N100. Occupational Doses In ABB Atom BWRs

Radiological surveillance programs carried out in ABB Atom's boiling water reactors (BWR) have been a great asset in achieving the enviable dose record of these plants. One of the most important of these programs is the dose rate measurement exercise carried out regularly at all ABB Atom BWRs during their annual outages. The measurements are taken by ABB Atom personnel, and cover 200-250 measurement points per reactor. The points have been carefully selected to enable direct comparison of the different plants, and the results are transferred to a computer system. The resulting database has proved to be very valuable, since it includes consistent measurements over a series of years. Up to 1990, more than 120 complete dose rate surveys had been included.

What lessons have been learned from the surveillance programs?

Cobalt Problems. The radiation fields are mainly due to Co-60, and are therefore primarily determined by the inflow of cobalt to the primary system. The main reason for this inflow is release from cobalt alloys in valve seats or release from stainless steel surfaces in the turbine plant -- especially the high pressure part of the plant. However, in-core sources, especially alloy X-750 in fuel spacers, also contribute to the Co-60 problem. This problem has been dealt with in ABB Atom BWRs by imposing stringent cobalt specifications on materials used. The cobalt limits presented used are 0.05% of stainless steels, and 0.01% for alloy X-750 in fuel spacers. No cobalt alloys are allowed inside the reactor pressure vessel; this means that the ABB Atom control roads do not have "pins and rollers" of cobalt-based material.

Release from cobalt alloys in valve seats has been identified as a major contributor to the cobalt inflow, especially in reactors with turbine plants using forward pumped heater drains. Work is in progress to replace such material with cobalt-free substitutes. Experience with these materials is, so far, very encouraging.

Corrosion Products. The release of radioactive particles from the fuel is made worse by a layer of thick, porous deposit (this is the case when the iron inflow to the reactor is high), and by accelerated corrosion of the fuel cladding (due, for example, to high copper inflow). A great deal of effort has therefore been spent on minimizing the inflow of corrosion products by the feedwater.

Reactor Water Cleanup. ABB Atom BWRs use a system based on specially designed deep bed ion exchangers with radial flow, and the flow rate is normally 2% of the maximum feedwater flow, although it can be increased to 4% during transients. High-temperature filters for selective removal of cobalt have been tested to obtain an even higher clean-up flow rate.

Hydrogen Water Chemistry (HWC). Some of the reactors are operated with HWC. The overall impact on water chemistry has been an improvement in the form of a reduction in conductivity. HWC operation has not been found to have any significant impact on the build-up of shut down radiation fields in the Swedish plants.

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