled industrial waste to a specialized waste disposal company. The water used for cleaning the containers for the third time or thereafter is discharged as experimental sewage. The experimental sewage is delivered from respective laboratories to the Experimental Drainage Treatment Facility, where it is physically and chemically treated, and temporarily stored in the treated water storage tank. Before releasing the treated water to the municipal sewage system, we analyze the water quality, confirm that it meets the set criteria, and obtain approval from the municipal waterworks office. The experimental sewage accounts for approx. 5% of the total sewage.

Gas is mostly used for absorption chillers of air-conditioning system. The gas consumption in 1999 was 2, 350 km³, approx. 16% up from the previous year: 6% of this increase comes from the consumption increase at the Structural Biological Facility, and the remaining 10% comes mainly from the consumption increase at SR. Fig. 4 shows the gas consumption in 1999 as compared with the previous year.

3. Operation and Maintenance

3.1 Operation and Daily Service

Based on the SPring-8 Master Schedule, the Division draws up the annual plan for the operation and daily maintenance of the facilities under its control to ensure they stay in good condition. The Division was able to maintain safe and stable operation of the facilities under its control without any significant trouble throughout the year.

To ensure stable operation of the facilities, the Division carries out a round of inspections of the facilities, while the operators constantly monitor running condition of the machines at the Facility Monitoring Center. The staff at the Center work in three shifts. Highly accurate temperature control and maintenance of coolant purity are required to maintain synchrotron radiation quality and to protect accelerator systems. The machine cooling system is, therefore, designed to control these parameters accurately. Furthermore, external factors that would affect the coolant control are monitored and necessary measures are taken if necessary, based on the past experience in operation. For example, we made fine adjustments of the operating conditions by setting the control values of the equipment according to seasonal changes in atmospheric temperature and humidity.

The maintenance and control of the facilities basically consist of periodic inspections, which are systematically carried out according to the annual plan. The inspection data are stored in the database so that they can be used for improving the future maintenance of the facilities. Periodic inspections and repairs are carried out not only in the facilities related to the accelerators but also in all the other facilities and buildings on the SPring-8 site. To maintain amenity in its living space, small repairs and services of the buildings and structures are carried out on the site, as well as regular inspections and operation monitoring. For instance, 220 sets of filters of the air-conditioning system were cleaned or replaced in the rooms of the Main Building, and approx. 1,600 light bulbs were replaced in the SR experimental hall.

The pending issues include the automatic fire alarm sounding a false alarm and ground water springing on the premises. We will follow up these issues in due course. In the Linac facility, synchrotron facility and SR facility, the operation of accelerators must be immediately stopped at the sound of a fire alarm even if it is a false one. It is a hindrance to synchrotron radiation application research works. In 1999, there were eight false alarms on the whole site, including one causing the accelerator to stop. The Division will check whether the type of the automatic fire alarm is suitable for the environment in which it is installed and take necessary measures to reduce false alarms.

3.2 Regular Inspection

In accordance with the annual plan which was drawn up at the beginning of the year, the Division carried out mandatory and voluntary regular inspections on the facilities and equipment under its control. Mandatory inspection is carried out on electric and fire-extinguishing system, cranes and elevators, etc. Items such as voluntary inspection is carried out on the equipment which is not subject to mandatory inspection but may hinder, if it fails, the operation of accelerators. Automatic controls of air-conditioning equipment, absorption-chillers, coolant pumps, feed water pumps are inspected voluntarily. The frequency and details of inspection depend on each equipment or unit. The Division intends to draw up a long-term plan covering all the equipment in order to carry out the inspections systematically without any omission.

4. Facility Management Program System

The Division is currently building a program system for achieving its objective in an efficient manner. This system is planned to be used not only in our Division's activities but also in other divisions' maintenance and upgrading operations for accelerators and beamlines. The Division plans to improve and expand the system, which will eventually consist of an operation management program system, a drawing management program system, etc.

4.1 Operation Management Program System

The Operation Management Program System was completed at the end of 1998, and has been used in practice. This system was developed for the purpose of effectively managing the operation and maintenance of many and diversified facilities and equipment under the control of the Division. The inspector carries a portable terminal (lap-top computer) on a daily inspection around the site or formal periodic inspection, and enters all the inspection data into the computer. The inspection data collected this way will then be transferred to a server computer and constitute a database. In addition to these data, the data of the subsystem, which is incorporated in this system and supports the preparation of equipment registers, monthly and daily reports on operation and servicing records, etc., are analyzed, as well as the data recorded by the existing monitoring system. The results of such analysis are utilized for improving the quality of operation management. After expanding the program for new buildings and equipment, maintenance data of these facilities will also be incorporated into this system in due course.

4.2 Drawing Management Program System

A preliminary study was carried out to build a "drawing management program system" for effective utilization of drawings and equipment registers. The objective of the study was to specify the contents and their quantity to be incorporated in this system, and the data to be shared with the operation management program system and data to be shared with other divisions. Taking the results of this study into consideration, the Division will develop this system from next year.

5. Repair and Improvement

The Division carried out various repairs and improvements, e.g. installing additional switchboards that became necessary due to increased activities in synchrotron radiation application research, improving the machine cooling system to rationalize its operation, taking measures against wear and tear of the equipment and setting up safety pathways in view of industrial safety.

5.1 Improving the Machine Cooling System

To stabilize further the temperature of the machine cooling system of the SR, the temperature control method of the secondary cooling system was improved. The temperature of the secondary cooling system is controlled at the cooling tower by opening and closing its damper. The conventional on/off control was modified to a type which can regulate the opening at any degree to attain more accurate temperature control. As a result of this improvement, the secondary coolant temperature fluctuates only within ±0.3˚C, and the primary coolant temperature can be controlled at the stabilized range of ±0.1~0.2˚C, both of which meet our original targets.

5.2 Anti-Corrosion Measures for Chillers

Chillers are installed for the secondary machine cooling system of the SR facility. A chiller consists of a compressor, condensor and cooler. In June, 1998, it was discovered that Freon gas was leaking from the cooler tubes of this chiller. The number of coolers with gas leakage later increased and reached nearly half the total number of units installed (total 18 units). The overhaul of the leaking cooler revealed that the leakage was caused by corrosion of the cooler tubes. The Division investigated into the cause of corrosion with the help of corrosion specialists and the manufacturer. The corrosion mechanism is identified as follows: a substantial amount of scale containing iron rust was generated by the activity of free carbonic acid and dissolved oxygen in the coolant. This scale accumulated at a part inside the cooler body where the flow velocity is relatively slow. The scale that accumulated on the surface of the copper tubes formed a concentration cell, which caused electrochemical corrosion of the tubes' wall and made a hole penetrating the tubes. In response to this investigation result, we cleaned the water tank of the cooling system, implemented design modification of the inner structure of the cooler body so that it can be cleaned easily, produced an improved type of coolers, and replaced those 8 units which were heavily corroded with new ones of this improved type. The Division is further examining ways to extend the product life, e.g. regular cleaning, chemical treatment etc.

5.3 Investigation on Vibration

The electron beam of the SR is sufficiently stable, even by the international standard. For use in advanced synchrotron radiation application research, however, we aim to realize even more stable electron beam. The Accelerator Division and others concerned are now investigating to pinpoint and eliminate the cause of the subtle vibration of approx. 10 nm currently observed. The Facilities and Utilities Division examined the vibration characteristics of the rotating machinery and investigated the way the vibration is transmitted. In this examination, the vibration was measured in four different operation modes: 1) when all the cooling and air-conditioning systems are operating, 2) when part of these systems are stopped, 3) when all these systems are stopped, and 4) when only the air-conditioning systems are operating. The result showed that the vibration generated from the coolant pump was transmitted to the ceiling of the SR tunnel via the pipes and water flow, and then affected the electron beam via the concrete structure. This data along with other factors will be analyzed by the Accelerator Division and will be used for devising future anti-vibration measures.

5.4 Frontend Cooling System Construction

The heat load of the frontend system is now more than originally planned since the performance of the insertion devise has been improved. Currently, the frontend cooling system is used within a common system with the electromagnet and the vacuum system. After the work currently under way, a new cooling system for the frontends use only will be installed, separate from the original one [1,2]. This will reduce the disturbance of coolant temperature by the SR electromagnet system, stabilize the electron beam, and can also enhance the cooling capacity. This work is considered essential for making the most of the quality of the insertion device which is extremely bright and has excellent directionality. This work started in December, 1998, and is scheduled to be completed in August, 2000. The work is to be divided into two phases. SR Blocks A and D, where more beamlines are installed, were designated as Phase I, and Blocks B and C as Phase II. Phase I was completed on August 19, 1999. Phase II, which is scheduled to be completed on August 31, 2000, is currently under way.

5.5 Improving Fire-extinguishing System

Newly built building has to pass the fire hydrant hose test according to the Fire Service Law before their use. The Fire Service Law stipulates that the fire pump shall operate with the emergency power supply even in case the regular power supply is suspended. Whether this function is in a normal working condition needs to be confirmed by testing. It would have been possible to carry out this test, using the main emergency generator protecting the major SPring-8 facilities. In this case, however, the regular power supply would have to be stopped, which results in a suspension of the accelerator operation. To avoid this, a diesel generator for dedicated use for the fire pump was installed, so that the test can be carried out at any time. This generator for emergency use is also connected to the water supply pump so that it can back up its power supply.

5.6 Improvement of Compressed Air Supply System

There are many air activating valves in the SR. The compressors to provide air to these valves are usually powered by commercial power supply. The Division installed a diesel generator as a backup power supply so that the valve can operate even in case of a long-time power stoppage e.g., at the time of power supply substation inspection. This has enabled constant supply of compressed air to the valves such as the ring gate valve for vacuum retention, main beam shutter for shutting radiation beam and temperature regulating valves of the machine cooling system.

5.7 Telephone Network

Rapid advancement is taking place in information technology. The users' needs for telephone network has been diversified corresponding to technological advancement. To keep abreast with these changes, telephone network is in the process of upgrading.

Telephone Network Management System is the program system which controls the telephone network of SPring-8 and is based on CAD. This system allows us to identify the locations where the network lines and apparatuses are connected or installed. If a trouble occurs on the network, we can pin down the location and take a speedy action. The server computer for this purpose is installed in the main PBX (private branch exchange) room, but to utilize this function more effectively, portable terminals (client version) have been introduced to the divisions in charge.

PHS (Personal Handy Phone System) terminals are being replaced with new models as the PHS functions have become advanced and diversified. The PBX software was not compatible with the advanced PHS functions. The PBX software, therefore, has been upgraded to a version that is compatible with the new PHS models.

5.8 Installation of Geared Trolley

The utility management aims to reduce the user time loss caused by equipment trouble as much as possible in order not to hinder synchrotron radiation application research. To achieve this goal, it is required not only to prevent problems from occurring but also to take safe and immediate action if a trouble occurs. In the machine cooling system at the SR facility, there are a number of demanding operations, e.g., lifting and moving heavy materials in a narrow space. To enable safer and easier operation, we installed I-beams and geared trolleys for lifting and moving heavy materials.

5.9 Installation of Delivery Door

Prior to constructing a beamline in the Biomedical Imaging Center, the Division installed doors for safe delivery of heavy or long materials and equipment to the building. These doors will continue to be used after the beamline is open for common use. For this reason, double steel doors were chosen, so that the space between the doors works as buffer room to maintain air-conditioning in the facility. This work had to be implemented quickly, considering its impact on the beamline construction schedule, in order to proceed with the beamline construction as scheduled.

6. Management of Chemical Substances and Waste

SPring-8 is visited by a host of researchers with varied interests from the world over. Accordingly, a variety of chemical drugs and substances are used in the research activities and hence a variety of waste is generated. To protect environment and to prevent contamination accidents, we, at SPring-8, consider developing a mechanism for proper control of chemical substances and waste.

6.1 Management of Industrial Waste

Waste comprises municipal general waste from offices and industrial waste. Industrial waste is sorted, collected and entrusted to a disposal company in accordance with the Waste Disposal and Public Cleaning Law as well as with internal regulations. Industrial waste generated by research activities at SPring-8 is controlled and is classified either as general industrial waste or as specially controlled industrial waste.

As shown in Fig. 5, general industrial waste consists mainly of packing materials used for protection of OA equipment. For collection of general industrial waste, six collecting stations have been set up on the site. Also, a storage tent has been put up, which is used for obtaining data for establishing an efficient method for

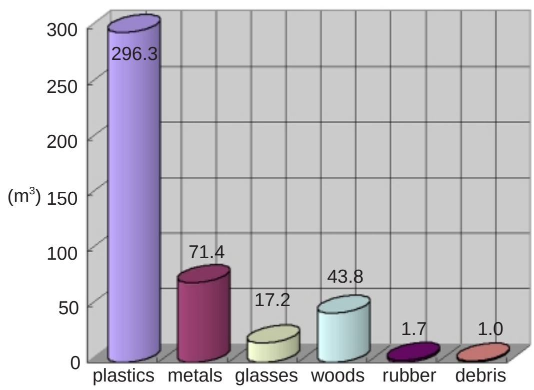


Fig. 5. 1999's General industrial waste.

sorting, collecting and managing waste. The storage is also used for temporarily storing large or bulky objects.

Specially controlled industrial waste consists of liquid waste containing hazardous or toxic substances or solid materials in which such liquid is absorbed. The amount of specially controlled industrial waste generated is shown in Fig. 6. Specially controlled industrial waste is strictly controlled under our operational regulations. In 1999, the Division prepared a draft for detailed rules to supplement the current regulations. The Division plans to authorize the draft within the year 2000.

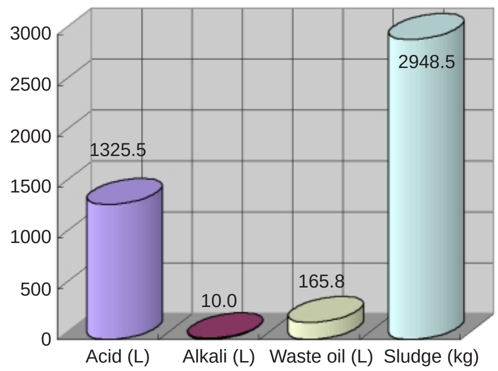


Fig. 6. 1999's Specially controlled industrial waste.

The Division currently entrusts the disposal of specially controlled industrial waste with a waste disposal company. To alleviate its environmental load, however, the Division is engaged in an effort to establish a practical waste degradation technology. In this regard, the Division has introduced the small size supercritical water oxidation system, which is expected to be put to practical use in degradation of organic waste. This system detoxifies organic substances under a high temperature and high pressure condition. In 1999, the Division operated the system using liquid waste and reagents to get its performance data. Henceforth, by changing operating conditions of the system according to the type of chemical substance to be processed, processing data for each type of chemicals will be collected. The result of this study will be reflected on the future plan of the processing system.

Municipal waste is sorted and collected, separate from industrial waste, at seven collecting stations on the site. This sorting and collection system has been working well, with the support of many people working at SPring-8.

Preparation has started toward a promotion of sorting and collecting municipal waste and packing materials in the experimental hall. The Division intends to adopt an efficient sorting and collection method, listening to the opinions of researchers responsible for the waste at the experimental hall. As biology-related research is expected to grow in future, the Division will also study how to handle biology-related waste.

6.2 Management of Chemicals

A great variety of chemicals are used at SPring-8. Some of them are hazardous, and require centralized control. To this end, the Division built a program system for controlling the chemicals coming in and out of the Chemical Sample Preparation Laboratory in 1998, and put it into use in 1999. This system has adopted a bar code system to ensure and simplify the control procedure. This system, which indicates the content and amount of chemicals in each container, ensures the control of chemicals used in SPring-8.

In 1999, the PRTR (Pollutant Release and Transfer Register) Law for regulating handling of chemical substances was enacted. In order not to violate the law, the Division reviewed the requirements stipulated in the law in details, and also surveyed practices of other organizations. From next year onward, the Division will take the results of these studies into consideration in controlling chemical substances, and improve the program system to cope with the PRTR Law.

6.3 Management of Hazardous Materials

Inflammables such as kerosene are designated as hazardous materials by the Fire Service Law and required to be specially controlled, for example, to be stored in a dedicated storage house. In 1999, prior to setting up the Hazardous Materials Storage, we collected data on the types and volume of hazardous materials used in research by a questionnaire. Based on the result of this questionnaire, the Division designed and constructed the storage house, enhanced the control system and began the preparation for its operation. The storage house will start operating by early next year as the central base for storage and control of hazardous materials. The volume to be handled there will initially be small, but is expected to increase in the future. The Division plans to review the control method and to design a management software program next year.

6.4 Preparation for ISO14000s Approval

The Division is thus actively involved in conservation of environment by sorting and collecting recyclable waste, controlling the handling of waste and so on. To promote these activities more positively, the Division now considers obtaining the ISO14000s approval. In 1999, we heard the opinions from specialists, dispatched our members to related seminars and carried out a survey on the approval preparations made by other organizations.

7. Electrical Safety

SPring-8 is a facility consuming a huge volume of electricity for the operation of accelerators and synchrotron radiation application research. To ensure safe operation and maintenance of electric equipment we have established the maintenance code for electrical facilities and designated a qualified electrical engineer with license.

In 1999, minor electric leakage occurred frequently due to mishandling of the appliances and equipment. The Division reviewed the safety measures to reduce such mishandling, in a safety-conscious environment after the JCO accident.

7.1 Confirmation of Safety in Electrical Works

We make it a rule to draw up a work implementation plan and submit it to the qualified electrical engineer before implementing electrical works To confirm which items are important in terms of safety and to prevent accidents and mistakes in electrical works, the qualified electrical engineer checks the plan and give advice and instructions if necessary. Furthermore, to prevent accidents of electric shocks, the qualified electrical engineer attends the operation to shut off the power supply to the work site, before the work starts. He also attends the operation to resume the power supply after the work is completed. In 1999, approx. 100 work implementation plans were prepared and submitted.

7.2 Annual Inspection on Transformer Substations

In accordance with the Electric Utility Industry Law, an annual inspection on the transformer substations was carried out on July 24th. Such inspection requires a suspension of the electric power supply to the whole SPring-8 facilities simultaneously. We, therefore, made due preliminary arrangements with each division of SPring-8 in advance, as well as with electrical engineering companies involved in the inspection. Such inspection needs to start early morning for the preparatory work for suspending power supply, and takes approx. 10 hours including the work for resuming the power supply after the inspection is completed. Since many electrical engineering companies were involved, which are responsible for different facilities, we made a special coordination arrangement in order to ensure safety and smooth proceeding of the inspection work. To carry out the inspection safely, we prepared a procedure manual for every inspection work, and advised made it known to everyone concerned to follow the manual.

7.3 Training Simulator

Minor electric leakage is occurring frequently due to mishandling of electric equipment. In the course of safety review carried out in the wake of the JCO accident, it was concluded that training and education in handling electric equipment would be required to prevent such incidents. As part of this plan, the qualified electric engineer and his staff started developing training simulators with which any staff member at SPring-8 can learn the proper operation of electric equipment and instrument by simulation. In 1999, a simulator for proper operation of electric circuit switches was developed. The simulator developed has been installed on the desk-top personal computer, with which workers can learn by themselves in an interactive mode. The characteristics of this simulator can be summarized as follows:

1) When the trainee selects a training item, a simulated electric circuit will appear on the display. If the trainee turns on and off the switches in correct order according to the instruction given by the computer, he can proceed to the next step. If he makes a mistake, an alarm sounds and "advice" will be displayed
2) The simulated electric circuits include the existing circuits of SPring-8 as well as conventional ones. So, the trainee can start form basic operation of the conventional ones, and then proceed to advanced training with the existing circuits. There are 8 types of existing circuits. The Division will set up the Training Room, taking users' convenience into consideration, and will put it into common use as early as possible. The Division plans to expand the simulation function step by step. To enhance its educational effect, the Division plans to modify the program into a game-like style and to include safety precautions and possible accident examples as well as to include more of the existing circuits.

7.4 Electrical Safety Education

According to the Electrical Maintenance Code, the electrical engineer provides electrical safety education to SPring-8 staff members. In 1999, the electrical engineer provided two lectures on safety measures for electrical works, essential points of the circuit design and suggestion in using tools. In the lecture on safety measures for electrical works, handling of electric circuits and grounding methods are instructed to prevent the leakage trouble.

7.5 Maintenance Code for Electrical Facilities

The detailed rules supplementing the maintenance code for electrical facilities have hitherto been applied as internal rules. After reflections on the JCO accident, it was decided that authorization would be necessary, and a draft was drawn up by revising the internal rules. In preparing the draft, the Division asked the divisions concerned for a review and comments. The

Division will now carry out a survey on the precedents in other organizations, incorporate the comments obtained in the draft and then start the proceedings for authorization.

8. Others

8.1 Safety Review Results

The President instructed to conduct a safety review on facility management and manuals in the wake of the JCO accident on September 30, 1999. The result of the safety review confirmed that the duties are properly performed and the facilities are well maintained in accordance with the related laws and regulations. Some of the internal rule are yet to be authorized, and the Division plans to systematically carry out the administrative procedures for authorization. Relevant sections are voluntarily and actively promoting training and education by encouraging the section staff to attend seminars and obtain licenses and qualifications. The Division decided to systematically promote such training and education to make it more effective.

8.2 International Exchange

1) Meeting with SSRC

SSRC *(the Shanghai National Synchrotron Research Center)* plans to construct a synchrotron radiation facility in Shanghai, and dispatched its delegate of seven members to us on November 29, 1999. We had technical meetings for seven days with the delegate consisting of researchers and engineers. The objective of the delegate's visit was to learn from our experience in the design and construction of SPring-8 facilities with a view to benefit from it for their own plan. Our staff members in charge of the design and construction of SPring-8 facilities explained their experience to the delegate.

2) Meeting with SRRC

Two researchers from SRRC *(the Synchrotron Radiation Research Center of Taiwan)* visited us on March 17, 1999. The objective of their visit was to use our experience in SPring-8 operation to good advantage to their questions on the air-conditioning of the beam tunnel, temperature control of the machine cooling system, coolant quality control and the power supply equipment, using flow charts, control trend recordings, skeleton models, etc.

8.3 Cost Integration Software Program

In placing an order for construction or maintenance works, it is required to integrate the cost in an appropriate manner by grasping the market prices for materials, equipment and labor. It is also important to eliminate mistakes in manual works and to simplify the document management, under the circumstances where limited number of people are dealing with multiple projects. To adapt to such needs, a renowned personal computer software program called "RAIDE" was introduced. The electric equipment version was first introduced, and upon confirming its effectiveness, the mechanical equipment version was also introduced.

8.4 Preparation Works for Superconducting Wiggler

In response to the completion of Russian-made superconducting wiggler, the Accelerator Division are planning related adjustments and experiments in the Accelerator and Beamline R&D Facility. Preparatory works were carried out prior to the arrival of the wiggler. The Facilities and Utilities Division collaborated in electrical works, water supply and drainage works, which were required for carrying out the experiments.

References

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[2] T. Suzuki and H. Ohtani, SPring-8 Information **4**(6) (1999) 17.