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**HAZARDS REVIEW FOR ELECTROLYTIC DISSOLVER
 INSTALLATION, HOOD 3, 236-Z BUILDING**

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HAZARDS REVIEW FOR ELECTROLYTIC DISSOLVER INSTALLATION, HOOD 3, 236-Z BUILDING

INTRODUCTION

The installation of two electrolytic dissolvers in Hood 3, 236-Z Building, is now being completed. These dissolvers will be used to dissolve plutonium metal in nitric acid by application of an electric current. The resulting plutonium solution will then be delivered to a holding tank for use as feed to the solvent extraction columns.

The dissolver system consists of the dissolver tank and electrodes, acid recirculation loop, primary and secondary heat exchangers, and off-gas system. To dissolve plutonium, the metal is placed between the cathode and anode of the dissolver and concentrated nitric acid is added. A potential of 15 to 24 volts is applied to the electrodes, causing the metal to dissolve on the cathodic side. Heat generated by the electrodes is removed from the system by circulating the acid through a heat exchanger. The water in this heat exchanger is cooled by a secondary heat exchanger. Gases produced by the electrolysis (NO_x and some H_2) are removed and diluted by a vacuum system. The off-gases are continuously monitored for combustible gases (H_2).

The present method used to dissolve plutonium metal requires several steps. The metal must be burned to form PuO_2 . This PuO_2 is screened, pulverized, and then dissolved in a nitric/hydrofluoric acid mixture in a batch pot dissolver. The oxide is difficult to dissolve and requires long heating and agitation times.

HAZARDS INVESTIGATED

The hazards review of the electrolytic dissolvers is based on information found in the references and inspection of the installed equipment. . A list of the hazards identified by the committee and conclusions arrived at are given below.

CRITICALITY

The hazards evaluation team performed an extensive review of the design and physical layout of the equipment and the operating procedures of the Miscellaneous Treatment Hood 3 Electrolytic Dissolver process. Special emphasis was placed on the prevention of a criticality. In studying the above-mentioned items, it was evident that some special consideration should be given to the following hazards:

Overbatching

Several problems exist within a processing hood of this type. Because of the limited amount of space within the hood and the restricted visibility, the hazard of overbatching becomes quite real. With the use of the slip lid cans and the difficulty of seeing into the cans, the hazard of exceeding the limit of more than two undissolved buttons in storage in Hood 3 appears to be likely if sufficient administrative controls are not used. There is also a question whether more than one undissolved button can be placed into the dissolver basket. It is recommended that strict administrative controls be used to preclude the possibility of overbatching in the storage locations and the dissolver vessels.

Deposition of Plutonium Solids

The deposition of plutonium solids in the Hood 3 holding tanks and heat exchangers is considered to be a significant hazard. Holding tanks are Pyrex glass-walled vessels and, when

new, are transparent so that a visual inspection for a buildup of plutonium solids can be made. As the process vessels age, the transparent condition may become opaque--rendering a visual inspection for accumulated solids impossible. The heat exchanger tanks are not constructed of transparent material and cannot be visually inspected for accumulation of solids. It is recommended that frequent routine radiation measurements be taken in Hood 3 of all process vessels that could accumulate plutonium solids. These measurements should indicate any significant buildup of solids which could cause a criticality.

Breaking of Pyrex Glass Holding Tanks

Pyrex glass holding tanks may break; which will cause the plutonium-bearing solution to drop to the hood floor. When this occurs, the solution on the floor should be critically safe but the problem of transferring the solution from the hood floor to a critically safe vessel may be difficult with the equipment provided. The committee recommends that proper equipment and an approved procedure be provided to rectify an occurrence of this type.

HYDROGEN GAS EXPLOSION OR FIRE

The off-gases from the dissolver are continuously monitored for hydrogen gas. The sensor is a platinum filament heated by an electrical current. When hydrogen comes in contact with the filament it burns and increases the temperature of the filament causing a change in its resistance. This change in resistance is measured by a Wheatstone Bridge and indicated on a calibrated meter.

Any instrument which is required to operate continuously and give immediate warning of a hazardous condition should be inspected periodically to ensure that it is operating properly. Since the sensor will be operating in a corrosive gas

atmosphere (NO_x), periodic inspection is even more important. The manufacturers of the analyzer recommend a schedule for periodic adjustments and calibration. This schedule should be adhered to when the dissolvers are in operation. Calibration should also be performed after long periods of equipment inactivity and/or system maintenance or repair; and should be performed with a hydrogen gas mixture. Since the formation of explosive hydrogen-air mixtures (>4 percent H_2) is much more likely at low acid concentrations ($<8\text{M}$ HNO_3), measures should be taken to prevent this conditions. Operating procedures call for maintaining a minimum of 7 liters of acid solution in the holding tank. Strict adherence to this minimum will prevent the HNO_3 concentration from getting too low unless a leak in the primary heat exchanger occurs, causing cooling water to dilute the acid.

PLUTONIUM METAL FIRE

There is a possibility of plutonium metal igniting in the dissolvers. Arcing between the electrode and plutonium has been observed in laboratory dissolvers and could cause the metal to ignite. Ignition of the metal would be much more likely if arcing occurred when there was no liquid in the dissolver. This condition is unlikely since voltage cannot be applied to the electrodes unless the acid circulation pumps are operating. A plutonium metal fire would probably cause damage to equipment and a cleanup problem, but no significant hazard if operators are made aware of this possibility.

RADIOACTIVE CONTAMINATION OF COOLING WATER IN SECONDARY HEAT EXCHANGER

The cooling water from the secondary heat exchanger is routed to the D-1 drain and eventually end up in an open ditch. Plutonium contamination of this cooling water could cause a

serious health hazard. In order for contamination to enter this stream, failure of both the primary and secondary heat exchangers must occur. To prevent contamination from leaks in the heat exchangers, the water pressure in the secondary cooling loop should be maintained at a lower value than that of the primary cooling water (PPW water). Also, the water in the secondary loop should be sampled frequently and analyzed for plutonium contamination.

HAZARD TO OPERATORS' HANDS

Operating procedures call for removal of the button heel from the dissolver tank after shutdown. Often the heel will have sharp edges that could cut a glove and cause a serious accident. It is recommended that the use of tongs or other mechanical device for handling the heels be studied in order to prevent this from occurring. This would also greatly reduce hand exposure during handling of buttons and heels.

DISSOLVING MATERIALS OTHER THAN PURE PLUTONIUM METAL

The hazards involved when dissolving plutonium alloys and other materials with the electrolytic dissolver were not considered in this hazards review. A separate review should be made before attempting to process these materials.

CONCLUSIONS

A comparison of the hazards involved in the existing process and the electrolytic process for dissolving plutonium metal shows that, in the opinion of the review team, no net increase in hazards will occur by operating the electrolytic dissolvers. This new process eliminates several hazardous operations such as metal burning and PuO_2 powder handling, and reduces operator time and, therefore, exposure. The new facility can be operated safely provided that the

recommendations given previously are implemented.

REFERENCES

1. R. D. Fox, "Electrolytic Dissolver for Plutonium Metal," ARH-2203, September 1971.
2. ARH-145, "Specifications and Operating Standards for Plutonium Finishing Section, 234-5 Building, Criticality Prevention Specification - Room 41, Hood 3, 236-Z Building," p. 82.8-1, January 25, 1973.
3. Plutonium Reclamation Facility Manual, Miscellaneous Treatment -- Section III, 3.01, Electrolytic Dissolvers -- Hood 3, January 31, 1973.
4. Atlantic Richfield Hanford Company drawings H-2-27002 to H-2-27008, March 1972.

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