

# EDUCATION AND TRAINING OF RADIATION PROTECTION OFFICERS IN SWEDEN

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## Introduction

The nuclear facilities in Sweden have their own radiation protection (RP) personnel, as legislated, but according to the Swedish system, the additional personnel needed during the annual outages etc. is hired from a number of consultant companies.

The nuclear facilities' own RP-personnel is only categorized in two different categories, RP-Technician and RP-Officer. External RP-personnel in Sweden is categorized in three different categories, where RP-Technician category C, is the lowest and RP-Technician category A, corresponding to nuclear facilities' RP-Officer, is the highest.

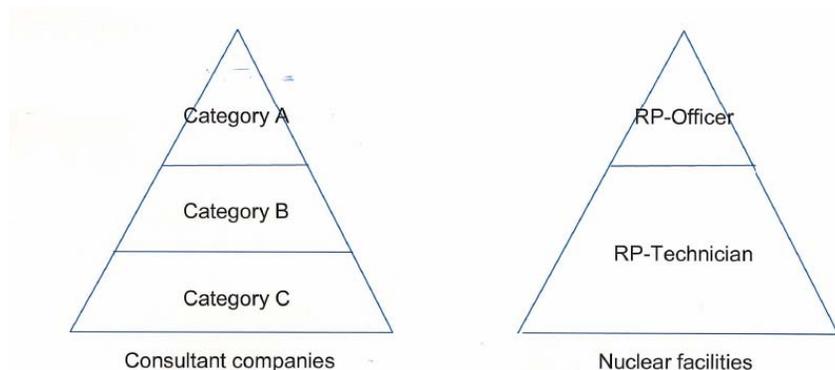


Figure 1. Three different levels of RPO's in Sweden

The companies themselves have the responsibility for guaranteeing and controlling the quality of their personnel according to the rules and regulations of the authority and the nuclear facilities. Traditionally the companies have taken care of the education and training (E&T) of their own personnel themselves without any more specific co-ordination between the companies and the nuclear facilities.

In a meeting year 2002 the heads of RP-groups at Swedish nuclear facilities and the representatives from the RP-consultant companies discussed the E&T of external RP-personnel. This discussion resulted in an extent co-operation between the different nuclear facilities and consultant companies in educating and training radiation protection technicians (RPT) and officers (RPO).

In the beginning of the year 2003 a joint work group called "FORS" was started. The idea behind this work group is that the nuclear facilities, together with the consultant companies, construct an education design based on a task analysis done at all levels of E&T. All the members in the FORS-group have a

solid background in practical radiation protection work but some are nowadays on other positions within the nuclear industry.

### **Executing the Task**

The first task for the FORS-group was to create a foundation for a renewed education for A-Technicians/RP-Officers, the so-called “FS-1” –course.

This education was traditionally executed by Kärnkraftsäkerhet och Utbildning, KSU, a company owned by the nuclear facilities in Sweden. The material, the requirements and the goals for the course had not been audited in a number of years and it was necessary to do that.

The work was started with performing a detailed task analysis on all the levels of education of RP-personnel. The task analysis resulted in a number of competence areas where it is considered that all the competence areas in a lower category are included in the demands of the higher category. The different competence areas identified were

- Radiation protection
- Fire protection
- Conventional working environment
- Knowledge of the main processes and systems at different type of nuclear power plants (BWR, PWR)
- Language skills
- Computer skills
- Project management (on A-level/Engineer only)
- Labour management (on A-level/Engineer only)
- Communication and presentation (on A-level/Engineer only)

Each competence area was then divided into a number of different competences and skills needed. The levels of the competences and skills were expressed as either “knowledge of” or “proficiency”.

### **Education for RP-Technician Category A/RP-Officer**

After completing the task analysis the foundation for the renewed education for A-Technicians/RP-Officers was created. The structure included:

- Radiation physics
- Measuring techniques, theory
- Measuring techniques, practice
- Radiochemistry
- Laboration
- Communication techniques
- Radiation biology
- ICRP etc.
- ALARA in practice
- SSI – the Swedish Radiation Protection Authority (legislation etc.)

- ISOE
- RP-experiences from the world around

The course is concerning two weeks at the university followed by self studies and examination by extensive homework instead of an exam. It was considered to be better to use homework than a written exam because this way the task is much more extensive and all-round. Also the fact that one can fail an exam because of nervs etc. speaks for this manner. The results support this method.

The pilot course was executed in April 2004. The questionnaire among the first group of students pointed out a number of improvements needed in the study material e.g. The lecture about communication techniques was erased from the schedule because it was considered as the area for the companies to take care of themselves.

Second course was executed in April 2005 and the questionnaire showed that improvements made were correct. A new approach was proved: before taking part in the course the students received a welcome package including the study material and a personal welcome letter with a number of arithmetical problems and a collection of formulas needed when solving the problems. This was experienced as a motivating factor and the students were considerably better prepared.

Before being qualified to take part in an A-education the student has to have practical experience at the facility for at least 32 work weeks as RP-Technician category B, including at least four of the following areas:

- Reactor hall
- Containment
- Reactor building
- Turbine building
- Waste management
- Active workshop
- CLAB (Swedish Central Interim Storage for Spent Nuclear Fuel) or
- Transport of spent nuclear fuel

minimum 2 work weeks per area, documented.

The course has been executed at least once a year since 2004.

The need for further education, as well, was identified while the FS-1 –course was been examined and revised. It was fully possible that personnel had taken part in a FS-1 –course for 15 years ago but not taken part in any higher RP-education after that. Therefore a so-called FS-2 –course was created.

The main features in a FS-2 –course are to repeat some basics and retain the existing knowledge and skills but most of all the course functions as a forum for discussion and exchange of experiences within the country and internationally.

### **Education for RP-Technician Category B**

Traditionally there has been a larger gap between the level of education for RP-Technician category A/RP-Officer and RP-Technician category B. According to questionnaires made among the RP-Technicians category B there is an experience of lack of knowledge needed during the A-education.

The most extensive part in the work of the FORS-group was to create a new foundation for B-education as well as produce the material for the education, including student material and instructor´s guide.

The task analysis executed year 2003 was used as a basis for this work as well. There was no material completely ready to be used so the members of the FORS-group divided the competence areas and were working separately only having a number of meetings for check-up of the material.

The work resulted in two books, the first one concerning:

- Radiation physics
- Radiation biology
- RP-operations at the facilities (including ICRP, ISOE, national legislation etc.
- Classification of areas
- RP-instruments
- Transport of radioactive material
- Waste management
- Conventional working environment
- Arithmetical problems to solve and
- Group work

The second book was concerning BWR and PWR extensively (the reactor types in operation in Sweden) and a short description of other, most common reactor types.

Before being qualified to take part in an B-education the student has to have practical experience at the facility for at least 16 work weeks as RP-Technician category C, including at least two of the following areas:

- Reactor hall
- Containment
- Reactor building
- Turbine building
- Waste management
- Active workshop
- CLAB (Swedish Central Interim Storage for Spent Nuclear Fuel) or
- Transport of spent nuclear fuel

minimum 2 work weeks per area, documented.

The course concerns one week at some of the nuclear facilities in a class room followed by a written exam two weeks later. It can be discussed whether or not this method is preferable because of the positive results gained in connection to A-education and it's homework as a method of examination. It is quite normal that some of the students have to take a re-exam in order to pass all the parts and be qualified as RP-Technician category B.

### **Education for RP-Technician Category C**

According to the task analysis executed year 2003 the category C education was the one with least problems. There is a material ready to be used.

The course contains the following areas:

- “Radiation Protection” (a two-day education administrated by KSU)
- “Hot Work” (a one-day education held by the Swedish Fire Protection Association)
- Life-saving / First Aid (a half-day education held by the Swedish Work Environment Authority)
- Safety Information (common for all the Swedish nuclear facilities)
- Reactor types in operation in Sweden (BWR, PWR)
- Personnel decontamination
- Waste management
- Radiation environment at NPP’s and classification of areas and
- A one-week practice at a nuclear power plant (by schedule)

The course concerns one week at some of the nuclear facilities in a class room followed by a written exam two weeks later. It can be discussed whether or not this method is preferable because of the positive results gained in connection to A-education and it’s homework as a method of examination. It is quite normal that some of the students have to take a re-exam in order to pass all the parts and be qualified as RP-Technician category C.

It is important to keep the existing material up-to-date. The revision of the student material will be done by the FORS-group as well.

## The Results in General

The line of education and training for RP-Technicians and –Officers in Sweden can be expressed as “stairs” where the knowledge and skills of the lower step is always included in a higher one.

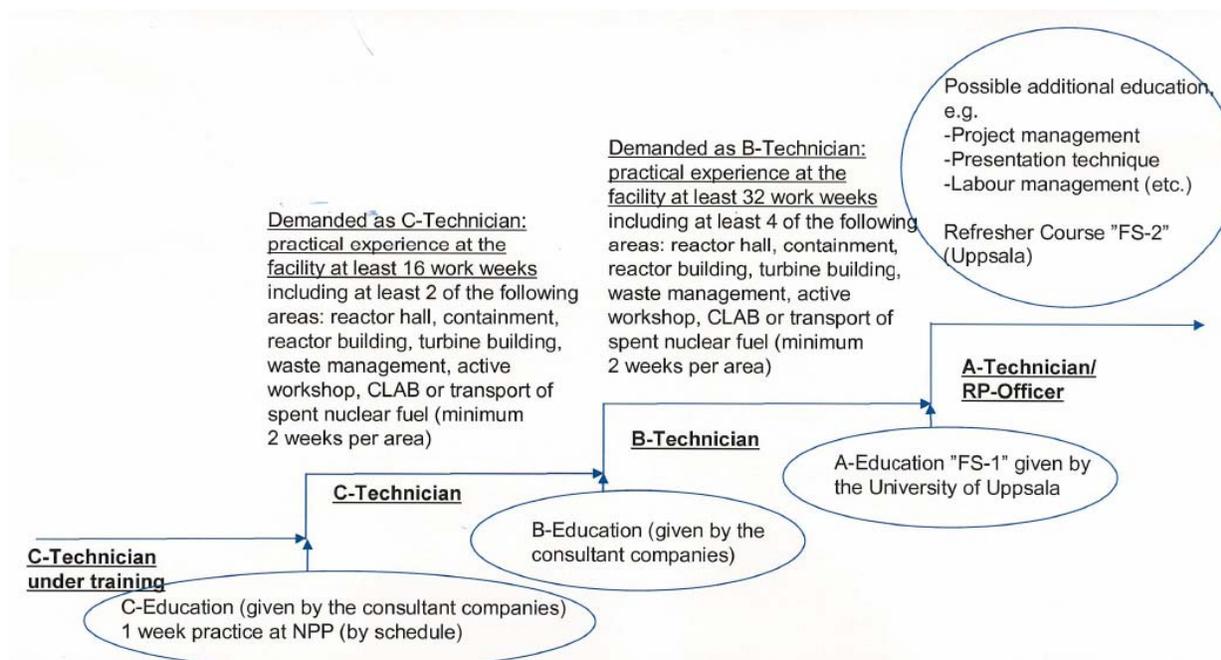


Figure 2. Education and training of the radiation protection technicians and officers in Sweden

After the FORS-group was finished with different steps in it's work, all the nuclear facilities have standardized the demands on RP-personnel on all the levels mentioned in this paper. The work of the FORS-group is considered as very valuable for the RP-professionals.

## **Future Challenges**

It is quite common that a major part of the personnel of the consultant companies work as RP-technicians or –officers while studying, mostly at the university. It is an assured summer job because of the yearly outages in the summer time in Sweden. But it is, unfortunately, quite common that the same persons after graduating do not return to this profession. Or that people staying within the profession are satisfied with a lower level of RP-education, e.g. work as RP-technician category B the rest of their work lifes.

There are possibilities to choose some of the next steps of the “career ladder”, to become a project manager or a radiation protection expert etc. In a not so far future more resources are needed, on a higher level of profession as well.

It is important to, somehow, attract the younger generation to become a lasting part of this profession and to be willing to educate themselves higher within it.