OSART Good Practices
RADIATION PROTECTION
Radioactive waste management and discharges

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.

Oskarshamn, Sweden

Mission Date; 16 Feb.-5 Mar., 2009

Use of effective decontamination method for the plant's main highly radioactive systems during outages has contributed to significant reduction of occupational exposure in past years.

In 1989 and 1994, the plant had experienced two decontamination campaigns for the reactor tank and its associated primary system at unit 1. Based on the experience of these decontaminations, the plant had established a new decontamination system that could be performed with efficiency and speed. Since this system, so called AMDA (Automated Mobile Decontamination Appliance), had been used in 1996, radiation dose exposure reduction with great efficiency has been achieved.

Decontamination of primary systems with DF (Decontamination Factor) between 10-100 has been performed over 20 times at the units1, 2 and 3 until now.

For instance, as a result of decontamination of reactor cooling system and main circulation cooling system in 1999, the dose saving was 12 manSv with DF 63.

Had this not implemented with efficient results, the necessary high activity work in the reactor vessel could not be performed. A very valuable advantage is that it is possible to reduce the doses to individuals and the collective dose at a reasonable cost.

All system decontaminations have been performed with the CORD-UV-method. The CORD-UV is an abbreviation of Chemical Oxidation Reduction Decontamination and Ultraviolet. The decontamination process consists of multiple-steps involving hot and diluted solutions of weak acids in 2-3 cycles. The equipment is connected to established tie-in points of the contaminated system in order to achieve a closed circuit. Water is filled into the system and then circulation is begun. Cold and hot leakage-checks are performed prior to dosing the chemicals.

As a result that the plant has continued to achieve significant ALARA goal to reduce occupational exposure, this is remarkable.

Metzamor, Armenia

Mission Date; 16 May-2 Jun., 2011

Well established environment monitoring program.

The Radiation Protection (RP) department has highly qualified proficient specialists; in particular three of them are PhDs. The RPD cooperates with Yerevan State University and implements international cooperation programs. Close cooperation with scientific organizations gives an opportunity for the department employees' qualification improvement and opportunity of implementation international good experience. All implemented activities improve the environment situation.

The RPD employees regularly publish scientific articles in international scientific periodicals that are based on the results of studies at ANPP in the field of environmental protection.

Close cooperation with experts on RP from Europe and the USA gives an opportunity for maintaining qualification of employees and communication with them aimed at implementation of advanced practice at ANPP.

Dukovany, Czech

Mission Date; 6-23 Jun., 2011

Radioactive waste management

The plant has implemented a robust and comprehensive waste management programme supported by new technologies, process monitoring, a decontamination facility as well as a packaging facility for the waste for the repository. The facility for free release measurement has also been commissioned and there is an authorized measuring process in place.

A comprehensive waste management programme, starting from the different waste streams to the final product, is supported by effective software tools. All relevant data are continuously updated and the inventory of radioactivity is controlled at each step of the process.

A new system of monitoring basic chemical, radiochemical and physical parameters of individual waste categories is used, based on a detailed characterization of individual wastes. Wastes are initially sorted as individual types using identification codes of the catalogue of conventional wastes.

Within the radioactive waste characterization process, all required analysis are performed and appropriate algorithms established for calculation of difficult-to-determine long lived radio nuclides within all waste streams. Input data are continually provided to the software and these algorithms are periodically updated.

The plant has substantially reduced the amount of radioactive waste generation by segregation and by applying multiple methods for waste reduction. This approach has been requested by the management and the waste processing is closely controlled by the regulatory body. Open communication between both parties is a key for this success. Technical conditions have been successfully assured and the legislation framework for clearance of all categories of waste is in force. Thermal stability of the treatment process has been also verified by the Nuclear Research Institute to eliminate any risks connected with the fixation of radioactive concentrate in bitumen.

The main radioactive waste processing technologies at the site are:

- Bituminization of evaporator concentrate
- Innovative usage of fixation of resins and sludge into a geo-polymeric matrix
- Regeneration or elimination of contaminated organic liquids

Conditioning of spent resins with the new solidification process was introduced in 2010. 260 tons of waste resulting from the modification of technologies was cleared during 2010.

Mühleberg, Switzerland

Mission Date; 8-25 Oct., 2012

Special shielded transport container for high doserate waste, reducing operator and public doses.

In order to reduce doses to the public and to workers at the plant, a specialised shielded container has been designed and produced to transport 200 ltr waste drums from the plant to the waste facility on the public roads. The plant has developed a container based on industrial standards, made modifications and added steel shielding to ensure that the drums cannot move in transport, cannot be damaged and therefore will contain the radioactive material in the event of a transport incident and that the doserates on the outside of the package meet the transport regulations (Type A). Additionally minimal handling at the site is ensured, using remote controls, so that personnel doses are minimised. The initial doserates of the drums are on average 6mSv/h, but can rise to 100 mSv/h. This container reduces these doserates to 1.5 mSv/h on the outside of the container. This results in reduction of the doses to the workers loading the container and the public during transport. The plant's estimated dose saving relative to using the traditional industrial containers is 0.5 man.Sv.

This proactive approach and this equipment specifically demonstrates a commitment to continuous improvement by the plant.

Clinton, USA

Mission Date; 11-28 Aug., 2014

Zero radioactive liquid waste release.

The station effectively operates a Liquid Radwaste Treatment Installation to prevent the need to discharge.

- The station has a “zero discharge” policy and has not performed a radioactive liquid discharge since 1992.

- The station maintains a rigorous process of tracking seasonal changes in station water inventory. This process predicts changes in station inputs due to environmental conditions such as humidity/temperature and necessary water movement from refuel activities, ensuring there is adequate storage space to receive and process water without the need to discharge.

The primary concern for processing radioactive wastewater is to produce a high quality of water for use as process water while achieving zero discharge from the station by utilizing waste segregation and adequate, timely sampling and processing.

The Liquid Radwaste Treatment Installation is fed by three wastewater streams:

- The Floor Drain Waste Water System is the primary source of contaminants. These contaminants range from organic material and cleaning solutions to high levels of crud, sediment, and resin.

- The Chemical or Equipment Drain Waste System contains liquids from numerous chemical drains and sumps. Liquids in this system will vary extensively in chemistry parameters and may contain organic compounds, detergents, volatile solutions, and resin.

- Laundry Waste system inputs can contain low levels of detergents from drains in the Turbine Building and Service Building.

Front end sampling is used in some cases to determine the best method of processing; in other cases specific tanks are processed without front end sampling, such as equipment drain tanks.

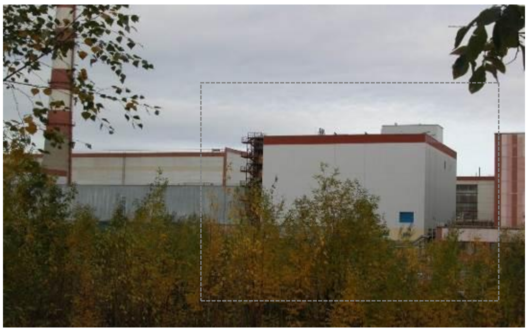
Kola, Russia

Mission Date; 10-27 Nov., 2014

Advanced Radionuclide Removal Technology for Evaporator Concentrate

A system for radio-nuclide removal of evaporator concentrate was implemented at the Liquid Radioactive Waste Treatment Facility of the plant.

The process is based on separation of Co^{60} and ^{Cs134,137} radio-nuclides and subsequent ion-selective purification. A specific sorbent is used (ferro-cyanide sorbent).



Liquid RW treatment facility

Shielded HLW container

Salt-melt

The advantages of the process developed by the plant are:

- Unlike the conventional methods of evaporator concentrate treatment (e.g. cementation, bituminization) the ion-selective purification has a significant radioactive waste reduction factor. A total effective volume reduction factor of more than 100 is achieved.
- The development of a filter-container with an ion-selective sorbent inside avoids dose-consuming operations related to handling of an exhausted cartridge. The container is shielded and will be directly used as a final waste package for disposal.
- The end product of the evaporator concentrate treatment process is solidified salt-melt, which does not fall into the category of radioactive waste.
- The process media are re-cycled: secondary steam condensate is used to flush equipment and to form a water layer (together with floor drain water) for the dissolution of salt deposits.

The implemented technology reduces considerably the volume and converts the radioactive waste into a single type of container suitable for long term safe storage, transportation and subsequent disposal.

Novovoronezh, Russia

Mission Date; 9-26 Nov., 2015

Introduction of the latest technologies in the system of rad waste treatment.

Organization of zones for collection of radioactive waste by radioactive monitoring and segregation at the source, with the purpose to decrease the amount of rad waste generation.

At the plant Controlled Access Area equipment for segregation of waste into radioactive and non-radioactive was installed with the purpose to decrease the amount of radioactive waste generated at the plant. Waste segregation is based on gamma-dose rate measurement. In addition, the segregation process is under video monitoring (allowing investigations in case violations are detected in the segregation of rad waste).

Waste segregation in radwaste and non-radwaste in the CAA

Rad waste packages undergo radiation monitoring in the CAA of Unit 5 aimed at rad waste and non rad waste segregation (rad waste and very low level rad waste – industrial waste contaminated by radioactive substances).

Place for waste sacks monitoring

In the rad waste clearance area with low background waste packages are measured once more to separate very low level rad waste (VLLRW) and 'non-contaminated' (industrial) waste. This area is equipped with radiometer and spectrometer units.

On completion of measurements a decision is taken either wastes are VLLRW or "non-contaminated" industrial waste. If the waste is VLLRW, it is placed in the prepared cask. Then the cask undergoes characterization by spectrometers and is placed at a separate storage site for collection (prior to be disposed at VLLRW storage facility). Non-contaminated wastes are disposed as industrial waste at the industrial waste landfill.

For the purpose of waste clearance a procedure of waste radiation monitoring for identification of waste amount and type is used.

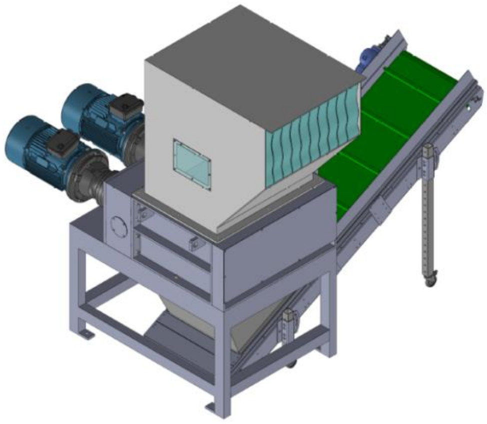
Almaraz 2, Spain

Mission Date; 5-22 Feb., 2018

Volume reduction of compactable, heterogeneous solid waste with the use of a shredder (Trituradora).

With the aim of reducing the volume of compactable heterogeneous solid waste, the plant has purchased a shredder for treating this kind of waste before it is compacted inside a 220-litres drum.

The shredder, specifically developed for the plant, is gear-driven and encompasses a 600x800 mm cutting chamber, 2 axis with 20 hardened cutters and a conveyor belt to evacuate the shredded waste into the 220-litres drum.



Once shredded, the waste is finally compacted in the drum with the aim of optimizing its volume and maximizing the use of the drum.

For the most part, the shredded materials are shoes used in the RCA, rigid hoses used by Operation, electric cable covers, shoe covers, etc.

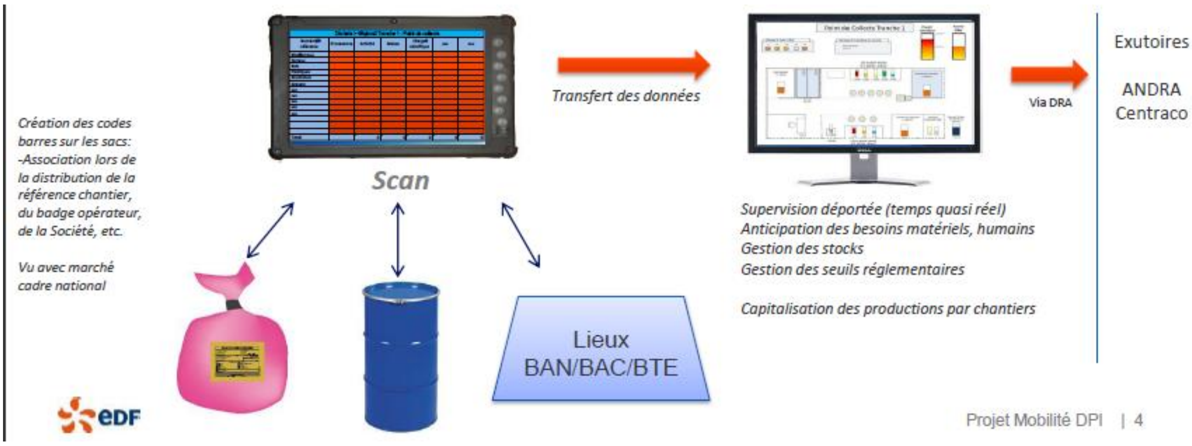
The volume of materials such as shoes and hoses is reduced significantly by 45-50% and approximately by 40% in the case of other materials.

In the time the shredder has been in operation, the plant observed an average volume reduction close to 50%.

Flamanville 3, France

Mission Date; 17 Jun. - 4 Jul., 2019

The plant has implemented a bar-code system that tracks radioactive waste from the point of generation to the eventual disposal site. The system is called WasteApp.



At each work site, the person in charge sorts and puts the radioactive waste in bags labeled with a bar code. A tablet allows this person to scan the bag and enter information regarding the person who bagged the waste, the location of the work site, the number of the work permit, the type of waste in the bag, the dose rate on contact with the bag.

Bagged waste is then compacted into drums. Each drum is identified with a bar code. The operator uses a tablet to scan the drum and scan each bag put into the drum. Ultimately, each shipment to the ANDRA disposal site can be tracked by bar code and the full history of the waste stored at the site can be retrieved.

All of the Intermediate-Level Waste, Low-Level Waste and Very-Low-Level Waste packages (including waste bags and other types) are tracked by the application. The system provides information on where they were produced, processed, and stored (such as Nuclear Auxiliary Building, Auxiliary Waste Conditioning Building, Waste Treatment Building, Very-Low-Level Waste storage area, ANDRA).

This system allows the plant to comply with the administrative and regulatory requirements related to tracking the content of radioactive waste in an effective and efficient manner. It reduces the administrative burden associated with these tasks.

Benefits:
The system provides real-time information on the quantity of waste produced, where it is currently stored, and what it contains.
The plant can gather OPEX on the quantity of waste generated by each type of intervention on the plant’s systems.
It is also possible to track the inventory of bags, containers, drums and order more when the inventory falls below a threshold.

Saeul (Shin-Kori 3&4), Korea, Rep. of

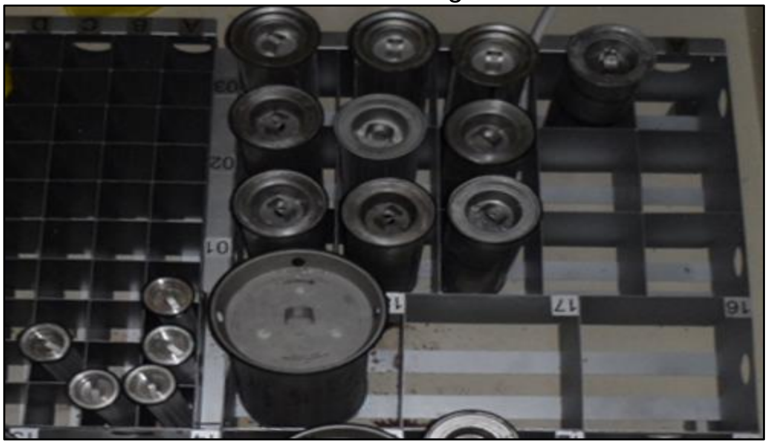
Mission Date; 31 Oct. - 17 Nov., 2022

The plant has utilized innovative methods for the control, storage, and identification of radioactive waste.

- Designed and implemented Chemistry and Volume Control System (CVCS) Filter Storage Racks in Filter Pit (Auxiliary Building Elevation 78m) storage area to improve storage for decay and future retrieval.
- Designed and implemented CVCS Filter Shielded Area and Storage Rack in Compound Building Truck Bay, allowing additional decay and long-term storage.
- Designed and implemented Liquid Radwaste System (LRS) Reverse Osmosis (RO) Membrane Filter and Micro Filter storage cabinets to prevent spread of contamination.
- Designed and implemented segregation of Steam Generator Blowdown resin from other liquid radioactive waste resins, reducing production of radioactive waste.
- The plant also utilizes detailed identification methods for radioactive waste in order to ensure traceability with their waste repository.

Benefits:
By using these innovative methods, the plant was able to better maintain dose As Low As Reasonably Achievable (ALARA). The implementation of CVCS filter storage racks and Liquid Radwaste filter cabinets have minimized the spread of contamination and reduced dose to personnel.

CVCS Filter Storage Rack



CVCS Filter Storage Area

LRS RO Filter Cabinets