15.7 Radioactive Release from a Subsystem or Component

The pressurized water loop facilities contain tests with a significant inventory of radioactive material. The radioactive material contained in the tests could be released either by failure of the loop piping or by dropping of a test out of the cask during test handling.

The pressurized water experiment loop facilities described in Chapter 10 (Experiment and Irradiation Facilities) are the only systems not previously discussed in Sections 15.1 through 15.6, whose failure would result in the uncontrolled release of radioactivity to the environment under transient conditions. The testing program includes irradiation of fueled tests in the experiment loops. A loss of flow or a loss of coolant accident (LOCA) in the experiment loop could result in melting of the test. Both a 1/2-in. experiment loop LOCA and an experiment loop flow coastdown are considered Condition 2 occurrences. The Condition 2 loop flow coastdown is terminated by a loop scram that should prevent fuel damage. A larger than 1/2-in. experiment loop LOCA and loss of flow without a loop scram are considered Condition 4 events. If test damage were to occur, only the LOCA events would allow fission product release into the loop cubicle. Any fission products released during a loss of flow event would remain contained in the loop piping and the release to the ATR building and environment would be enveloped by those from the LOCA.

Analyses of the off-site consequences of a loop facility LOCA with fuel melt for a test with 200 kW fission power were completed (Knudson 2000). The computer codes employed were comparable to that used for dose analyses in Section 15.12. The ORIGEN code was used for the source term calculation and the RSAC-5 code was used for the dose analysis. The analysis assumed 100% of the noble gas inventory and 25% of the iodine inventory in the fuel was released to the ATR building. RMSS actuation was assumed. Worst-case (99.5%) site-specific meteorology was used. The resulting dose was 192 mrem[a], TEDE, for the maximally exposed individual at the INEEL NSB. This result meets the Condition 2 ATR Plant Protection Criteria of 500 mrem off-site dose.

Since operating personnel are routinely in areas of the plant close to the loop facility cubicles, the potential personnel exposures resulting from the loop facility LOCA were determined (Lucas and Wagoner 2001). The dose for a worker outside of the loop cubicle including inhalation and external dose was determined. The analysis assumed the worker evacuated the area in 5 minutes in response to radiation and air monitoring equipment alarms. The resulting dose was 1.95 rem, TEDE, which is below the Condition 2 ATR Plant Protection Criteria of 5 rem worker dose. The dose to other TRA personnel was 7.4 mrem, TEDE. The dose to workers at INTEC was 15.8 mrem TEDE. INTEC doses are higher due to a longer evacuation time.

The consequences of the Condition 4 loop facility LOCA would not be significantly different from those described above for the Condition 2 loop facility LOCA (Knudson 2000). The source term, building dispersion, and meteorology would be the same. The only difference would be that fuel failure would occur earlier in the blowdown and potentially more of the fuel fission product inventory would be released slightly earlier to the loop facility cubicle. The dose for a 200-kW experiment was 192 mrem, TEDE to the maximally exposed individual at the NSB for entire plume passage as calculated for the Condition 2 release. For onsite personnel, the dose received during the Condition 4 event was the same as the Condition 2 results.

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[a] Includes committed effective dose equivalent from inhalation and external dose from air immersion and groundshine pathways.

The limiting control setting for the RMSS is ≤315 mR/hr. The worst-case setting is conservatively established to limit the thyroid inhalation dose at 10^4 meters from the ATR to less than the 10 CFR 100 siting criteria for releases during an off-normal event. The worst-case setting is 350 mR/hr (Peterson 1995). With a response time of three minutes for the action to seal confinement, the estimated thyroid inhalation dose at TRA would be 30 rem (one tenth of the siting criteria). The acceptable setpoint accuracy for the system is ten percent of the setting (35 mR/hr). This analysis was conducted using a different set of assumptions than was used for the dose consequences for the loop events discussed in this section. The analysis was done at a different time and was based on previous analysis completed in the late seventies. The analysis was done for a one MW test using, a 3-minute response time on confinement isolation and a 15-minute evacuation time. While these assumptions are somewhat different than what has been used here and in Section 15.12.10 due to the large conservatism in the results and the limited impact that using different assumptions would have this analysis was not repeated for the UFSAR.

For the event where a cask holding an experiment is dropped, the experiment could be ejected. This ejection could lead to a significant direct radiation exposure. This event is considered the limiting Condition 3 event for loop experiment handling experiments. The consequences from this event are substantial (Marts 1998) with the possibility of lethal exposure to personnel involved with the work. For collocated workers an evacuation is required. The highest dose for an evacuating collocated worker was estimated to be 4.7 rem.

15.7.1 References

Knudson, D.L., 2000, *Radiological Analysis Supporting an ATR UFSAR Revision,* EDF-TRA-ATR-1562, May, 30, 2000.

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