"TEPCO's Challenges for Occupational Exposure Reduction: Installation of Additional Condensate Pre-Filter in Fukushima-Daiichi NPP"

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The collective dose of Tokyo Electric Power Company is about the world average for those of Fukushima-Daini (2F) and Kashiwazaki-Kariwa (KK); however, the collective dose of Fukushima-Daiichi (1F) has been falling to within the worst quarter, world-wide. One of the main reasons is that while in 2F and KK, a condensate pre-filter (CF) is applied for the entire water circulating system, in 1F it is applied only partially.

The collective dose for BWR has been on a downward trend since the 1980s after implementing measures such as low-Co materials. The radiation source reduction measures for the reactor cooling system piping can be roughly divided into improvements in three areas: (I) materials, (II) equipment and systems, and (III) operation.

In order to reduce the exposure around the reactor cooling system piping, which is the primary cause of work exposure, it is necessary to minimize the amount of radioactive corrosion products produced in the reactor that are brought into the system. In order to achieve this, it is important to introduce CF to reduce the iron concentration in feed water. The components of Fe, Co and Ni in feed water are radioactivated to form the radioactive radionuclides, Mn-54, Co-58, and Co-60, respectively, which have a serious impact on exposure.

In terms of improvements in operation methods, temperature-regulated shutdown (soft shutdown) has been implemented. This is a method to limit the dissolution rate of radioactive corrosion products from the fuel rod surface to not more than 5% by limiting the temperature drop rate at the time of shutdown to not more than 15°C/hr, thus contributing to the reduction of exposure at the time of periodic inspections. The effectiveness of soft shutdown has been verified at Gundremmingen NPP in Germany.

After the completion of the 21st cycle of 1F-6, in which the rate of CF application had been originally 20% of the total water circulation, CF was installed for 100% of the water circulation system. After installation, the iron concentration in feed water went down smoothly even after the removal of the control rods, and is currently maintaining the levels to below 0.1 ppb. As a consequence of the additional CF installation, the amount of iron introduced into the reactor is expected to become 37 kg at the 22nd cycle, down from 510 kg at the 21st cycle. If we assume that the iron concentration in feed water is maintained at 0.1 ppb in 1F-6, work exposure will be reduced by about 40% at the 27th periodic inspection, 6 cycles from now.