

RADIATION PROTECTION PROFESSIONALS IN NUCLEAR FACILITIES: AN INTERNATIONAL OVERVIEW ABOUT REQUIREMENTS ON EDUCATION AND TRAINING

Swen-Gunnar Jahn

Swiss Federal Nuclear Safety Inspectorate (ENSI), Industriestrasse 19, 5200 Brugg, Switzerland

ABSTRACT

Exchanging information on education and training (ET) in radiation protection (RP) is still an important aspect for **ISOE**¹ to strengthen RP in nuclear power plants now and in the future. On the ISOE Management Board meeting in 2016 one special session was dealing with education and training for radiation protection professionals in nuclear power plants (NPP). Representatives of France (FR), South Korea (KR), Switzerland (CH), United Kingdom (UK) and USA (US) presented and discussed the learning objectives, training scheme and other details on this subject. During an ISOE meeting in 2014 representatives from nine European regulatory bodies exchanged information on legal requirements about education and training in RP for personnel in nuclear power plants (add. Germany (DE), Finland (FI), Netherlands (NL), Spain (ES), Slovenia (SI), Sweden (SE)).

This report reveals the results of a comparison of demands on ET for “RP managers” and “RP technicians” in nuclear power plants, which with exceptions is also valid for other nuclear facilities. Although the requirements regarding the learning objectives for these particular professions with similar function, role and tasks are nearly conform, the demands on pre-education level, amount of lessons and duration of on-the-job-training are differing clearly between those countries operating nuclear facilities. On the other hand, several countries have nearly the same requirements, which would simplify the process of a mutual recognition of ET certifications.

1. Groups of different roles and functions

Radiation protection in nuclear power plants is a challenging issue and comprises numerous of different exposure situations. Therefore the staff of NPP has to deal with many different tasks in RP. Considering this, a clear distribution of reasonability and responsibility on different roles and functions is needed. In this report we focus on RP professionals only (RP managers and RP technicians), not dealing with other organizational units or positions for single persons in a NPP carrying responsibility in RP (for example: delegate of licensee in matter of RP, head of the NPP, control room staff, external RP services, radiation worker). In contrast to Radiation Workers and all other positions in a NPP the RP professionals work fulltime on RP issues and consequently RP is their first priority.

Other facilities within the nuclear cycle (as uranium mining, fuel production, waste management, fuel recycling, interim storages) as well as research reactors and nuclear (hot)

¹ ISOE = Information System on Occupational Exposure, supported by OECD/NEA and IAEA, representing around 400 nuclear power plants and 28 regulatory bodies

laboratories, may demand adequate functions and roles, but there are varieties concerning ET and the range of tasks.

1.1 RP managers

This term comprises positions or functions, which are termed as the “head of RP unit”, “RP radiation safety manager”, “RP commissioner”, “RP specialist”, “RP supervisor”, “RP surveyor” or “operational RP group leader” and her or his substitutes. They are responsible for the whole range of RP tasks including those of RP expert and RP officer as referred in the EU-Directive 2013/59/EURATOM called EU-Basic Safety Standards (EU-BSS). Only few countries (NL, UK) require an independent “RP advisor” or “RP expert” additionally to the “RP manager”. In few countries (SE, SI) the company or organization employs one well experienced RP expert who gives advices to the NPP management and supports the RP manager on strategic issues. These RP advisors or RP experts should meet the same requirements on knowledge and experience, so these functions may be added to this group of “RP managers” also.

1.2 RP technicians

Because the term “RP technician” is common in several countries, we use it within this report for all other RP professionals in contrast to “RP managers”. The RP technician perform tasks, which - referred to the EU-BSS - are assigned to the “RP officer”: preparing, realization and supervision of the RP measures inside the facilities to protect the personnel of a NPP. There are different levels of “RP technicians”, which are hereinafter called “RP senior officer”, “RP junior officer”, “RP foreman” “RP practitioner”, “RP controller” or “RP assistant”.

2. RP managers

2.1 Roles, functions, tasks, responsibility

These positions (comprised by the term RP manager) take responsibility to develop, implement, manage and control the radiation protection programme at the nuclear facility (ES, CH, DE, SI), including the translation of RP legislation or facility license requirements into company internal rules. The RP managers are particularly responsible for:

- prior critical examination of installation plans and its projected power operation and outages from the radiation protection perspective, including evaluation of activity inventory, radiation power, source terms, exposure paths, dose rates, contamination levels, radiological risk to exposed workers, persons on site, public and environment in normal operation, minor deviations and events;
- determination of generic RP measures as classification of radiological controlled areas (RCA) depending on potential dose rate and contamination levels, optimisation of structural, technical and personal protection equipment;
- implementation of monitoring for different areas, systems and workplaces, personal dosimetry, monitoring intakes, control of exhaust air, of effluent releases and of material outlet and immission monitoring outside the RCA in accordance with legal requirements;
- determination of policy, strategy, concepts, radiation protection tasks and responsibilities within a RP program;
- RP personnel staffing and qualification requirements necessary for completion of all RP tasks during power operation, outages as well as during incidents and emergencies;
- classification of workers into different categories;

- prior evaluation of procedures as well as single jobs regarding radiological risk; determination of additional job specific RP measures considering optimization as well as implementation of extra monitoring;
- evaluation and monitoring the status of radioactive goods before transportation in compliance with international regulation;
- acceptance into service modification of the installation, including new radiation sources, from the radiation protection perspective and
- giving advice to the facility management ensuring sufficient resources and authority for the personnel implementing radiation protection.

2.2 Necessary knowledge, experience and skills, requirements on ET

The necessary competence dealing with all the tasks from the list above comprises a deep understanding of the physics of radioactivity and radiation, interaction with material as well as of biological effects. Furthermore the optimized application of protection measures and measuring instruments demands knowledge and experience on the technology. The RP managers also need experience to imagine expectable events. Skills as leadership and communication are necessary to manage these complex tasks in collaboration with other divisions and RP professionals.

In some countries very detailed requirements about knowledge, experience and skills for the Head of the RP Unit and substitutes (CH, DE, ES) are laid down within the legislation.

The educational level for these positions is a graduate degree in technology or natural science (DE, CH, FI, ES, SI), as for example bachelor in engineering or architecture (ES). There are also exceptions for RP senior officer without university level but with long-term experience, which gives an adequate background comparable to high school level. With these educational levels, candidates have to participate in an ambitious RP-course and pass through an examination. In some countries the content of education and training, as well as the duration or amount of school lessons, theoretical and practical exercises and on the job training is described in a special ordinance or guideline about education and training in RP (CH, DE) or in the RP program approved by the authority (ES). The duration of these courses ranges between around 80 h (SE), 150 h (DE, CH), 200 h (SI), until 300 h (ES).

Another way to achieve the necessary knowledge is to study RP in specialised high schools and pass an exam for RP Bachelor, RP Master or RP engineer degrees. Additional to these studies knowledge about design and operation of NPP is required, if it was not in the content of the study.

Additional to the RP knowledge gained at high school or in specialised courses, in all mentioned countries the candidates have to gather RP work experience at least in the RP unit, where she or he takes over the function of RP manager. The minimum duration of on-the-job learning in RP ranges between 6 months and 3 years (CH: 12 months, ES, US: 3 years). Additionally the candidates have to get a detailed insight to the design, organization and processes of the facility (CH: 6 months, US 1 year). Some countries require the participation of RP managers within the emergency preparedness organization. Therefore particularly the candidates have to participate in emergency exercises as required for recognition.

2.3 Competence level and its recognition:

The competence level of RP managers described above is as high as of the “RP expert” referred in the EU-BSS. According to EU-BSS all EU member states have to install an recognition system for the RPE.

Nearly all countries (CH, DE, ES, FI, SI) already require the recognition of the RP manager competence level by an authority body. The candidate have to provide evidence about its competence with certification of course participation (knowledge), testimonial of exams (skills) and letter of references (experience). Some of the authority bodies perform final examination, take part during examinations or inspect emergency exercises.

3 RP-Technicians and other levels of RP-Professionals

3.1 Roles, functions, tasks, responsibility

In most countries, besides the RP-managers, positions in RP of NPP are installed which demands well trained and experienced RP professionals, although they are not defined as such in regulatory guides (DE, FI, US). The roles and functions of these positions are to support the RP managers by planning, preparing, performing and controlling the RP measures and monitoring including the tasks, which - referred to EU-Directive - are assigned to the “RP-officer (RPO)”.

In some countries different levels of RPOs exist, depending on the range and complexity of tasks assigned to them. These different positions demands different states of knowledge and experience. The amount of levels is typically two or three: RP senior officer, RP junior officer and sometimes a kind of RP officer assistant.

“RP senior officers” are postulated to deal with tasks including planning RP measures and monitoring for infrequent, high risk jobs which need a wide experience. The usual term of the competence level of those “RP senior officers” is “RP technician” (CH, FI, ES, US). In some countries, these senior RP officers are mentioned in the legislation (“Strahlenschutztechniker” in CH, “Expert Technicians in RP” in ES) or some legal document regarding the qualification of people engaged as RP senior officer positions (“Strahlenschutzmeister” may be translate as “RP Handcraft Master” in DE). These RP technicians typically manage and control all RP aspects within limited areas of the NPP (turbine hall, drywell, etc.) or on special aspects/projects (rad waste, monitoring systems, decommissioning etc.). These RP technicians may lead a group of RP professionals with lower levels of competence. They also instruct radiation workers.

The next lower level termed “RP junior officer” (or RP controller, RP practitioner) is used in several countries for RP professionals responsible for regular (scheduled, routine) RP tasks (CH, DE). For example, they are supporting the exposed workers respectively radiation worker in using protection equipment. They survey the radiological conditions on the workplace and generate radiation work permits.

In some countries, a so-called “RP assistant” level exist as a pre-stage of “RP controller” (CH, DE) or they are students (FI). They are supporting the RP-officer junior by preparing the protections measures. They do simple jobs without radiation risk. They take no responsibility and they need no experience.

In FR and in UK there is no distinction between RP senior officers and RP junior officers because the “Radiation Workers” (RW) complete tasks that are within the responsibility of RP junior officers in other countries (e.g., proper use of monitoring equipment and personal

protective equipment). In FR the tasks of RP senior officers are undertaken by PCR (persons competent in radiation protection) in a RP service, RP engineering or SSQ (Service in charge of RP controls).

Beside of “RP engineering personnel” in the UK there are different levels of RW (training for unescorted access to controlled areas: 2 hour instruction; training for RW including monitoring on workplace and exit from RCA: 1 week).

In KR legislation does not require RP professionals but makes ET for Radiation Workers mandatory, which last between 12 and 40 h depending on the stage of RW (exposed persons or persons frequently handling radioactive materials)

In most countries RP technician from external RP companies are taken under contract supporting the RP unit during outages and other people-intensive projects.

3.2 Necessary knowledge, experience and skills; requirements on ET

Because of several differences in the countries, a detailed explanation of an example of a training career from CH starting from zero up to RP technician (RP senior officer) is given in the following:

- Normally starting with a basic vocational degree the “RP assistants” have to attend an introduction course. This introduction comprises a two weeks basic classroom training in RP plus 6 weeks on the job training in the facility and a one week basic course on NPP technology (main-systems and operation). This introduction into the career as a RP professional offers the opportunity for the candidate as well as for the employer to decide, whether this career path does or does not fit to the person.
- Based on this introduction, the training of “RP controller” (RP junior officer) starts with a detailed fundamental education and training on mathematics, physics, radioactivity and ionizing radiation. Further on the ET course deals with the most evident exposure situations in a NPP as well as the corresponding RP measures and monitoring procedures (without being too academic in contrast to those courses for RP managers). Accordingly, the course explains the technique of protection equipment and measuring instruments as well as their application. The course further contains a detailed study of the design and operation of NPP systems, which have an influence on RP, including water chemistry, decommissioning and waste management. This course comprises classroom training, table top exercises, exercise using real RP equipment and measurement instruments, exercise in one-to-one environment (or on-the-job-training inside radiological controlled areas). The duration of this intense course is approximately 500 h. The course finishes with written, oral and practical examinations.
- After several years of vocational experience as RP junior officer (in CH in total 3 years, exceptionally 2 years) the RP technician (RP senior officer) training may start, wherein candidates repeat the content of initial RP controller course in depth. The training objective focus on the generating of RP plans for typical (radiological high-risk) jobs in a NPP including the analysis of risk due to normal operation and events. The course lasts 350 h. As a final examination, the candidate has to work out a RP plan for a job within the nuclear facility and has to represent the plan to the examination board.

In total the training courses for reaching the RP technician level in CH comprise around 40 weeks, including 12 weeks of practical exercises, several month on the job training accompanied by an experienced RPE or senior RPO as well as at least 2 years of gathering experience. For the continued ET RP technicians as well as RP controllers have to attend a refresher course of two days each third year.

In DE the requirements on knowledge and experience for the first two stages “RP assistant” and “RP junior officer” (“Strahlenschutzfachkraft”) are nearly identical to CH, with one major difference; The candidates may attend the course voluntarily, but they have to pass written, oral and practical exam, which are rigorous. For the third stage “RP technician” the NPP in Germany arranged an agreement, that persons with a pre-education as technician or engineer having the knowledge of “RP junior officer” and several years of experience may be called “RP technician”. RP technicians may broaden their skills by attending a demanding course for “RP Handcraft Master” comprising several modules including business administration and project management.

In the US, RP technician candidates have to attend nearly the same amount of education and training lessons as in CH. A guideline for training and qualification of RP Technicians contains the requirements for initial and continuing training. The ET schedule starts with an initial training process for RP technician. Duration of initial training is generally six to nine months comprising classroom training, participation in on the job training and task performance evaluations. The RP continued training process consist of refresher training and of operating experience training (lessons learned from events). Duration and frequency of RP continued training: Approximately 24 to 32 hours each calendar quarter.

In UK, there exist a training programme for “RP engineering personnel”, which follows mainly the same scheme as the US RP technician guideline with an initial and a continued training.

In FR, an RP staff specific training program exists, which is a mixture between theoretical/practical training (12 weeks) and on-the-job training (in total 6 month duration). This programme includes lessons about conventional safety, fire safety and radioactive goods transport regulation additional to RP issues.

In most countries, RP technicians from external RP services usually have to meet the same requirements on ET as the RP technicians in the RP unit of the nuclear facility. Additionally to the core RP training as described above, these outside RP professionals have to participate in specific training given by the particular NPP.

3.3 Recognition

The utmost competence level is noted as “RP technicians” (CH, FI, US) and the course is recognised either by specialised company associations, by the Head of RP Unit or by RP Services (DE: Industrie- und Handelskammer, ES, SE, US: National Academy for Nuclear Training). In CH the regulatory body ENSI recognise the courses or individual qualification. Experts from ENSI take part in the final examination.

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Presentations are available on <http://www.isoe-network.net/>

References (legislation, guidelines, standards, agreements etc.) containing the requirements on each ET issue are mentioned in these presentations.

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