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BOOK OF ABSTRACTS

The Practices and Researches of HYH Plant Optimized Radiation Protection

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Abstract: The basic requirement for radioprotection management is to guarantee the effective dose of the public and personnel worked for the nuclear plant should not exceed the threshold based on national laws and regulations. Optimized radioprotection in a nuclear plant aims to realize ALARA occupational exposure in consideration of the cost and society issue. Based on its application, the Hongyanhe plant radioprotection team has summarized and developed a five dimensional model of optimized collective dose control. The five dimensions are primary loop purification, hot spots shielding and removing, the improvement of instruments and technologies, maintenance project and process optimization and the promoting of staff safety skills and awareness.

The primary loop purification mainly includes the element control of system material and spare parts, the optimization of outage purification operation, the upgrade and optimization of radioactive system filter. The hot spots removal and shielding are mainly based on the formation mechanism researches, and carried out by means of flushing and fixed shield. The instrument and technology improvement bound to promote work efficiency are carried out by special tool developments by maintenance groups according to task characteristics. The typical ones are the application of valve seat grinding special fixed holder, the scaffolding construction process improvement of reactor refueling pool and spent fuel pool cooling and processing system spray lines, insulation improvement of high dose rate areas and so on. Maintenance project and process optimization are achieved through merging and adjusting the maintenance task windows and optimizing working procedures, and eventually reducing the radiation level of the site or the on-site working time. The main practices include nuclear aux building maintenance work preparation optimization, outage intensive maintenance work area scheduling optimization, pneumatic head disassembly procedures optimization. The promoting of safety skills and awareness starts from designing safety courses dedicated to different maintenance scenario, on-site training, accurate notification of radiation safety information, and providing professional guidance and good practices, and eventually the working teams and members perform optimized dose strategies on their own initiative, and are willing to build and spread the awareness of dose optimization.

In 2018, the annual CRE indicator of Hongyanhe unit 1 reached excellent level of WANO PWR units. The H401 outage marked the optimal collective dose of ten-year outage of all CGN PWR units. Annual outage collective dose has repeatedly reached top 1/4 among CGN.

Keywords: nuclear plant; radiation protection; unit outage

EDF'S Eye Lens Doses Study: Methodology, Results and Strategy chosen for Interventions in an Industrial Environment

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Transposition of Euratom 2013/59 directive into French regulations and in particular the lowering of annual regulatory limit for eye lens dose from 150 mSv to 20 mSv has led EDF to carry out an impact study on its employees. This study complements the work of the "Eye Lens Dose French working group" in 2013. Its aim is to quantify the impact for the nuclear industry and retain a strategy for dosimetric monitoring of eye lens.

As passive equivalent extremity dosimetry, eye lens dosimetry is under responsibility of the employers. As operator of a nuclear electricity production facility, EDF must inform provider companies involved of eye lens risks specific to certain activities.

A first list of activities, called at risk of specific exposure of eye lens, had been identified and characterized during an inter-company "Eye lens WG" in 2013. As a reminder, this WG also aimed to harmonize monitoring practices with all provider companies.

In 2018 and 2019, our additional study targeted a sample of EDF employees made up of workers carrying out activities known to be dosing in controlled areas (monthly dose read on the passive whole-body gamma dosimeter greater than 100 µSv). A sample of five to fifteen people per Business Line, on several EDF sites (Dampierre, Flamanville and Gravelines NPP's) and at different levels were selected for this study. Eight professions have been targeted:

- Operations Department: Field operator
- Logistics/waste Department: Waste handlers.
- Mechanical Service: Plumber/Pipefitter and Boilermaker.
- Risk Prevention Department: Radiation protection technicians.
- Mutualized Outage Team: Controlled area technicians, Reactor building Coordinators.

Additional employees from other EDF units have also been introduced in the sample: Mutualized Outage Teams (EMAT - UTO) from 10 to 20 employees per service and teams from the Maintenance Logistics Unit (ULM - DTEAM) from 30 to 50 employees.

Results obtained were shared with the subcontracting companies also carrying out specific eye lens dose studies. The first observation shows that employees, in an industrial environment as NPP are not concerned by a predominant exposure to eye lens. Our study is based on 526 measurements of one month. For each wearing period whole body dosimetry Hp(10) and eye lens dosimetry Hp(3) were collected. The collected data and results are analyzed according to the LNE-LNHB study [1]. At the end, EDF also propose a schema to decide if employees need to monitor eye lens dosimetry of employees or not.

These results will be presented along with the strategy validated by EDF to ensure that the risk of exposure to eye lens is properly taken into account.

[1] Monitoring of eye lens doses in radiation protection. J.-M. Bordy CEA, LIST, Laboratoire National Henri Becquerel (LNE LNHB), 91191 Gif sur Yvette Cedex, France. Radioprotection 50(3), 177-185 (2015).

Practical Implications of the New Dose Limit to the Lens of the Eye at Forsmark Nuclear Power Plant

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Due to statement and recommendation of ICRP, a lower dose limit regarding equivalent dose to the lens of the eye was introduced in both IAEA and EU Basic Safety Standards. The limit was lowered from 150 mSv/year to 20 mSv/year. Considering this new dose limit the Swedish nuclear facilities identified a need to monitor workers´ eye lens doses in order to ensure compliance.

Nuclear facilities in Sweden, in cooperation, identified specific works tasks where extra monitoring of the eye was needed. These were situations where the eye is more exposed than the rest of the body due to shielding or where the eye is closer to the source of radiation than the rest of the body.
During 2018 and 2019 Forsmark NPP identified and monitored several different work tasks.
For measurement of equivalent dose to the eye Forsmark NPP uses dosimeters from Public Health England Personal Dosimetry Service (PHE PDS).

The results from 2018 and 2019 presented in this study, show that for certain work categories, at boiling water reactors, the equivalent dose to eye lens can exceed the effective whole body dose, measured by passive TL-dosimeter, by up to 50 %. Thus can dose to the eye lens be limiting when ensuring compliance with dose limits. Results for work on Control Rod Drive Mechanisms (CRDM) showed a high tendency for a higher dose to the eye than the effective whole body dose. For other work groups there was little or no difference between the eye dose compared to effective whole body dose. This shows that it is important to continue identifying risk task in the facility and investigate different work forces in risk of higher dose to the lens of the eye than the effective whole body dose.

The results indicated that nuclear facilities in Sweden need to continue to monitor workers, especially itinerant workers. For correct measurements and analysis, it is important to continue to identify risk task in the facility, assign dosimeters to the right individuals and make sure worker wears the dosimeter in a correct manner.

RP Assessments and Planning: Competences, Strategy, Processes, Tools

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Developing a RP-assessment process fulfilling ALARA must be founded on several aspects including: detailed information exchange, experienced and well-trained RP staff, systematic strategy, accurate process structures and issue-related IT-tools. This all is needed equally for the planning and preparation for jobs that may comprise a radiological risk.

Within this report the necessity for a suitable assessment of the radiological conditions as well as the arrangements for RP measures and furthermore their monitoring for upcoming modifications in nuclear facilities, comprising the installation and the operation of tools and equipment used for dismantling, will be discussed. The method of assessment and planning is shown using the example of the removal and conditioning of radioactive sludge from pools of a research reactor.

Updating the "alpha value" used at EDF – Presentation of the work performed by a dedicated working group

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As a radiation protection decision making-tool, the monetary value of the man.sievert – the so-called alpha value – is used periodically at EDF, for design or operating purposes. As the last version of the alpha value system was elaborated in 2003, it was time to consider its update. For this purpose, a pluralistic working group, gathering EDF engineers and researchers from various radiation protection fields and also members from the CEPN, has been set up in 2017.

In the framework of this update several tasks have been conducted:

- The preparation phase (2017) dedicated to collect and analyze international current practices (the ISOE network was notably appealed to answer a survey) and a documentary review or reassessment of the notions and input data involved in the alpha value calculation,
- The analysis of EDF's real case-studies involving the use of the alpha value (or a multicriteria approach),
- The proposal of various scenarios that can support a new alpha value system (2018, 2019),
- The evaluation of consequences of each scenario and the questions they can raise.

Taking into account the EDF operating experience related to the use of the system, it has been decided to introduce a single reference alpha value (instead of a system of values depending on the annual personal dose of the workers concerned by the task). Nevertheless, the system is flexible and radiation protection criteria have been identified to allow the use of an increased reference value to support EDF managerial decisions in some situations presenting specific radiation protection issues.

In this presentation, we will focus on the main elements that were taken into account to propose a new system of reference monetary values of the man.sievert at EDF. We will also approach the question of how the reference alpha value could be used depending the various radiation protection situations.

Management of radiological contamination – Feedback experience from several ISOE utilities

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Radioactive contamination control in nuclear power plant is essential to prevent personnel contamination and the spread of radioactive contamination towards clean areas and EDF has identified this theme as an area for progress for its fleet. With a view to assess current EDF fleet performances with regards to the control of radioactive contamination based on actual and comparable data, as well as to identify good practices that could be implemented, EDF asked the ISOE European Technical Center (ETC) to collect feedback experiences from other utilities.

ETC performed then a survey on the management of radiological contamination addressing a number of sub topics including:

- rules for the classification of areas,
- means for controls of contamination,
- management of PCEs,
- organization and performance indicators.

A dedicated questionnaire was sent to a number of RPM identified in ISOE community. Ten answers were collected and analysed.

This presentation aims at providing highlights from the survey with regards to the actual controls of contamination (levels and devices), the management of PCEs and actions implemented for preventing spreading of contamination.

Impact of Radon on Personal Contamination Monitors at the Exit of the RCA in EDF NPP's

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Between 2008 and 2017, EDF has gradually replaced old personal contamination monitors (C2 Nardeux) with a new generation of PCM. These new portals have beta and gamma detectors.

The renewal of these devices allowed: a better monitoring of C2 portals' alarms triggering, beta and gamma measurements more reliable and more precise, minimization of dead zones and carry out morphological compensation due to the attenuation effect of the background (generated by the body).

The improvements mentioned above make this new PCM extremely efficient and capable to detect low contamination activities. The sensitivity is such that we are starting to detect solid descendants of Radon such as Polonium present on the clothes of people controlling themselves in these portals.

In order to quantify the impact of Radon and its descendants on the triggering of C2 portals, a study was undertaken. Beyond the physical aspect, several issues are targeted by this study:

- Provide quantitative explanations to people concerned by the C2 alarms attributed to Radon,
- Reliability of the radiological cleanliness indicators and more precisely the "C2 trigger rate" indicator which is monitored monthly by EDF,
- Try to optimize practices, namely to wait 30 to 40 minutes between the end of the work and C2 control at the exit of RCA.

The study consisted of measuring the activity of radon descendants deposited on several types of coveralls used in EDF NPPs. To assess the impact of Radon, several factors were tested, including exposure time, Radon concentration and nature of fibers constituting clothes.

For this study, several key technologies from the CENBG, a research laboratory jointly managed by the nuclear and particle physics institute of the French National Center for Scientific Research (IN2P3/CNRS) and the University of Bordeaux were used. This include the use of 222Rn emanation source standard as well as their calibration method. This method requires emanation chambers of various volumes between 60 liters and 750 liters. The Radon concentration checks in the sample exposure atmospheres are carried out jointly by commercial and also experimental radon detectors. Measurements of 222Rn solid descendants on clothes are made immediately after exposure by gamma spectrometry control on HPGe detectors. This experiment was carried out on PRISNA measurement platform (Plateforme Régionale Interdisciplinaire de Spectrométrie Nucléaire en Aquitaine).

BLAYAIS NPP (FRANCE) DRAIN PIPE EVENT

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In 2015, the inspection of the drain pipes of BLAYAIS 2 Steam Generators (SGs) showed the presence of important deformations in their extremity near the welded zone, on the Primary Channel Head (PCH).

These deformations were noticed on two SGs: SG1 hot leg side (HL) and SG2 cold leg side (CL). Since the deformation is more significant on SG2, the priority was given to detailed study.

In 2017, SGs were subjected to further inspection and the measurements carried out on SG1 showed an evolution of the deformation compared to those noticed in 2015.

Between 2015 and 2017, there were three operating cycles that is to say three transients of startup-shutdown however SGs were only opened in 2015 (end of the 1st cycle) and in 2017 (end of the 3rd cycle). Consequently much that what was observed in 2017 is the result of what happened in all three cycles.

If we call the deformation « blister », for SG1, the 6mm high blister observed in 2015 had reached 10mm in 2017, two cycles later.

An intervention is scheduled for 2018 on the two SGs to repair the drain pipes. This intervention includes the treatment of the deformations, the insertion of a new drain pipe and the welding of the two extremities inside the PCH.

Considering the high stakes in Radiation Protection with a collective dose approximately 60 man.mSv per SG, a dose rate around 30 mSv/hour and the entrance of personnel inside the PCH for tooling and welding processes, an ALARA approach in charge of optimizing (reducing) the overall exposure has been applied :

- A PCH mock-up has been designed to train the employees and thus optimize the intervention durations
- A specific tool has been designed to avoid the presence of personnel inside the PCH for the treatment of the deformations
- A collaborative Working Group ALARA (EDF Study & EDF Power Plant & Subcontractors) has been set up in preparation phase to define practical ways to reduce the collective and individual doses
- Decontamination processes and specific biological shielding have been studied
- Personal protection equipment has been optimized to facilitate the intervention, ensure the control of the technical gestures with a high level of protection against radiological risks
- The follow-up methods for collective and individual doses have been reinforced to control and anticipate any dose deviation from expected levels

Improvement of emergency radiation protection arrangements at the Tihange nuclear power plant

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ENGIE Electrabel is owner and operator of 7 nuclear power plants located on 2 sites, 4 at Doel and 3 at Tihange., all of PWR type.

In 2018, a Peer Review conducted by the World Association of Nuclear Operators (WANO) at the Tihange NPP, highlighted that the emergency radiation protection arrangements were not ranging in the international standards. More precisely :

- The Emergency Coordination Center (ECC) was not enough protected against the hazards of radioactive contaminants, because of the lack of radio-iodine filtration and because the building was not designed against seismic hazard ;
- Several radioprotection arrangements were planned in procedures but not enough exercised by the appointed emergency workers.

The presentation will describe how the Tihange NPP tackled those shortcomings.

In 2019 a back-up ECC facility was built on the Tihange site, characterized by a seismic resistance of 0.25 g, filtered against iodine and airborne contaminants and located above the beyond design flooding level. The back-up ECC hosts a mobile trailer equipped with the various communication media, needed to manage the crisis and is designed with a decontamination sas.

In parallel, since the very beginning 2019, the emergency personnel was involved in exercises with enhanced realism with regard to accidental situations with radioactive contaminants.

A third area for improvement was the development of arrangements for preparing, transporting ("NORIA" procedure) and getting back our emergency workers, from a rear base located in a non-contaminated area, involving Corporate and contractors resources.

Those main three areas for improvement converged into a challenging exercise organized in 2 days and involving ~ 140 interveners during 4 successive shifts. This exercise was the opportunity to test and demonstrate our improvements in the management of beyond design accident conditions, with significant radioactive releases.

Application of Reference Dose Levels for Radiological Emergencies at Forsmark NPP, Sweden

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In the event of a Radiological Emergency the normal Radiation Dose Limits are substituted by Reference Dose Levels. Sweden has recently implemented a new Radiation Protection Regulation with updated Dose Limits and Reference Levels in order to harmonize with the BSS Directive 2013/59/Euratom.

The aim of this report is to describe how Forsmark NPP has applied these Reference Levels both in general terms and for task specific optimisation. In the latter case the dose assumed for a specific action must be motivated by the aim and result of the specific action. We have also defined when an event at the NPP automatically transforms from a disturbance to a radiological emergency. Moreover this work has been implemented in guidelines with operational intervention levels (OIL´s) facilitating the work of the Radiation Protection Manager in an emergency situation.

Based on task specific Reference Levels we have pre-set dose and dose rate alarms on our emergency EPD system.