

OSART Good Practices
RADIATION PROTECTION
Radioactive Waste Management and Discharges

Gösgen, Switzerland

Mission Date; 8-25 November, 1999

In addition to early planning for waste management from a process and design perspective, Gösgen has participated in development of interim and final waste storage programs with the remaining Swiss nuclear power plants and HSK. The nuclear power plants in Switzerland have entered into a joint venture to fund NAGRA, the planner of the proposed final disposal facility. The collaborative process developed by Gösgen, other nuclear power plants in Switzerland and NAGRA showed considerable foresight in establishing a program for development and approval of waste packages and waste types, conditioning or treatment processes, and quality assurance measures to be implemented by each generator. The process includes prototype testing to facilitate development, throughout the approval process, of appropriate quality assurance requirements for each type of treated waste. The regulatory authority was actively engaged in the development and approval of each waste type and treatment process. The process should minimize the potential for rejection of waste packages upon transfer to the final disposal facility when it becomes available.

In a collaborative effort, an integrated information system has been developed for documenting and retaining all information on waste packages, including characterization, content (nuclide and activity), location and total inventory for each waste generator. The information system is shared by all Swiss nuclear power plants and NAGRA, so information on any single waste package is readily available to each generator and the future operator of the final disposal facility. Gösgen has entered information in the system for all waste packages generated during operation of the plant. This system allows each generator and NAGRA to access information on specific waste packages, as well as the total treated waste inventory at a specific generator's facility. Gösgen actively uses this system to monitor trends and status of waste generation, treatment and storage.

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Performance in the area of waste management is excellent with regard to procedures and practices aimed at minimizing radioactivity in liquid effluents and the volume of radioactive waste generated and stored at the plant. This effort is critical to successful management of radiation levels in the plant and collective dose since all radioactive wastes generated to date must be treated and stored at the plant because no external disposal or interim storage facility is available. The waste treatment system at Goesgen has significantly contributed to reduction in personnel doses and waste volume.

A unique waste treatment system was established during early plant operation involving a bitumen-solidification facility which is used to process both liquid and resin wastes. The solidification system is fully remote controlled, which has contributed to lower personnel doses for this activity. Contaminated liquid waste is processed in an evaporation system to minimize volume, and the remaining concentrate is processed through a screw extruder where water is removed, and the concentrate waste is mixed with bitumen to produce a final waste product. The bitumen mixture is automatically loaded into 200 litre steel drums which serve as the final waste package. A similar process is used to treat ion exchange resins for disposal. The resins are dried and mixed with bitumen by processing the material through the screw extruder. Sampling occurs throughout the treatment process to ensure that approved waste type criteria are met. Although two process systems are used for initial treatment of liquid and resin wastes, a single remote controlled extruder system is used for the final solidification processing of the two main waste streams.

The solidification system is fully remote controlled, which has contributed to low personnel doses for this activity. Portions of the waste treatment systems are contained in a hot cell which consists of two parts; one part houses the extruder and a second houses a drum filling station. Both sections have concrete walls of 0.7-0.9 meters, providing significant shielding for local plant areas and the system control panel where personnel are stationed. Drum lids are mounted and bolted using a remote handling system and are subsequently transferred to a survey station with automated control for performing dose rate surveys, gamma scans and contamination surveys. Final waste packages containing "intermediate" waste, or processed resins, are stored in an area specifically designed to provide shielding and retrieval capability.

Use of conservative segregation practices and the solidification facility have contributed to reduction of waste volume at Goesgen. Approximately 15 cubic meters of solidified waste, in final form, are produced annually, compared with an international average of 65 cubic meters per year for PWR plants, according to WANO reports. Capacity for waste storage was initially estimated to be sufficient for 10 years of operation; however, based on current waste management performance, actual capacity is estimated to be sufficient for 40 years of operation, if needed. Examples of dose savings achieved as a result of the system design include an accelerated solidification campaign in 1996. A total of 55 drums with an average dose rate of 350 millisievert (mSv) per hour were solidified. This project resulted in an annual collective dose of 15 mSv for the individuals involved, which corresponds to less than 2% of the collective dose for that year.

The station has played a pioneer role in the development of several waste treatment processes. Examples are as follows:

- all safety-relevant data required for a final storage of radioactive waste are managed by means of an efficient databank system (Information System for Radioactive waste, ISRA). This system is recognized by the Swiss authorities (HSK) and is also used by the company that is responsible for final storage of the waste (NAGRA) and by the other Swiss nuclear power plants. It has been recognized in an earlier OSART as a good practice;
- modern methods are used in order to reduce the volume of spent resins and sludge and to put it in a waste matrix. The new method, called Cement Volume Reduction Solidification (CVRS) minimized also the personnel radiation doses;
- for conditioning spent resins and sludge, a solidification system has been installed in the existing radwaste processing building. The conditioning process includes the pretreatment of raw wastes, a thermal treatment of resins, and the immobilization in cement, which has been optimized with regard to volume;
- the CVRS solidification system is suitable for the conditioning of the resins and sludge either arising from current plant operation or already existing. Pretreatment of the resins allows the waste load of the cement matrix to be increased by 50% compared to conventional cementation techniques. In spite of cementation, this treatment even results in a slight volume reduction of approximately 10% since the wet waste, due to its lower density, takes more volume than the waste matrix produced;
- for spent incore components, the plant uses a new calculation method to characterize the radioactive inventory only by calculation. The code, developed in cooperation with GRS (Gesellschaft für Anlagen- und Reaktorsicherheit), allows reliable characterization of a wide range of reactor internals. Extensive analyses performed on KKM fuel channel pieces from normal reactor operation made it possible to validate the new code, to the extent of determining the nuclide inventories of the structural material of all reactor internals except neutron absorbers. For neutron absorbers, recently another calculation code was developed and used to characterize the nuclide inventory of KKM control-rods and curtains of boron. In the future, costly sampling and measurements on activated reactor internals will thus no longer be necessary. The code, which runs on a PC, is accepted and used also by the NAGRA.

Penly, France

Mission Date; 29 Nov.-16 Dec., 2004

All nuclear waste present inside the waste treatment building (concrete drums and other waste) is managed on a near real time basis with a full inventory and package plan. With this tool, an action plan can be implemented. Each year, this action plan is reviewed in order to decrease the inventory of the waste building, hereby also dealing with the historical waste items stored there for a longer time.

The plant objectives related to the inventory of the waste treatment building involve both concrete and metal drums generated during the year but also the historical waste items stored for a longer time as extra treatment is needed or special arrangements have to be foreseen with control bodies. An inventory of all the waste present in the BTE and the very-low activity storage area has been drawn up. A package plan is updated at each movement of waste within the storage areas.

The reduction of the historical inventory decreases the dose rate and the risk for inadvertent contaminations on the surrounding area (ALARA principle).

An action plan is drawn up every year to achieve fixed targets. This action plan reviews each type of waste (concrete drums or other) and determines the actions to be taken to ship them by setting the priorities for the following year. The origin of packages that are not in compliance (concrete shells) is also determined and corrective actions are put in place before the package is produced.

Performance indicators are monitored every month and reported both to the site management and to the EDF national organization in charge of the treatment of waste (UTO-DC). These indicators make it possible to raise an alarm when the inventory in the storage areas becomes too high in comparison with the regulatory specifications (especially for the very low activity storage area).

Blayais, France

Mission Date; 2-19 May, 2005

Development of specialized shielding and enclosure for onsite transport of radioactive waste reduces collective dose and enhances contamination control. The team brings to the attention of other plants the development and implementation of radioactive waste containers for reduced collective dose and enhanced contamination control during on-site transportation.

The plant developed two types of containers for the on-site transportation of radioactive waste from the auxiliary building to the waste treatment and storage building. Sacks of low-level waste are stored in a stainless steel cabinet with tight-fitting doors and wheels for easy transport. Concrete shields that fit around waste containers for higher-level activity of waste are placed on trailers for towing to the waste treatment and storage building. The implementation of these has resulted in no spillage of waste, control of contamination, and reduction of doses during transport

Volgodonsk, Russia

Mission Date: 1-19 October, 2005

The plant has a very efficient solid waste reduction system and significant achievement has achieved in the past years.

Though the utility target of yearly solid waste production for VVER 1000 type of reactor is 250 m³/reactor, in the past 4.5 years of commissioning, operation and 3 outages, the total solid waste generation in this plant is only 199.45 m³. This value is the lowest one compared with all other VVER1000 plants in Russia and less than 15% of the designed production volume. This result is also remarkable in comparison to the world nuclear industry in respect of solid radioactive waste volume control.

The main strategy in management and technical aspects are:

- Reduce solid waste generation. All waste generated in Radiation Controlled Area are sorted on the spot and later by the solid waste management department according to the contents and contamination level of the materials.

- Decontaminate any reusable objects such as equipment, components, protective clothing etc., so that they can be recycled.

- High radiation wastes such as filters from the primary circuit are directly placed into casks for final disposal.

- Improve the awareness of workers to solid waste reduction and management through various training.

- Modernization of related plant waste treatment systems. The plant has recently completed its modification to the solid waste solidification system, and the project of the integrated conditioning facility (including the incineration) for solid waste is planned to be in operation by the end of 2006.

Chinon, France

Mission Date; 27 Nov. - 14 Dec, 2007

The oversight and control over the transportation of radioactive materials and wastes, including the construction and use of the BUC "Bâtiment Ultime Contrôle" (Final Control Building), has significantly reduced the number of reported transportation-related events and provided an effective means of continuing improvement.

As a result of numerous transportation-related events reported to the French regulator, EDF was banned from making certain shipments of radioactive waste in 1998. The plant appointed an advisor for transportation to ensure compliance with regulatory requirements. Follow up actions included placing the transport of radioactive materials and waste under a Quality Assurance programme, and organizing a specialized transportation section that is responsible for all organisational, scheduling, administrative, and regulatory aspects regarding the transportation of radioactive materials, excluding spent nuclear fuel.

In calendar year 2007, the plant completed construction of the BUC, a building specifically designed and used for activities pertaining to the transportation of radioactive materials and waste. The building is equipped with a truck reception plant protected from the elements, a crane for transferring containers to the container monitoring station, which includes container drying equipment (to facilitate surveys for removable contamination) and enables full survey coverage of all six sides of the container, and new equipment to facilitate radiological surveys. In the past, surveys of vehicles transporting radioactive wastes and materials were performed outside, without protection from the elements. Furthermore, transport containers were surveyed on the transport trailer, which limited access to the top of the container and a large majority of the bottom surface of the container.

As a result, the plant's focused oversight of transportation activities and the use of the BUC has been an effective means of continuing improvement in the transportation of radioactive materials and waste. This is demonstrated by a significant reduction in the number of reported transportation-related events. In addition, this has helped the plant cope with the processing of approximately 1000 shipments of radioactive materials and waste each year, including wastes from the Irradiated Materials Laboratory (AMI), and the decommissioning of Chinon Units A2 and A3. This oversight programme and the BUC facility are unique to the plant.