3. RELEASE-LIMITING EQUIPMENT

FAILURE OF EQUIPMENT LIMITING THE RELEASE OF RADIOACTIVITY

Much of the equipment and instrumentation used to limit the release of radioactivity during SRP operations is described in Section II. The effects of radioactivity released as a result of total or partial failure of these devices is assessed in this section. These assessments assume normal process operating conditions at the time of the failure. Estimates of the extent and duration of the failure and the quantities of radioactivity released include a judgment of the probability and severity of the failure, the presence of available indications of failure, and means of process shutdown or waste stream diversion. In some cases, the estimates are based on actual experience. Except where noted otherwise, doses to offsite populations are calculated using 95th percentile meteorology (see Appendix F) or, for releases to aqueous streams, are based on a hypothetical man who consumes river water downstream of all SRP discharges.

Separations Areas

Sand Filter

The original sand filters used to remove radioactivity from the separations areas ventilation air have partially failed on two occasions as a result of support collapse. A new sand filter, designed with improved support structures, has been installed in F Area, and another is being installed in H Area. However, the release from the H Area filter collapse can serve as an estimate for a release from a similar occurrence. This failure caused the release of 0.55 Ci of ^{238}Pu and 9 Ci of ^{103,106}Ru over about a 5-day period. The release would probably be much lower, because, as described in Section II, the 200-H filter failure experience led to much quicker evaluation of a similar failure in 200-F. Assuming annual average meteorological conditions over the period of release and considering a several-day release from the stack of 0.55 Ci of ^{238}Pu and 9 Ci of ^{106}Ru, the dose to an individual at the plant perimeter would be 2 mrem to the bone and 0.05 mrem to the whole body. The doses could be somewhat higher because of fluctuations in meteorological conditions for specific 5-day periods compared to the annual average values. Analyses of ^{238}Pu in soil on and off-plant indicate a higher rate of particulate deposition than is assumed in calculating the doses above; this would cause actual doses to be lower than these estimates.

HEPA Filter

The maximum release from failure of HEPA filters is judged to be 2 mCi of ^{238}Pu resulting from mechanical damage to a pair of filters in the 235-F exhaust system. The duration of release is assumed to be 24 hours, the maximum time between routine determinations of effluent activity. The 2 mCi value is based on observed ^{238}Pu concentrations upstream of the HEPA filters. Failure of HEPA filters in other facilities would result in lower releases because of backup filtration (sand filters or HEPA filters) at locations sufficiently remote to the failed filters that no common mechanism would be expected to cause simultaneous failure.

The dose to an individual at the plant boundary from the 2-mCi release (95th percentile meterorology) would be about 5 mrem to the bone. This potential release will be minimized when the 235-F exhaust air is routed to the new F-Area sand filter installed in 1975.

Iodine Absorber

Failure of the silver nitrate absorbers to restrict radioiodine emissions from the 221-F and 221-H fuel dissolving operations could conceivably result from mechanisms such as 1) breakthrough of the absorber by channeling, 2) a break in the line leading to the absorber, or 3) failure of the dissolver vacuum system causing iodine to be released to the canyon air, thus bypassing the absorber. The release would be detected by the stack iodine monitor, and steps such as quenching the dissolving process would be taken to limit iodine release. It is estimated that a maximum of 3 Ci of ^{131}I could be released from the stack by these failures. The resultant thyroid dose by inhalation to an individual at the plant perimeter would not be expected to be greater than 4 mrem. The dose calculation assumes an instantaneous release and represents a 95% probability that the 4 mrem value will not be exceeded. The 95th percentile dose would probably be less than this value because the individual would not be expected to remain in the plume centerline (area of maximum concentration) during a several-hour release period as is assumed for an instantaneous release.

Segregated Cooling Water Monitor

If the radioactivity monitor in the 200-F separations area segregated cooling water diversion system (see Section II) fails or if the mechanical system fails, the potential exists for unplanned releases of activity to Four Mile Creek. The estimated releases given in Table III-45 are based on assumptions that the monitor failure occurs immediately after a back-up sample is taken and continues until detected by the next scheduled sample (a period of at most 12 hours), that the failure is accompanied by an increase in radionuclide concentrations in the water that would have caused diversion, and that the cooling water flow is 400 gal/min. The maximum dose to an individual using Savannah River water during the period of peak activity following the release of the 39 Ci (assumed to be ^{137}Cs) would be 0.2 mrem, whole body dose.

TABLE III-45

Potential Releases from Segregated Cooling Water, 200-F

Basis of Assumption and Activity	*Potential Release, Ci*
Diversion to seepage basin required (4.5×10^{-6} μCi/ml βγ)[a]	0.005
Diversion to retention basin required (4.5×10^{-4} μCi/ml βγ)	0.5
Highest activity observed in segregated cooling water (3.6×10^{-2} μCi/ml βγ)	39.0

a. $10^{-6} = 0.000001$, $10^{-4} = 0.0001$, $10^{-2} = 0.01$.

Tritium Monitors

In the 200-H tritium processing facilities, many operations and recovery systems rely on tritium monitoring devices to detect abnormal conditions. Failures of these monitors in various locations were assumed, and the resultant tritium releases were estimated. The estimates included varying periods of time before the inoperability of the monitor is detected, based on the degree of normal attention to the monitor readings.

The estimates for most of the releases were in the range of 1000 to 2000 Ci of tritium to the atmosphere with release times varying from a few minutes to several hours. The maximum estimate was about 3000 Ci. The 3000 Ci release would result in a perimeter dose of 1 mrem for 95th percentile meteorology.

Reactor Areas

Deionizers

The deionizers used to treat the reactor area fuel and target storage basin water may become depleted during normal operation or during a basin purge. The effluent is sampled and analyzed every shift to provide protection against a large breakthrough. In the unlikely event of failure of the monitoring system to detect activity in the deionizer effluent, the release of one to two curies of mixed fission and activation products could occur. The quantities of individual nuclides would be comparable to those released to plant streams from the reactor areas in 1975 (Table III-1). This estimate is based on the average number of curies removed by a single deionizer during normal operations.

Fuel Flushing System

Failure of this system for flushing fuel during discharge from the reactor can occur by piping or deionizer pluggage or breaks in hose connections. It is estimated that a maximum of 500 Ci of tritium, in addition to the amount normally discharged, would reach the fuel and target storage basin. Because this tritium would not be released until a basin purge is required, it can be considered as additive to the annual releases from the storage basins. In 1975, tritium released from fuel and target storage basins to plant streams and the K-Area confinement basin totaled 38,600 Ci.

FAILURE OF RELEASE-LIMITING EQUIPMENT FOR NONRADIOACTIVE MATERIALS

NO_x Recovery Units

Nitric acid is widely used in the separations areas where uranium metal is processed. In the course of dissolving and denitrating steps in the process, NO_x is evolved, and a portion is discharged to the atmosphere through a 200-ft stack. An acid recovery unit is included to recover HNO_3, and this unit when operating recovers over 80% of the NO_x evolved. The calculated contribution to the annual average concentration of NO_x at the plant boundary from this source would be about 1/50th of the South Carolina and Georgia standards, which are 100 $\mu g/m^3$, if the acid recovery unit did not operate. Failure at the water scrubber in the fuel fabrication area would make a similar calculated contribution.

Fly Ash and Ash Basins

If one of the electrostatic precipitators used for the removal of particulates from the largest powerhouse stacks should fail, particulate releases from that stack would exceed South Carolina emission standards. The effect of such an increased release would be very small offsite because, due to the size of SRP, little of the fly ash would be transported offsite.

The failure of one of the ash basins would result in the discharge to plant streams of effluent containing suspended solids in excess of the proposed EPA standard governing such discharges. Little effect would be observed in the Savannah River because the suspended solids can be expected to deposit in the SRP stream beds.

Sewage Treatment Facilities

Sewage treatment facilities are provided in each of the plant areas at SRP. In most of these facilities, the sewage is digested to remove in excess of 85% of the suspended solids and biochemical oxygen demand (BOD) before discharge to plant streams. Failure of the treatment equipment or electrical failure to any facility would result in effluent discharge which would exceed the EPA standard for both suspended solids and BOD. Increased BOD releases affect the dissolved oxygen in the streams and therefore the stability of the aquatic organism species. For the two largest treatment facilities (A and F Areas), the dissolved oxygen contents of the streams into which they discharge (Upper Three Runs and Four Mile Creek, respectively) are about 7.5 and 5.7 ppm below the discharge points. If the sewage treatment facilities should fail, the increased oxygen demand would reduce the dissolved oxygen in these streams to approximately 7.4 and 4.6 ppm, respectively. Moore's[49] results show that fish in general will live in water containing more than 4.2 ppm O_2.