OSART Good Practices
RADIATION PROTECTION
Radiation work control

Mochovce, Slovakia

Mission Date; 4-20 Sep., 2006

The plant monitors extensively the effectiveness of the barriers against contamination propagation and statistically analyzes all revealed cases of personal contamination including contamination of protective clothing and tools. Analyzing trends in contamination of individual rooms and corridors, the plant can take effective measures to further improve radiation work control.

Automatic personnel contamination monitors alarm levels are set up on the lowest possible value (0.3 Bq/cm2 if possible regarding to dose rate). This creates an effective barrier against contamination spread.

Personal contamination is measured by several types of devices; any discovered contamination is to be reported by a prescribed form to the RPU. Moreover, alarms of the PCM2 devices (personal monitors) and from tool monitors in change rooms are signalled in RP control room and automatically recorded into a database. Workers are not punished when an alarm occurs, but they are obligated to report the circumstances. They are encouraged to notify all cases of contamination. This helps to keep reports as complete as possible and to make the analyses more valuable.

Permanent places for collecting waste are equipped with device for dose rate/contamination monitoring. It helps to keep dose and possible contamination as low as possible.

Floor washing water from corridors and rooms in RCA is sampled and measured on gamma spectrometry in order to analyze contamination spread. This practice is not frequently used in NPPs.

All records are statistically analyzed in order to map contamination sources, keep the contamination in RCA as low as possible, and evaluate the effectiveness of the barriers against contamination propagation and the effectiveness RP measures.

St. Laurent, France

Mission Date; 27 Nov.-14 Dec., 2006

A laser pointer is used in carrying out radiation and contamination surveys in application of the ALARA principle of optimization of individual radiation exposure. A technician with an audio link indicates the points to be surveyed to another technician doing the survey in a hostile environment such as reactor cavity. Dose saving is reported to be about 30 %.

Yonggwang, Korea, Rep. of

Mission Date; 16 Apr.-3 May, 2007

YGN 5&6 uniquely uses a camera system as an additional supervisory tool to follow workers' actions in order to reduce exposure, optimize working time of radiation workers inside RCA and reduce radioactive waste production.

In addition to the regular monitoring system the so-called CCTV system is managed by the RP Section. The system has been developed as a tool for instant feedback with fast response. The system provides instant real time information regarding people's movement and behavior inside workplaces where radiation risk activities are expected. The connection between workers and operators is organized by all kinds of connecting links (pager phones or other ways).

The system consists of fixed cameras and portable cameras which are located as required to support important or high radiation work. Fixed cameras of CCTV system are located at workplaces and entrances and exits from the RCA, and whole system allows additional control of the efficiency of the radiation works. Operation of the system has brought effective collective dose reduction, reduction of radioactive waste production and reduction in working time. Reduction in working time means reduction of exposures, as well.

The team assessed the contribution of CCTV as very useful tool which significantly enhances radiation protection.

Yonggwang, Korea, Rep. of

Mission Date; 16 Apr.-3 May, 2007

YGN 5&6 uses advanced radiation monitoring system which serves for comprehensive and easily accessible information for radiation workers regarding radiation situation, provides complete operations regarding radiation work permit and ensures detailed environmental information to the public.
The RIS (Radiation Information System) is a very advanced system carrying out many functions.
The RIS has been made as:

- Radiation information system as a part of the environmental management of knowledge information society.
- Advanced radiation safety control such as a reduction of the exposure of workers inside YGN 5&6 RCA.
- Improvement of credibility and reliability of submitted information from YGN 5&6 under domestic and foreign conditions.

The system provides a unique feature easy access the following:

- Direct access to this information by each worker at the entrance/exit of RCA
- Linking with the operating radiation control system (ERP/RAM)
- Ensuring requirements for workers to access and exit the RCA
- Dose database in break down to every single entry to RCA
- Informing each worker of his dose during a certain month or period
- Informing each worker of the radiation situation inside RCA
- Ensuring that the Radiation Protection Permit contains the latest information so that the workers can work inside the RCA safely by providing latest information on real-time basis
- Maximization of efficiency for the radiation control such as convenience of work service
- Information on the dose rate of total 632 monitoring points.

The system offers as follows:

- Direct data exchange with ERP system at KHNP Headquarters and resulting security of handling speed and safety inside RCA
- Provision of more rapid and stable information by securing mass storage server systems
- Unification of system operation equipment and personnel
- Systematic system integration control (unification of server computers and also information on the personal dose for YGN plants 1,2 &3, radiation information by regional groups, homepage of the RP Section)

The Radiation Information System used to support access of and provide doses of radiation workers at YGN 5&6 is a powerful tool which enhances ALARA approach and reducing doses.

Balakovo 4, Russia

Mission Date; 19 May-5 Jun., 2008

The plant use a computer and portable equipment based radiation survey system which allows easy accessible and retrievable information on radiation situation in every room of the RCA. Survey can be carried out periodically or on demand. During a survey is no need to fill tables or to take notes of values.

The needed software is commercially available and easy to set for plants.

The computer database consists of sketches of all RCA rooms together with main technological components. In selected points of the sketch is possible to show values of radiation characteristic entities as dose rates and contamination values. Data are available to all technical positions on the plant. Access and retrieve ability of the information is via intuitive graphic interface.

Radiation survey is performed by a set of pocket personal computer (PPC) and dose rate/contamination measuring device. During a survey RP technician check visually survey points on screen of the PPC as singular pre-planned tasks (detailed pictures of the room in proportional scale are available) and confirm storing of the measured values to the MPC memory. Time stamp of every particular measurement is automatically added.

Data from PPC are later transferred to the PC net computer. The ORACLE database enables to check tasks of radiation technicians, values of radiation survey, trends of values, graphics etc...

The system enables:

- To reduce time in performing the survey
- To present actual information to the workers, work planners and group leaders on
- radiation characteristic in rooms and on equipment
- To improve quality of survey
- To create database of characteristic radiation values
- To create graphic presentation of rooms and equipment with points of measurement

Ringhals 3/4, Sweden

Mission Date; 1-18 Mar., 2010

In-situ gamma spectroscopy to determine surface activity concentrations on internal surfaces of plant systems.

The plant has for many years performed a systematic analysis of the deposition of radionuclides on the internal surfaces of primary coolant and auxiliary systems components using a portable high-resolution gamma spectrometer.

Furthermore, the plant uses radiation dose rate data from a number of fixed points to calculate a “dose rate index”. This index can be used to evaluate the effectiveness of the source term reduction initiatives and to aid wider understanding of how plant operations affect radiological conditions around the plant. Whereas collective radiation exposure is a function of dose rate and occupancy (i.e. the scope of an outage) , the use of an indicator of radiation dose rate on the plant enables an assessment of the effectiveness of the plant chemistry and radiological protection programmes to be made; independent of the outage workload.

These tools have yielded information that has assisted in determining the optimal primary coolant chemistry to reduce source term and optimize occupational doses as low as reasonably achievable. As an example, in 2008, increasing deposition of Ag-110m was detected on cool surfaces of the chemical and volume control system (CVCS) indicating a leaking control rod. Conventional sampling of the coolant system was unable to detect this release and deposition. The leaking control rod was replaced before the Ag-110m became a significant contributor to dose rates around the CVCS.

Doel, Belgium

Mission Date; 8-25 Mar., 2010

Index cards are available describing radiation protection measures as well as the protective clothing and equipment needed for a variety of activities.

The radiation protection department has developed descriptions of a number of standard maintenance tasks (in the form of index cards). The index cards contain the following:

- A description of the functional location
- A brief description of the work, including whether there are any requirements relating to the task according to Technical Specifications
- Radiation protection measures needed for the task
- Protective clothing and equipment needed for the task
- Measures to be taken by the Maintenance department

Index cards also exist for some generic activities. The index cards are available at the radiation protection counter at the entrance to the radiation controlled area. Whenever work is to be carried out, radiation protection staff follow the instructions on the index card to prepare the radiation protection measures needed at the work site.

The index cards are compiled by all radiation protection staff and submitted to review. Periodic review of the index cards is also carried out.

The identified benefits of the index card system are:

- Minimized possibility of errors when preparing radiation protection measures for a work site
- Minimized dose in work site preparation
- Time saved in work planning
- Operational experience of work involving a radiation risk is transferred when index cards are updated.

Evidence of the effectiveness of the system is that the performance indicators for collective work dose at the site are within the best quartile of the industry.

Koeberg, South Africa

Mission Date; 22 Aug.- 8 Sep., 2011

Provision of portable radiation monitors to non-Radiation Protection personnel to allow them to confirm the radiological conditions in their work area and assist in dose reduction.

The RAD-EYE monitor was first used in August 2010 where it was introduced as a dose reduction initiative in the outage. The function of the RAD-EYE is to provide radworkers with a hand held device that can be used to better identify the dose rate gradients in their work area, and on transit to the work area, as a supplement to survey signposting at room entrances. The dose rate readings from the RAD-EYE are for information only, with RP surveys and signposting serving as the official survey data for all control zone areas. The RAD-EYE is mainly to be used by supervisors at the job site in the controlled zone.

The use of the RAD-EYE has steadily improved with radworkers themselves seeing the benefit of the instrument. The RAD-EYE is used by on-job supervisors for insulation installation and removal teams, where lay down areas are identified and higher dose rate areas can be avoided or time in the area minimized as work progresses throughout the controlled zone. Scaffolders can identify areas for staging that represents the lowest practical dose rate in the work area, and can change access routes to the job site based on the lowest dose rate path. Maintenance individuals can better understand the use of time and distance when performing work on valves and pumps. For all groups, the RAD-EYE is used for the radworker to better identify the dose rate characteristics of the work area, where even a few µSv/h can make a substantial difference to the job collective dose when the task proceeds for more than a few hours.

Additional benefits of the RAD-EYE are radworkers awareness of changes in dose rates in work areas and a reduction in EPD alarms.

The RAD-EYE has resulted in real line group accountability for dose, where the radworker now has the independent ability to better appreciate the radiation gradients in the area. The RAD-EYE plays a role in the many initiatives to reduce CRE at Koeberg.

Examples of dose savings:
1) Work was performed at 2RCP001BA The workers did a survey and discovered that they were in an elevated general area dose rate zone. By avoiding the localized area they made a substantial saving.
2) During outage 218 when scaffolding was erected at the RCP pumps, the supervisor performed a pre job survey and realised that the higher the scaffold was erected the more dose they would have incurred. In discussion with RP they applied shielding and also achieved a considerable saving on the job. Similar conditions existed at all three pumps.”

Rajasthan, India

Mission Date; 29 Oct.-15 Nov., 2012

To ensure timely dissemination of radiation protection information, the Health Physics Unit (HPU) has developed a unique display system consisting of a TV-screen and White Board outside of the HPU shift office, which results in rapid and accurate information to all staff on radiological and other related data. This is well visible to all personnel prior to entry into the inner controlled areas. Unique numbering is attached to jobs performed in controlled area.

On the TV-screen are displayed:

- The photos and names of shift health physicists and technicians;
- Information on accessible and non-accessible areas of the reactor building and other relevant rooms;
- The dose rates, contamination levels and air concentration of tritium in various rooms and areas.

On dedicated white boards are displayed:

- Information on the relevant “hot spots” in the station;
- The collective dose targets and the incurred doses for the present year and for some years back.

The data is regularly updated after the surveillance performed during each shift and as new dose data becomes available. It enables both the HPU staff and the other personnel who work in the station to get quick and accurate information about the prevailing radiological conditions, accessible areas and the performance of the radiation protection programme of the station.

Furthermore, a unique numbering scheme is used for different jobs in the controlled area. This enables detailed tracking of dose and trending for repeated activities.

Chooz, France

Mission Date; 17 Jun.-4 Jul., 2013

Enhancements to standard identification of orange zones.

Orange zones are areas of elevated dose rates that require specific authorization for people to enter. In order to prevent inadvertant access without the appropriate authorization the plant has established enhanced warnings at the entry to all orange zones.

Where an orange zone is accessed through a door, as well as the standard warnings posted on the door, the plant have placed fixed extendable barriers at chest height.

Where there is a partial orange zone (term used when only part of the room is classified as an orange zone) the plant apply the standard barrier tape which is supplemented with a visible and audible sign that has motion sensors that activate the flashing lights and audible warning.

Since the implementation of both practices in 2009, the plant has not had a significant reportable event of persons entering and orange area without appropriate authorization.

Flamanville, France

Mission Date; 6-23 Oct., 2014

Preventing access to very high risk radiation areas

Some rooms containing primary circuit demineralizers are classified as red areas (very high risk radiation areas) as they contain active resins. As it is not possible to physically lock the shielding providing access to these red areas, the plant has developed a system using 2 plates secured by tamper-proof screws that are fixed on the bunker slab, thereby preventing access to embedded lifting rings.

- Vis inviolable SPR
- Vis inviolable DIRECTION

Appropriate control of access to the red area is thus guaranteed The first key is managed by senior management and the second is managed by the RP department with 2 different tamper-proof screws.

This practice eliminates the risk of unauthorized opening of the resin bunker without having required authorization and without using the red area access process.

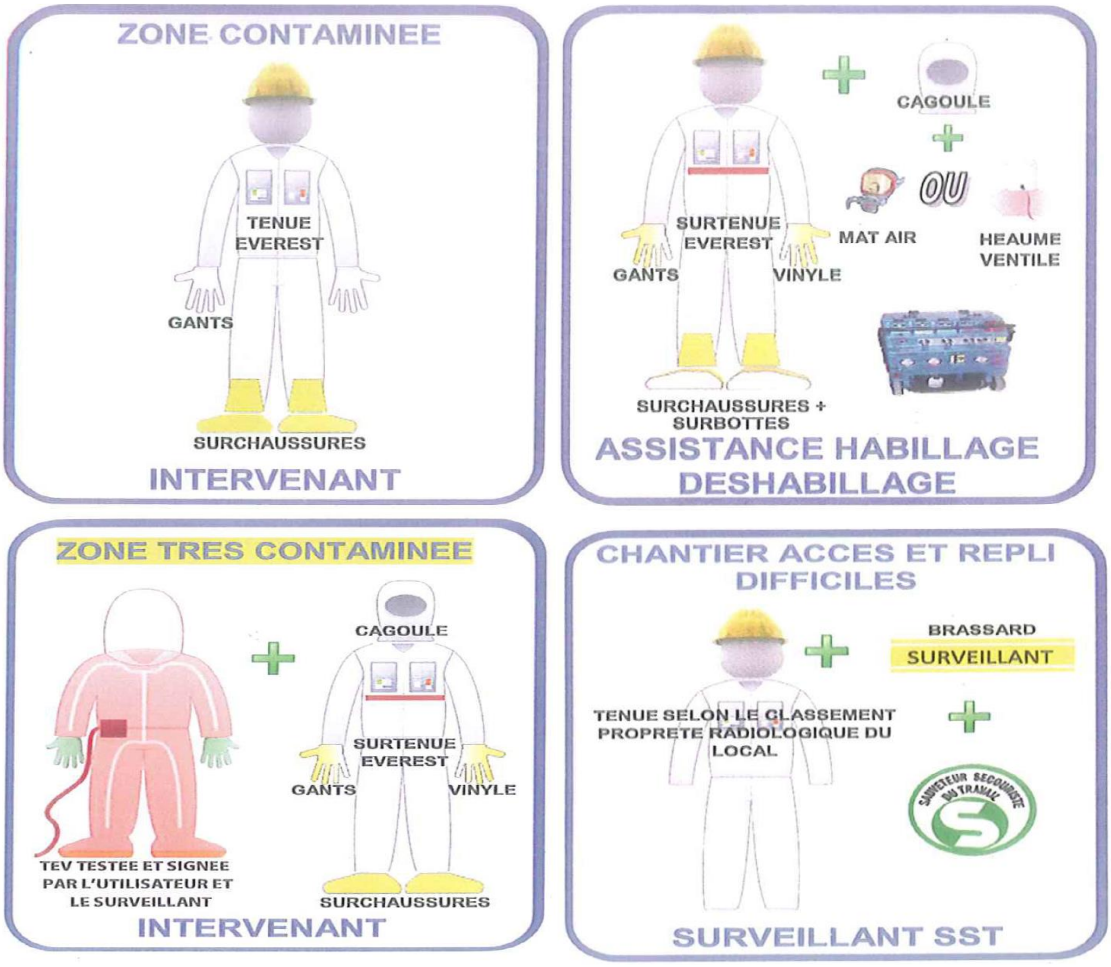
Flamanville, France

Mission Date; 6-23 Oct., 2014

Stickers for radiation protection work areas

In the past, access conditions for RP work areas were listed in written form on sheets, parts of which had to be completed by hand depending on the area's classification.

These sheets have been replaced by stickers, which correspond to the different types of predefined working conditions: the sticker is affixed to the worksite identification sign and stipulates prerequisite conditions for entering the work area.



Clearly legible stickers provide a simple illustration of the equipment to be worn for entering the area (PPE + other appropriate equipment).

This stand-alone worksite identification sign eliminates potential errors and omissions associated with handwritten information. It also promotes consistent work practices.

Torness, UK

Mission Date; 22 Jan. - 8 Feb, 2018

Remote viewing of Radiation Controlled Area contamination monitors.

The operating status of the Radiation Controlled Area exit monitors can be remotely viewed and interrogated from any networked personal computer (PC) in the station. This enables verification that all alarms are investigated and reported as well as early reporting of defects.

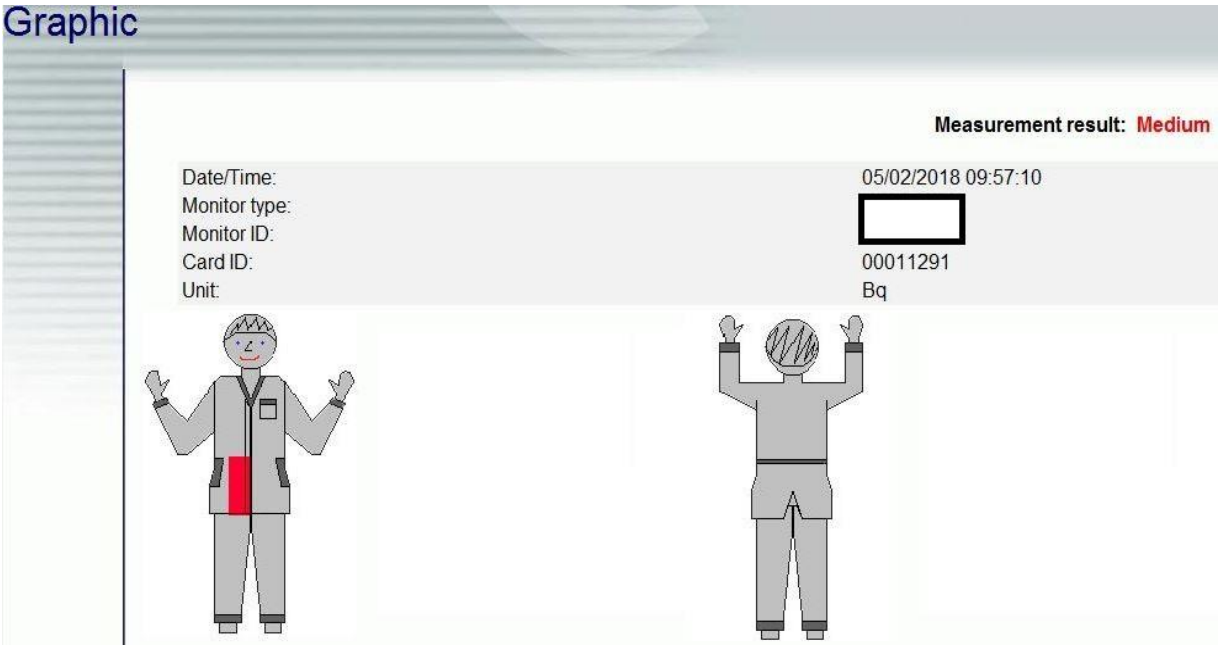
The system software enables the user to trend results for individuals working in the Radiation Controlled Area.

The previous version of the Radiation Controlled Area exit monitors could not be remotely interrogated in this way, which did lead to some events (approximately 2 events per calendar month) going unreported. This has now been completely eliminated.

The station has also identified other benefits of using networked Radiation Controlled Area monitors, such as:

- The ability to remotely view individual monitor operating performance improves ease of fault finding and early reporting of instrument faults.

- The ability to trend sub-alarm, low level build-up of chronic contamination on worker clothing. This enables early radiation protection (RP) personnel intervention to reduce the number of unnecessary alarms by suggesting laundering the personal protective equipment (PPE).



Flamanville 3, France

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

Optimization of the design to improve occupational exposure and the effectiveness of RP facilities.

Since the beginning of construction of FLA3, the radiation protection group has analysed the way work will be carried out in the RCA and has requested several design changes to optimize radiation exposure during operation and outages. Some of the examples include:

- Installation of five portal monitors C2 and three small object monitors CPO at the exit of the RCA instead of six portal monitors C2 and two small object monitors. This modification improves the flows at the exit of the RCA and reduces the background of interference of portal monitors.
- The installation of a container full of RP equipment in the extension of the fuel building. The equipment is used to check the fresh fuel upon arrival.
- The C1-RB portal monitors were relocated at the exit of the airlock at 19.5m to maintain good contamination control.
- A room was repurposed for decontamination at the exit of the RCA.
- The water filter transfer machine adapted from Konvoy initially lacked a system to ensure negative pressure during transfers. The plant requested a system modification to deal with this inadequacy.

Benefits:
The design changes allow better work flow, shorter intervention times, improved radiological conditions, better contamination control and more efficient entry and exit from the RCA.

Thanks to the design changes, the modified equipment, facilities, and layouts provide noticeable improvement in the usability of the installations. This will lead to shorter stay time in high radiation areas, better shielding, and more efficient work flow resulting in reduced occupational exposure.

Belleville, France

Mission Date; 15 Nov. - 2 Dec., 2021

Radiation Protection had a double barrel key control programme for High Radiation Zone access in which Senior Management person and a Radiation Protection (RP) officer are the only key holders. Both people must attend to open the lock.

Access to the High Radiation Zones is granted by meeting the following criteria:

- A justified and planned activity
- An approved High Radiation Zone access form
- An approved specific Radiological Work Permit (RWP)
- A specific Risk Analysis
- A briefing of the workers in the presence of plant senior management (one key holder) and a Radiation Protection officer (second key holder).

These well-defined access criteria include senior management engagement for both access and briefing. The senior management engagement in granting access to red area contribute to the heightened awareness on this topic. There have been no reported High Radiation Access Events in the last five years. This practice can be applied to any plant.

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

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

The plant has designed and implemented a Smart Thermoluminescent Dosimeter (TLD) system

- Camera system identifies TLDs that have not been returned on a daily basis, automatically notifying TLD owner via SMS text to return TLD. Prior to implementation, this was done manually. Estimated time savings, 5 days at end of month for processing TLD.
- TLD kiosk enhances worker knowledge for assigned TLD number, especially useful during outages when new workers arrive at plant.
- TLD kiosk allows workforce to identify which Radiation Work Permit (RWPs) they are approved to work.
- TLD kiosk allows workforce to determine dose received for the month.
- TLD verification utilizing fingerprint to validate person is using correct TLD.

Benefits:
This system has enabled Radiation Protection to improve the effectiveness of TLDs management and enhances radiation worker knowledge.

TLD Camera System

TLD Kiosk