OCCUPATIONAL DOSES AND ALARA - RECENT DEVELOPMENTS IN SWEDEN

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ABSTRACT

Sweden has traditionally experienced very low doses to workers in the nuclear industry. However, this trend has since last year been broken mainly due to significant maintenance and repair work.
This paper will describe occupational dose trends in Sweden and discuss actions that are being implemented to control this new situation.

INTRODUCTION

Nuclear power in Sweden is generated by 12 reactor units at four sites. Nine of the reactors, all BWRs, were supplied by the Swedish company ASEA-Atom, now ABB-Atom. The remaining three, which are PWRs were delivered by Westinghouse.
Nuclear accounts for half of the electric power generated in Sweden. The 12 reactor units have a total installed capacity of approximately 10 GWe.

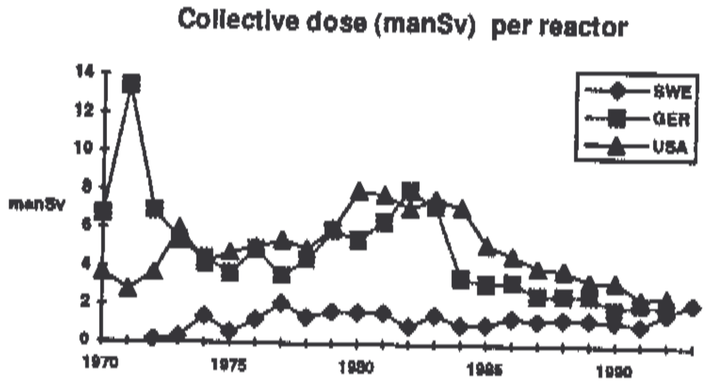
Figure 1. Nuclear power facilities in Sweden.

Unit	Type	MWe	Commissioned	Owner
Barsebäck 1	BWR	600	1975	Sydkraft
Barsebäck 2	BWR	600	1977	Sydkraft
Forsmark 1	BWR	970	1981	Forsmarks
Forsmark 2	BWR	970	1981	kraftgrupp AB
Forsmark 3	BWR	1155	1985	
Oskarshamn 1	BWR	440	1972	OKG AB
Oskarshamn 2	BWR	600	1974	OKG AB
Oskarshamn 3	BWR	1160	1985	OKG AB
Ringhals 1	BWR	820	1976	Vattenfall
Ringhals 2	PWR	860	1975	Vattenfall
Ringhals 3	PWR	915	1981	Vattenfall
Ringhals 4	PWR	915	1983	Vattenfall
Swedish NPPs		10000		

Figure 2. Nuclear power plants in Sweden.

OCCUPATIONAL DOSES IN SWEDEN

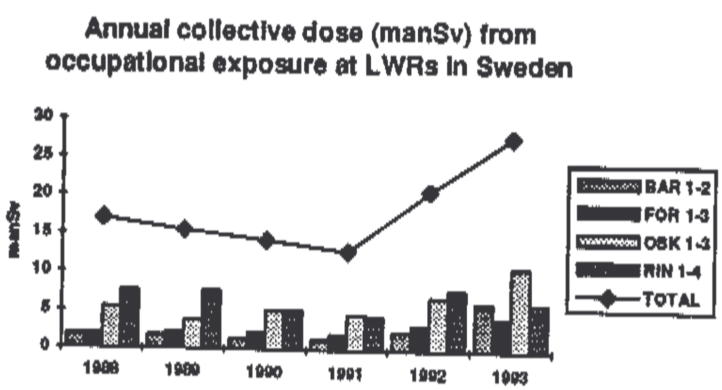
Sweden has traditionally experienced very low doses to workers in the nuclear industry. This can be seen in a comparison with the collective doses in other countries operating light water reactors.



The decrease of doses that we have seen in several countries during the 80s, can partly be the result of new reactors taken into operation but probably more as the result of the "new view" on radiation protection.

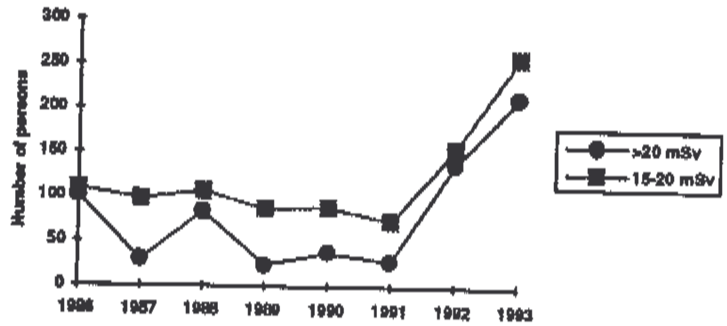
We understand that the ALARA-way of thinking was early accepted in many countries and have been developed even more during the years.
Of course, most of the countries started their dose reduction programs when the dose levels were high and from which it must have been relatively easy to reach spectacular decreases.

Unfortunately, in Sweden we have seen the opposite development in recent year. From the positive trend up to 1991, we found the collective dose for 1992 to be "all time high", 20,5 manSv and it become even worse in 1993, namely 27,5 manSv.



We have also seen an increasing number of persons with relatively high doses, for example in 1993 there were 216 persons exceeding 20 mSv, compared to 38 in 1991.

Number of persons in high dose intervals



The reasons for increasing doses in Sweden can be

- Ageing reactors requiring significant maintenance and repair works; and
- Increasing safety requirements resulting in extended test programs.

Additionally, some "routine" may have gone into the radiation works resulting from the many years of "easy" operations.

Of course, the dose increase that we have seen is most likely the result of a combination of different causes, but it is obvious that the lack of goals for the radiation protection activity contributes strongly to this increase.

In spite of the many large and difficult repair works which have taken place at the reactors during 1993 and particularly during 1992 we would argue that most of the doses can be related to "ordinary work" during the outages.

Let us look back to the steam generator replacement at Ringhals 2 in 1989, a work which was carried out with success following careful planning. The collective dose from the replacement became as low as approximately. 3 manSv, at that time a very low collective dose for such a significant works. However, today is such a dose common for similar works, some have been even more successful to keep the dose at a low level, but we believe Ringhals showed the way how to handle this kind of a problem.

During the spring of 1993, approximately 400 pipe bends had to be replaced at Oskarshamn 1 because of problem with stress corrosion. Also, this job was carried out after careful planning. Combined with a successful decontamination which resulted in a decontamination factor DF of 20, the collective dose could be held on a very low level.

What the result will be from the current renovation work at Oskarshamn 1 is too early to say, but the dose reduction actions taken so far have been extremely successful. They include a large decontamination of the reactor vessel, the main recirculation loops and several other parts of the reactor system, as well as shielding of the inner wall of the reactor vessel, especially at the core region.

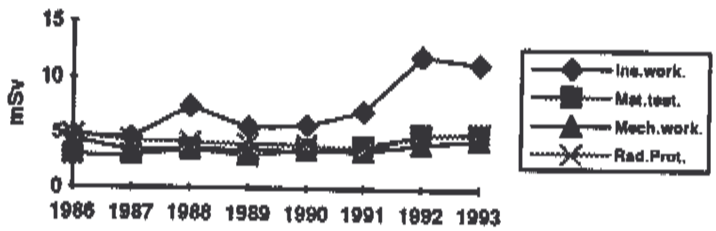
In July 1992, a safety valve in the automatic depressurization system at Barsebäck 2 opened inadvertently at 30 bar and blew stream to upper drywell causing a simultaneous clogging of both trains of the emergency core cooling system. Five of the Swedish reactors, those with external recirculation pumps and small stainer areas, were later that year taken out of operation.

At four of the five reactors a decision was taken to replace most of the fibre insulation with metallic insulation. At the fifth reactor fibre-glass insulation was chosen. All of them increased their stainer areas.

From a radiation protection point of view, we have had some unsatisfactory experience from the use of metallic insulation, it requires some time-consuming and troublesome handling.

We have also seen a considerable increase in the individual doses to insulator personnel. Therefore, we had some doubts in the whole operation.

Average individual dose for different worker cateogries



However, the replacement took place and it was not a success neither from a radiation protection nor a technical point of view.

Lack of planning, wrong drawing support combined with an extremely tight time schedule gave a collective dose of approximately 7 manSv in total for the four reactors installing metallic insulation.

ACTIONS TO TURN THE TREND

At the Radiation Protection Institute (SSI), we cannot accept a prolonged negative dose trend, and therefore, we have worked hard to find countermeasures to turn the trend.

In the new regulations on occupational exposure, which will be issued in the very near future, new requirements were included. First of all we decided to introduce a new individual dose limit, 100 mSv in 5 consecutive year in addition to the annual individual dose limit which is 50 mSv.

We have also required an extended education and training program in radiation protection, addressed especially to foreman and team-leaders, working for the utility as well as for contractor. We believe that this program will increase the understanding and motivation of the personnel to more heavily engage in dose reduction.

Additionally, we believe in an ALARA, or work management, approach, i e where the utilities systematically review their strategy towards radiation protection and develop goals in the area of occupational doses. The SSI has initiated such a review and in discussion with the utilities we have asked them to develop plans for dose reduction based on the ALARA way of thinking. This review should result in individual and collective dose goals concrete means to reach those goals as well as system for feedback analysis. Finally SSI requires an organisational structure to manage and monitor the occupational dose control program.

The SSI established long ago, an ambition level for collective doses to workers in the nuclear field in Sweden. This level, which was set to 2 manSv/GW installed electricity, is emphasized even more in the new regulations and the Institute now requires the utilities to plan all their works according to this level.

Using our research funds, we have recently started a significant development program in the field of dose reduction. The Swedish "reactor maker" ABB-Atom is on one behalf studying the reasons for the increasing dose levels, estimating the expected dose situation during the years to come, as well as giving advice on concrete actions to reduce occupational doses.

Moreover, we support the international cooperation in this field, and therefore, we participate in the NEA ISOE program. In order to improve our possibility to exchange information with other countries, we have decided to adjust our regulations for reporting occupational doses. This will mean that we plan to include parts of the ISOE reporting system in the Swedish regulations. We are also reviewing the electronic dose recording software (ASPIC), development by the ISOE system, with the view of introducing it in Sweden.

FINAL REMARKS

We are convinced that the negative trend we have experienced in the area of occupational doses will be broken already in 1994. This, however, will require hard work, including increased emphasis on ALARA and on ways to manage work in radiation fields. In order to be effective, this "culture" in radiation protection will require the cooperation between various professional groups with the utilities as well as a continuous dialogue between the utility and the regulator.

Author Biography

Thommy Godås is a Senior Radiation Protection Physicist at the Division for Nuclear Inspection and Emergency Preparedness at the Swedish Radiation Protection Institute. Mr. Godås is also responsible for the Institute's supervision of the Oskarshamn Nuclear Power Plant, which includes 3 BWR reactors and the Central Storage for Spent Nuclear Fuel (CLAB).

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