94-0005849

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

June 14, 1993

MEMORANDUM FOR: G.W. Cunningham, Technical Director

COPIES: Board Members

FROM: David C. Lowe

SUBJECT: Y-12 - Chemical Process Safety Review Trip Report (March 10-12, 1993)

1. **Purpose:** This trip report documents the Defense Nuclear Facilities Safety Board (DNFSB) technical staff March 10-12, 1993, review of the Y-12 chemical process safety program.

2. **Summary:**

   a. The chemical stability and physical characteristics of LiH/LiD are not fully understood and therefore the risk associated with LiH/LiD storage is not completely known. But, Martin Marietta Energy Systems, Inc. (MMES) has not conducted an unreviewed safety question determination (USQD). Additionally, lithium storage has been classified as a moderate hazard operation, but there is no approved justification for continued operation (JCO). The Department of Energy (DOE) and MMES personnel stated that documentation has been developed that contains the same information as a JCO, but has not gone through the same review and approval process. This documentation is not part of the facility authorization basis for operation.

   b. There apparently is no technical bases (including identification and use of standards) for design and operation of several process safety related systems (e.g., off-gas systems) in some lithium unit operations.

3. **Background:** MMES operates the Y-12 Plant for the Department of Energy Oak Ridge Operations Office (DOE-OR).

   DNFSB technical staff included in this review were David Lowe, Jim McConnell, and Derek Barboza.

4. **Discussion:**

   a. Safety Analysis Report (SAR) Upgrade Program: The safety analysis upgrade program consists of the following phases:

Phase 0	Hazards Identification and JCO
Phase I	Hazard Analysis
Phase IA	Operational Safety Requirements (OSRs) Upgrade
Phase II	Quantitative Hazards Analysis
Phase III	SAR Development

The purpose of Phase 0 is to identify the greatest hazards in each facility, justify continued operation for that facility, and categorize each facility as low, moderate, or high hazard. There are no high hazard facilities and nine moderate hazard facilities or operations.

b. Lithium Operations: Lithium is a very reactive metal which will react violently with water producing hydrogen. The hazardous chemicals involved in lithium operations at the Y-12 plant include hydrogen/deuterium gas, lithium hydride (LiH)/lithium deuteride (LiD), lithium metal (Li), lithium hydroxide (LiOH)/sodium hydroxide (NaOH), hydrochloric acid (HCl), sodium hypochlorite (NaHClO) and chlorine gas. These operations include: LiCl production from LiOH, Li metal production from LiCl, LiH/LiD production from Li metal, weapons components machined from LiH/LiD, and storage of the various lithium compounds.

(1) Lithium Storage: Phase 0 of the SAR upgrade effort identified lithium processing operations as a moderate hazard process and lithium storage as a low hazard process. Accordingly, a justification for continued operation (JCO) was prepared for lithium processing and not for lithium storage. However, during Phase 1 the storage of LiH/LiD was identified as a higher potential risk than lithium operations, and was accordingly reclassified as a moderate hazard process. But, a JCO was not developed for the storage of LiH/LiD. DOE and MMES personnel stated that documentation has been developed that contains the same information as a JCO, but had not gone through the same review and approval process. This documentation is not part of the facility authorization basis for operation.

Currently, the chemical stability and physical characteristics of LiH/LiD are not fully understood and therefore the risk associated with LiH/LiD storage is not completely known. MMES are currently conducting an analysis of the chemical stability and physical characteristics of LiH/LiD. DOE and MMES stated that this situation does not represent an unreviewed safety question (USQ) and the LiH/LiD inventory continues to increase. DOE Order 5480.21 *Unreviewed Safety Question*, paragraph 10.c, states:

"A situation involves a USQ if:

(1) The probability of occurrence or the consequence of an accident or malfunction of equipment important to safety previously evaluated in the facility safety analyses could be increased;

(2) The possibility for an accident or malfunction of a different type than any evaluated previously in the facility safety analyses could be created; or

(3) Any margin of safety, as defined in the bases of the TSRs [Technical Safety Requirements], could be reduced."

There appears to be sufficient justification for performing a USQ determination (USQD) on lithium storage.

(2) LiH/LiD Dissolution: Dissolver operations produce LiOH from LiH/LiD. This process produces hydrogen/deuterium gas at a rate of 16 CFM which is burned with oxygen. There apparently is no technical bases (including identification and use of standards) for design and operation of the dissolver off-gas system. Operating procedures are relied upon to shut down dissolver operations if the off-gas system fails.

(3) LiCl Processing: Electrolytic cell operations produce Li metal from LiCl. Chlorine gas is produced at a rate of 2 liters/minute during operation. The cell is operated at 800°F and the operators manually shovel the LiCl into the cell through an open "manhole".

There apparently is no technical bases (including identification and use of standards) for design and operation of the electrolytic cell off-gas system. Adequate airflow is necessary for ensuring that chlorine gas is not released to the operating area. There are chlorine gas monitors in the vicinity of the electrolytic cell, but a facility engineer stated that the monitors do not work very well.

Additionally, the electrolytic cell is operated approximately two months out of the year, yet operator experience is relied upon as a key component for preventing and mitigating an accident. It appears that operator training and qualification is marginal. This topic will be the subject of a future staff review.

c. Enriched Uranium Operations: Enriched uranium operations are located in Buildings 9206 and 9212. Building 9206 is being phased out of operation and will then transition to decontamination and decommissioning. Building 9212 is undergoing modifications to perform the current Building 9206 mission.

The uranium processing facilities utilize the following hazardous chemicals: nitric acid, aluminum nitrate, sodium hydroxide, hydrofluoric acid (HF), nitrogen tetroxide (N_2O_4), hydrogen peroxide, sulfuric acid, tributyl phosphate, and dibutyl carbitol. Anhydrous HF and N_2O_4 are not presently being used in any process, but are stored onsite. The N_2O_4 is planned for removal from the site. Upgrades are being made to the anhydrous HF storage and unloading process, but the existing transfer line will be used inside Building 9212. The HF piping traverse over 100 feet of operating area before connecting into the process. HF monitors and alarms are located in the vicinity of the process and in the storage area, but there are no HF monitors in the vicinity of the transfer line.