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Health physics experiences during maintenance works performed in high background shielded cells of fast breeder test reactor (FBTR)

FBTR is a research reactor operating at Kalpakkam, India, with an installed capacity of 40 MWt. The reactor serves as a test bed for irradiation of fuels and materials and provides experience in handling of sodium and reactor operation. It has attained the design power level of 40 MWt in March 2022. The reactor containment building is divided into four zones and further subdivided into cells. The reactor assembly is housed inside a cylindrical cavity surrounded by biological shield. Primary heat transport system piping and equipment are located in B1 and B2 concrete cells. Primary sodium purification circuit and primary sodium storage tank is housed in B6 and B4 cells respectively. The pipelines in the primary circuit are provided with devices viz., wire and plug type sodium leak detectors and temperature sensors.

In 2021, two major works were performed for the first time in high background B cells of FBTR. In B6 cell, nine sodium leak detectors and a temperature sensor were rectified. Post rectification, all the devices were energized and observed to be in a healthy state. In B4 cell, the primary hot argon line connecting the storage tank and overflow tank was observed to be blocked due to sodium aerosol deposits and normalisation of the line was performed. In B4 and B6 cells, the background gamma radiation level was 0.12-1.4 mGy/h and 0.4 - 0.7 mGy/h respectively. The maximum gamma radiation level of 5.5 mGy/h was observed on the lines of B6 cell.

Radiological work permits were cleared during the work to control exposures. Industrial work permits were cleared to ensure oxygen levels, mask air, illumination and scaffolding to reach different areas as intended. PPEs were provided during the work and personnel monitoring devices were issued. For the reduction of external exposure, temporary shielding was provided at few locations and lead aprons were provided to the individuals. Approved step-by-step procedure, micro schedules, pre-job ALARA meetings and discussions were held during the course of work to ensure safe completion of each task as intended with minimum personnel exposure. The repair works include scaffolding to access different regions, checking healthiness of cable by visual inspection followed by opening the cable termination at sensor end and measurement of voltage. Rectification of sensor was carried out by replacing cables with proper thermal insulation at junction box. Removal of thermal insulation and relaying of the same was performed whenever the sensors could not be repaired at junction box level. In B4 cell, radiography was performed on the nozzle portion of the hot argon line near the storage tank. The line was cut to remove sodium deposits and welded back. No air activity or contamination was observed on the lines and floor of the cells. The collective dose expenditure for the leak detectors rectification work and choke removal operation was 42 P-mSv against the budgeted dose of 64 P-mSv. The works were completed as planned and provided enough confidence to the plant for carrying out maintenance works in high background cells, if required.

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