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10 YEARS OPERATIONAL HEALTH PHYSICS AT THE BEZNAU NUCLEAR POWER PLANTS

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The two PWR of 350 MWe each have accumulated together more than 10 years of operation - in fact almost 12 years at the present time - and have produced about 30 billions kWh electrical energy. The accumulated experience has been very important. The scope of this paper is to highlight some aspects of the operational health physics problems.

Health Physics is concerned with doses: doses to the personnel and doses to the environment. These two angles will be evoked and some consequences will be shown.

DOSES TO PERSONNEL

Fig 1 gives the evolution of the yearly accumulated doses in both plants (Beznau I has begun operation in mid 1969, Beznau II two years later).

Initially, fairly high doses have been accumulated. This was due to an initial fuel loading with a high failure rate (approx. 1 %), a corrosion problem of the vessel head, and the steam generator problem.

The steam generator problem is still a cause of concern. The work associated with the necessary inspections has not been substantially reduced, but we have learned to live with it, developing new and better techniques. As an example, the dose per inspected steam generator tube has declined by more than a factor 5 in the last three years, being now about 3 mrem per inspected tube.

Needless to say that legal dose limits have never been exceeded, but careful planning of high dose-jobs is mandatory.

However, a special aspect is worth its consideration. Incorporation of radioactive nuclides is a source of dose and extremely severe measures have always been taken, including large safety factors. The accumulated experience has shown, however, that such a working philosophy, i.e. weighting more the dose commitment due to incorporation than the dose by external radiation, has several inconveniencies. The protective measures (mask, clothing) slow the work, thereby increasing the working time in a radiation field, decrease the efficiency of the worker (the sight is limited, the movements are hindered) and impose a very strong load on his physical strength (heat, breath, etc.). The net result can be - and very often is - an increase of the total absorbed dose coupled with physical exhaustion with a job less well done because the worker is tired, irritable, and even aggressive.

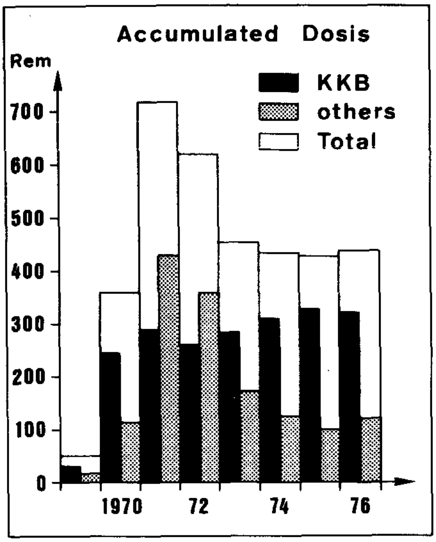

Fig. 1

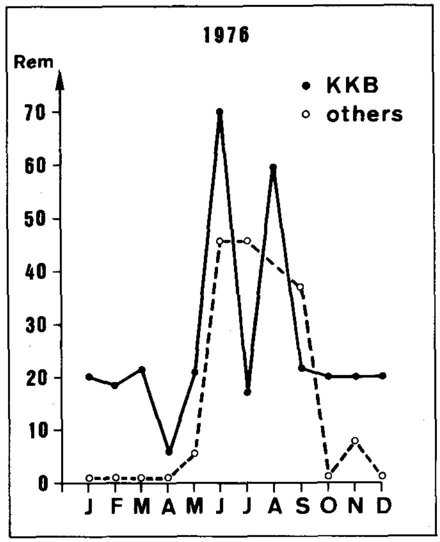

Fig. 2

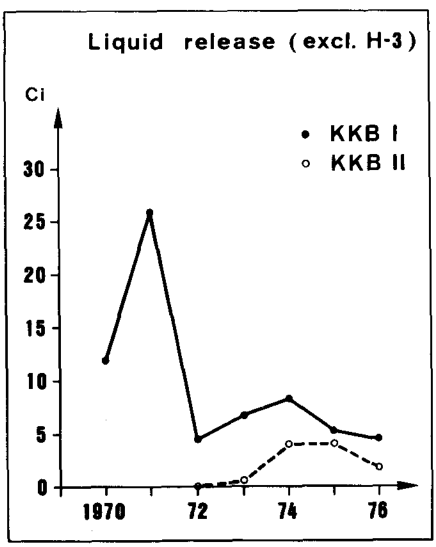

Fig. 3

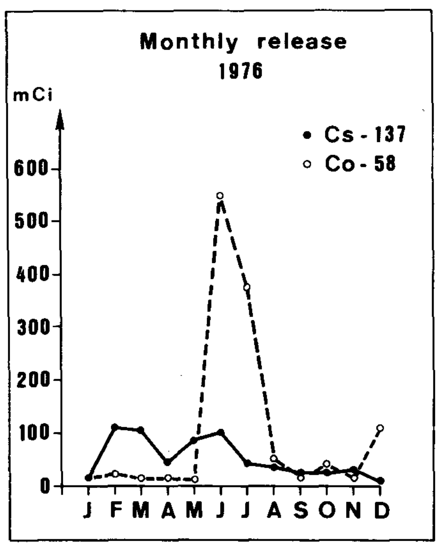

Fig. 4

One possible answer to these problems - and the answer we use - is to take only the necessary protection against incorporation, and to control frequently the workers with a whole body counter of a simple type in order to detect if incorporation had taken place. This has not been the case since this instrument was installed three years ago. Actually, we use a screening monitor giving a yes/no answer; eventually necessary fine measurements beeing the task of a well installed facility. We believe that dose commitments by incorporation in a nuclear power plant are a lesser problem than doses by external radiations: it has to be remembered that, by appropriate treatment, an incorporation can be reduced; a received external dose cannot. The accumulated experience shows that, in a PWR, the incorporation problem is easy to solve, and that the overconservatism of the first years can be somewhat reduced.

Fig 2 shows the doses accumulated during the year. It can be clearly seen that the major part of the doses is accumulated during the two refueling and revision periods (June and August). The small November peak is due to a shut down and repair of steam generator tubes. One of the main health physics problems is obvious: the work load is very unevenly distributed: during the shut down of Beznau I in 1976, for example, 4400 controlled entries in the containment building were registered. It is difficult, therefore, to have enough good health physics personnel for this intensive work period, and then to occupy them meaningfully during the rest of the year. An obvious conclusion, also, is that self control should be the rule, and surveillance the exception, this beeing reserved for very special jobs or for new or temporary personnel. A good health physics training is given therefore to all employees, and everybody is permanently motivated to enforce health physics and safety measures.

DOSES TO THE ENVIRONMENT

Fig 3 gives the amount of nuclides, excluding Tritium, released to the Aare river. The initial difficulties with the fuel, and also some operational difficulties, have led to releases in 1971 up to about 70 % of the allowed limits. Experience and improvements have reduced the amount of radioactivity released.

The lower releases of Beznau II are due to the fact that some services (laundry, decontamination) common do both plants are located in Beznau I.

It has been calculated by our Regulating Authorities that the release of both Beznau plants has caused a hypothetical dose to the population of 0.08 mrem/year in 1975. On the other side, waste treatment, necessary for the reduction of the released activity, is responsible for a part of the dose accumulated by the personnel. This personnel accumulates therefore additional doses of some hundred mrem per year, its general exposition is already much higher than that of the general public.

We must take into consideration this very fundamental, but unfortunately much neglected problem. The trend to always more stringent release specifications has to be payed not in money - which should be of minor importance - but in manrem for the personnel - not to speak of the increased risks due to concentration, transport and storage of radioactive waste.

Fig 4 shows some special aspects of the release problem. The type of nuclides released, and the amount, changes during the year. The release of a typical fission product, Cs-137, is rather equally distributed during the year. The activation product Co-58, on the other side, is solubilised during the shut down period, and the rate of release increases during this period. The waste treatment system must take these facts in account.

CONCLUSION

If it has been repeatedly and convincingly shown that the health physics problems can be solved in a nuclear power plant in complete observance of the ICRP rules, there is an aspect of the present situation which worries the author. The presently observable trend forces the health physicist to a more bureaucratic attitude: the number of rules, guides, requirements increases daily, the variety of forms, papers, statistics requested seems to be in inverse proportion to the accumulated manrem. The author has the privilege to work in a country where the bureaucratic growth has up to now been moderate, but considering the world at large, it seems that, according to Darwin, the survival of the fittest will lead to favorise the bureaucratic instead of the innovative mind, and this will without doubt lead to a deterioration of the professional level of the health physicist. It can only be hoped that reason will win.