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7. Abstract This CSER covers the 340 Facility which acts as a collecting point for liquid and solid waste from various facilities in the 300 Area. Criticality safety is achieved by controlling the amount and concentration of fissionable material sent to the Facility from the originating facilities, a method similar to that used elsewhere at Hanford for the waste tank farms. Unlike those, however, the waste received at the 340 Facility will be far less radioactive. While the 340 Facility is classified as an Isolated Facility, it also meets the criteria for and could be classified as a Limited Control Facility.		
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CSER 94-012

Title: Criticality Safety Evaluation Report for 340 Facility

Prepared by: Sidney J. Altshuler Date: 12/14/94
Engineer, Criticality & Radiological Analyses

Reviewed by: Shirley E. Furr Date: 12/14/94
Engineer, Criticality & Radiological Analyses

Approved by: J. W. Daugherty Date: 12-22-94
Manager, Criticality & Radiological Analyses

Summary and Conclusions

This Criticality Safety Evaluation Report (CSER) covers the 340 Facility which acts as a collecting point for liquid and solid waste from various facilities in the 300 Area. Criticality safety is achieved by controlling the amount and concentration of the fissionable material sent to the 340 Facility from the originating facilities in the 300 Area, a method similar to that used elsewhere at Hanford for the waste tank farms. Unlike those, however, the waste received at the 340 Facility will be far less radioactive.

It is concluded that present operations meet the two contingency criterion. The facility will still be safely subcritical even after two independent and concurrent failures (either of equipment or administrative controls).

The solid waste storage and liquid waste will be managed separately. The solid waste storage area is classified as EXEMPT because it contains less than 15 grams of fissionable materials). The Radioactive Liquid Waste System is classified as ISOLATED because it contains less than one third of a minimum critical mass.

The criticality safety of the 340 Facility devoted to the Radioactive Liquid Waste System (RLWS) is assured by the form and concentration of the fissile material and could also be classified as a limited control facility. However, the 340 Facility has been operated as an isolated facility which results in a more conservative limit.

Description of Facility

The 340 Facility is located in the 300 Area. It consists of two liquid waste systems; the Radioactive Liquid Waste System (RLWS) and the Retention Process Sewer (RPS). These systems receive waste from the 324, 325, 326, 327, and 329 Buildings also located in the 300 Area.

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The Retention Process Sewer (RPS) receives waste with only the potential for radioactivity. Diverter stations located at each of the originating facilities monitor the RPS waste and if radioactivity is detected, reroutes the waste to the RLWS. This feature eliminates the need to address criticality in the RPS.

The Radioactive Liquid Waste System (RLWS) receives waste known to contain radioactivity. The system consists of two 15,000 gallon tanks located below ground in the 340 Vault. These are backed up by six 8,000 gallon tanks located in 340A Building. Two of these tanks have some added lead shielding.

RLWS waste is analyzed before being discharged from the originating buildings. Waste acceptance criteria for the RLWS require less than 0.01 grams per gallon of fissionable material (uranium enriched to less than 1% doesn't count) and facility notification prior to discharge. The consolidated waste is analyzed before being transferred out of the 340 Facility.

Solid wastes that are generated or received contain very little fissionable material. The maximum inventory of containers would total much less than 15 grams of fissionable material and when considered by themselves qualify as an exempt quantity.

Accidents and Errors Considered

The events required to cause a criticality would be to provide a sufficient amount and/or concentration of fissionable material.

The RLWS is 6 inch diameter pipe, a relatively favorable geometry. To cause criticality in it would require filling it with fissionable material with a density at least 300 g Pu/l (ARH-600, III.7(100)-3). This assumes no ^{240}Pu and the equivalent of full water reflection. The slug of concentrated fissile material should be about as long as its diameter which would require at least 1.0 kg of Pu.

Alternatively, the criticality could occur in one of the Radioactive Waste Tanks. These are large tanks and can be assumed to be infinite (i.e., no geometry control). Unlike the Waste Tank farms in the 200 Area, there would be relatively little sludge in the 340 tanks. This is because the tanks are agitated before transfer. Therefore, the concentration required would be the minimum concentration required for criticality in water, 7.2 g Pu/l (ARH-600, III.A-2).

Method of Analysis and Results

To obtain sufficient fissionable material to cause a criticality in the piping requires a violation of the waste acceptance criteria, 0.01 grams fissile material per gallon of waste. There would have to be the discharge of several liters of concentrated (300 g Pu/l) fissile solution. This concentration would be 100,000 times the limit. Furthermore, the discharge would have to be done all at once so that a slug of concentrated solution would fill the entire

cross-sectional area of the pipe. There would also be a violation of the criticality prevention specification of 340 Facility which being an Isolated Facility is limited to less than one-third of a minimum critical mass, i.e. 170 grams. Thus, to cause a criticality in the piping system would require two violations of operating requirements. Since the drains in the originating facilities are smaller than the diameter of the piping systems, criticality due to a slug of concentrated fissile solution may be physically impossible.

Criticality in the tanks of 340 Facility would require the undetected accumulation of large amounts of fissionable material or its concentration into a relatively small volume. The mechanisms for such concentration are not obvious. No precipitation is carried out in the tanks. The waste acceptance criteria restricts solid and solidifying substances including waste streams that precipitate. The only operations are slow filling and occasional emptying. Due to the slow filling, it would take a long time to accumulate sufficient fissionable material to be of concern.

The 12 inches of concrete between the solid and liquid waste systems is enough to isolate them neutronically. Therefore, the solid and liquid waste systems can be regarded as separate systems. This separation remains true for far higher fissile concentrations and inventories.

Comments

Some attention should be paid to the possibility of sludge accumulations in the tanks of the RLWS, most particularly if it is relatively thick and localized rather than spread evenly over the floors and sides of the tanks.

Isolated Facilities generally do not receive fissionable material from other facilities by plumbing. The 340 Facility is unusual in this regard. There is no problem with the (minimum 6 ft) spacing between other facilities, but rather in keeping an accurate inventory when the fissionable material comes through a pipe rather than in neatly labeled, assayed packages.

Being an Isolated Facility, it is necessary to keep a running inventory of fissionable material. Since the originating facilities may not notify the 340 Facility of amounts less than a gram if the concentration is sufficiently low (0.01 gram per gallon) to meet specifications, the analysis done when 340 Facility ships to the 200 Area Tank Farms implies production of fissionable material. The amounts (several grams) are low, but this could cast doubt upon the reliability of the method of keeping inventory. The method of keeping inventory is adequate given the size of the error compared to the safety margin (i.e. one third of a minimum critical mass).

An alternative method of proving compliance with the inventory requirements of an Isolated Facility would be to base the inventory on the concentration in the tanks in 340 Facility rather than the inputs from the originating facilities. As an example, if the facility held 13000 gallons, the limiting concentration would be 0.0034 gram per liter to ensure compliance with the 170 gram limit.

This concentration (0.0034 g/l) is far lower and thus more conservative than that required to prevent criticality (7.2 g Pu/l for Pu-water solutions, 0.82 g Pu/l for Pu-SiO₂ mixtures). Classification as an isolated facility is far more restrictive and provides a much greater margin of safety. Since the 340 Facility has been operated as an Isolated Facility without this much tighter limit unduly restricting operations, continuing this classification avoids unnecessary administrative change.

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