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ADDENDUM 4 TO CSAR 81-001 INSTALLATION OF AN
OFFICAL CRITICAL DRAIN ON THE PLEXIGLASS
CONTAMINATION BARRIER IN HC-227T HOOD

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ADDENDUM 4 TO CSAR 81-001, INSTALLATION OF AN OFFICIAL CRITICAL DRAIN ON THE PLEXIGLASS CONTAMINATION BARRIER IN HC-227T HOOD

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Abstract: This report defines the maximum space allowed between the floor surface and the lower edge of an official criticality drain which is to be installed on the plexiglass contamination barrier in HC-227T Hood.

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ADDENDUM 4 TO CSAR 81-001

Title: INSTALLATION OF AN OFFICIAL CRITICALITY DRAIN ON THE PLEXIGLASS
CONTAMINATION BARRIER IN HOOD HC-227T

Prepared by: Tung Chien Date: 12/4/95
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Approved by: [Signature] Date: 12/5/95
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1.0 INTRODUCTION AND SUMMARY

Plutonium Finish Plant (PFP) Engineering has installed a plexiglass enclosure (PGE) inside the Hood HC-227T as a contamination barrier. This enclosure creates a container with a 81.3 cm X 177.8 cm (32" X 70") floor area. ADDENDUM 2 TO CSAR 81-001 (CHIAO, 1994) was prepared to define the criticality safety controls needed with the PGE.

ADDENDUM 2 required that sufficient official criticality drains including mesh to be installed on this enclosure. It was suggested that the bottom of criticality drains be at least 1.27 cm (1/2 inch) above the floor to permit retention of limited volumes of solution spilled, prior to overflowing into the occupied space in room 227.

The reviewer's comments that

"the recommended vertical positioning of the drain (0.6 inches from floor to bottom of hole) will accommodate spilling of a full container without overflow to the room, in keeping with the objective of the enclosure"

seems to imply that the distance between the lower edge of the official criticality drain and the floor surface is required to be less than 0.6 inches.

If the distance between the lower edge of the official criticality drain hole and the floor surface is to be less than 0.6 inches, the maintenance of the official criticality drain may be jeopardized, according to PFP operational personnel. This 4th addendum is to review this problem and to clearly define the maximum allowed distance between the lower edge of the official criticality drain and the floor surface as the basis for installation of an official criticality drain on the PGE in Hood HC-227T.

The re-evaluation concludes that the distance between the lower edge of the official criticality drain hole and the floor surface should not exceed two inches.

2.0 ANALYSIS

The analysis performed in "ADDENDUM 2 TO CSAR 81-001 (CHIAO, 1994) regarding the criticality drains are quoted in the following for completeness as well as easy reference.

"Criticality Drains

Free-flowing criticality drains are used routinely to ensure that a Pu-bearing floor solution depth does not become excessive for criticality safety. Based upon the data of ARH-600, a solution depth of 5.04 cm (2

inches) is acceptably subcritical in contact with a concrete floor as determined below.

According to ARH 600, III.A.5(100)-5, for an infinite slab, which is more conservative than a finite slab, the $k_{eff} = 1.00$ if the depth of the solution slab is about 6.553 cm (2.58 inches) with a solution of Pu concentration at 450 gm/L under 1" H₂O and 10" concrete reflection. The $k_{eff} = 0.98$ if the depth of the same solution is 6.325 cm (2.49 inches). Chart II.B.1-10 in ARH-600 (Reference 2) shows that if a solution slab thickness is in the range between 85% to 100% of its minimum criticality thickness, i.e. 6.553 cm (2.58 inches) in the current case, the k_{eff} decreases almost linearly with the decrease of slab thickness for fully reflected Pu-H₂O with 3 wt.% of ²⁴⁰Pu. The linear relationship is expected to be similar for Pu-H₂O with 0 wt.% of ²⁴⁰Pu (Reference 3). Extrapolation of the ARH-600, Chart III.5(100)- 5 curves for $k = 1.0$ and $k = 0.98$, then yields a thickness of 5.98 cm (2.36 inches) for a k_{eff} of 0.95. Therefore, if the depth of Pu solution can be kept less than 5.04 cm (2 inches, 76.9% of the minimum critical thickness), the solution with a concentration of 450 g/L of Pu on the floor will assuredly be subcritical ($k_{eff} < 0.950$) with the 10" concrete and 1" H₂O reflection conditions.

The criticality drain must be located and sized such that the depth of solution in the PGE area does not exceed the 5.04 cm (2 inches), for the maximum foreseeable solution addition rate".

However, one of reviewer's comments to ADDENDUM 2 TO CSAR 81-001 (CHIAO, 1994) suggested that "a 2 inch diameter criticality drain placed so its bottom edge is within 0.6 inches of the floor would limit the accumulation of water to a depth of 2" within the contamination barrier enclosure" based on the following reasons:

"To exceed 2", external water from sprinklers would have to enter the hood. J. E. Hammelman calculated in ARH-2406 entitled "Z PLANT SPRINKLER SYSTEM, CRITICALITY SAFETY ANALYSIS REPORT," dated January 7, 1974, a 6 gpm entrance rate of sprinkler water into the glovebox HC-227S. The 6 gpm was the maximum entrance rate and was the most common calculated entrance rate for sprinkler water entering gloveboxes during an upset event. Assuming that 6 gpm could enter the hood as is calculated for the adjacent glovebox HC-227-S, the criticality drains would need to allow a out flow of 6 gpm to limit the solution to a 2" depth in the bottom of the hood. The George D. Lehmkuhl report REF-2222 (TID-4500-R60) entitled "CRITICALITY DRAIN PERFORMANCE STUDY" dated August 29, 1974, shows in Figure 3 that a flow rate of 6 gpm is sustained in a 2" diameter side drain with a 1.4" head of water above the bottom of the hole. A larger diameter drain needs a smaller head for a flow rate of 6 gpm".

If the solution from a 10 liter container with a concentration of up to 450 g/L Pu were completely spilled to the floor, the 1.445 square meter (15.6

square feet) floor area could have up to 290 grams Pu per square foot areal concentration, but a depth of only 0.69 cm (0.27 inches) keeps the system subcritical because it is too shallow. If additional external water (from the sprinkler) enters into the PGE to increase the depth to 5.08 cm (2 inches) or to 8.64 cm (3.4 inches), the concentrations of Pu would be decreased to 61 g/L or 36.0 g/L respectively. For a 61 g/L Pu solution, the estimated $k_{eff} = 0.95$ depth is 3.15 inches (extrapolation of data on Chart III.5(100)- 5, ARH-600), or 1.2 inches more than available for that concentration. At 36 g/L Pu solution, the estimated $k_{eff} = 0.95$ depth is 3.6 inches, still 0.2 inches more than assumed to give such solution dilution. Thus, with the drain bottom two inches above the floor, a 1.4 inches head to handle a 6 gpm flooding rate will not provide a critical solution depth.

3.0 REVIEWER'S COMMENTS

Technical review of this evaluation was provided by A. L. Hess of the Criticality Evaluation team of the Consequence Analyses section of Safety Analyses and Nuclear Engineering, who provides the following comments.

This reviewer concurs that the basis in Addendum 2 for setting the drain hole bottom 0.6-inches above the floor was overly conservative, for it assumed four error conditions: a double batch of Pu in the 10-L solution, the contents entirely dumped to the floor, the PGE floor area half blocked, and water ingress to the PGE from overhead sprinkler activation. With normal conditions assumed as above (4500 g maximum available Pu), dumping the 10-L contents to the full PGE floor area and flooding by external water at 6 gpm will not raise the floor solution depth sufficiently for criticality if the bottom of the drain is no more than 2.0 inches off the floor; this scenario represents two contingencies, and there is still the required 5% margin of subcriticality.

Additional conservatism is implied in the analysis of the author above; it was assumed that the solution is ^{239}Pu -water, when most assuredly the load-in material will be nitrate solution with the Pu containing at least 3% ^{240}Pu . If the CPS requires such specifications (3% ^{240}Pu and nitrate solution fissile form), and that the PGE floor remain clear of equipment, the total fissile limit for the 227-T hood can be set at 5000 g, with the drain positioned 2.0 inches (or less) from the floor to the hole edge.

4.0 REFERENCES

Chiao, 1994, ADDENDUM 2 TO CSAR 81-001, USE OF A PLEXIGLASS CONTAMINATION BARRIER IN HC-227T HOOD, WHC-SD-SQA-CSA-20374, Rev. 0, Westinghouse Hanford company, Richland, WA 99352

ARH-600, "CRITICALITY HANDBOOK", Vol. II, R.D. Carter, et. al.. Atlantic Richfield Hanford Co., May 23, 1969

ARH-600, "CRITICALITY HANDBOOK", Vol. I, R.D. Carter, et. al.. Atlantic Richfield Hanford Co., May 23, 1969

W. E. Matheison, private communication

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