

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

December 7, 1993

MEMORANDUM FOR: G.W. Cunningham, Technical Director

COPIES: Board Members

FROM: A.K. Gwal

SUBJECT: Report of Trip to Y-12 Plant

1. Purpose: This memorandum provides a report of a DNFSB staff visit to the Y-12 Plant on November 3-5, 1993 to review fire protection, electrical, control, and instrumentation systems and to follow up technical issues from a previous review.

2. Summary: The review identified the following potentially significant issues and observations:

DOE/MMES plans to replace the 43 years old, fire detection and alarm systems with a new single fire alarm system by 1998. In the current system, design deficiencies exist related to the water sprinkler system in lithium areas, smoke detectors in the lithium metal vault, electrical cables, emergency light support system, and general lighting. In addition, a fire hazard analysis (FHA) has not been performed as required by applicable codes and standards.

The control relay matrix for the Criticality Accident Alarm System (CAAS) does not meet the single failure criterion. A DOE/MMES analysis estimated the probability of the unavailability of CAAS to be on the order of 10⁻⁴.

During the tour of the switchyard, the DNFSB staff observed that most of the manholes containing electrical cables were flooded with water.

DOE/MMES presented adequate resolution of open technical issues from a previous review related to the battery room ventilation alarm, the high transformer failure rate, and the non-safety loads on safety busses.

3. Background: On November 3-5, 1993, Ajit Gwal visited the Y-12 plant to review the fire protection, electrical, control, and instrumentation systems, as well as to resolve open technical issues from an earlier review on March 22-25, 1993. An expanded list of the topics and issues covered is in Attachment A. A list of documents requested from DOE is in Attachment B. A list of the handouts distributed by DOE/MMES during the briefing to the DNFSB staff members is in Attachment C.
4. Discussion: DNFSB staff observations and findings are as follows:

a. Fire Protection System:

Overall, Y-12 has a strong fire protection team headed by experienced and competent managers. Y-12 has excellent emergency response services. The fire department has well-trained and experienced fire personnel, and well-maintained fire trucks and accessories; it is headed by an experienced fire chief.

The fire detection and alarm systems at Y-12 are 43 years old. Regular light bulbs, which require frequent replacements, are used as an annunciator. The Gamewell fire alarm system, installed as original equipment, serves as the primary alarm system. A recent system condition assessment identified age-related degradation of most of the system components. DOE/MMES plans to replace the present fire detection and alarm systems with a new single fire alarm system by 1998, and are in the process of preparing documentation for this project. The DNFSB staff believes that installation of this system should be expedited.

The primary water supply is a gravity-type system from Oak Ridge City, with a 2 million-gallon water tank as a secondary supply. It could not be confirmed if this tank could withstand an earthquake. Two booster pumps are provided to raise the Oak Ridge City water supply pressure. Design details for this system will be reviewed by the DNFSB staff when they become available.

Because lithium hydride/deuteride and lithium metal are combustible and have toxic by-products, they are unsuitable for long-term storage. In addition, these materials react strongly with water, evolving hydrogen gas. A DOE/MMES team has been formed to provide a lithium storage standard. Several changes in fire protection in lithium areas have been initiated, including conversion to wet pipe sprinkler systems in LiH/D processing and storage areas. The DNFSB staff expressed concern about the use of water in these areas. Also, during a tour of the lithium storage areas, the DNFSB staff also observed that there are no smoke detectors in the lithium metal vault. MMES intends to propose a project to install them.

Fire hazard analyses for most of the buildings at Y-12 have not been performed as required by the codes and standards. Such reports are, however, being prepared. In 1991, Factory Mutual Corporation qualified Y-12 as a highly protected risk following its assessment of the fire protection system. A DOE Headquarters fire protection appraisal, also completed in 1991, indicated that improvement in procedures and documentation is required. The DNFSB staff will evaluate these documents when they are received from DOE.

The procurement specifications for cables at Y-12 specifically call for cross linked polyethylene or an ethylene propylene rubber insulation with a polyvinylchloride (PVC) jacket. Since the PVC jacket will melt in a fire and the drippings may propagate the fire, this type of cable does not meet IEEE-383, "Standard for Type

Test Class 1 E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations" and is prohibited in commercial nuclear power plants. This concern had been raised during the trip of March 22-25, 1993. DOE/MMES subsequently provided justification for the use of PVC cables on the basis that PVC cable is used only in conduits. The DNFSB staff has requested additional cable tray design documentation to evaluate this issue.

During the November tour, the DNFSB staff observed that emergency lights (battery packs) are not seismically supported and may not provide adequate illumination levels in some areas. DOE/MMES intends to evaluate this matter and provide the documentation to the DNFSB staff.

- b. Criticality Accident Alarm System (CAAS): The last failure of the CAAS occurred on February 6, 1992 when the digital voice message recorder failed for Building 92043 and two bad capacitors were found. Since then some improvements to CAAS have been made. During the March 22-25, 1993 visit, the DNFSB staff pointed out that the Y- 12 CAAS does not meet the single-failure criterion of DOE Order 6430.1A and IEEE-379, "Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems." Specifically, redundancy is not provided for the control relay matrix, and a single failure in the control relay matrix could result in the failure of the system. The staff believes that since the CAAS is classified as a safety class item, the system should comply with DOE Order 6430.1A and IEEE-379 (single failure criterion).

During the November visit, DOE/MMES presented an analysis which estimated the probability that the CAAS would fail to function at the time of an accidental nuclear criticality. This analysis estimated the probability of the unavailability of CAAS to be on the order of 10^{-4} . The DNFSB staff intends to review the reliability analysis supporting this estimate when it is received.

- c. Facilities Capability Assurance Program (FCAP): The FCAP involves upgrading the electrical distribution system for the Y-12 site, including various projects which are listed and discussed in a March 1993 trip report. During the November trip, the refurbishing of the 161kvELZAI substation was reviewed. While touring the ELZAI switchyard, the DNFSB staff observed that most of the manholes containing electrical cables were flooded. DOE/MMES stated that this deficiency will be corrected in the new proposed design of the substation. The DNFSB staff intends to review this subject in future site visits
- d. Battery Rooms Ventilation Alarm: There is a significant potential for hydrogen buildup in several battery rooms at the Y- 12 plant if the ventilation fans were accidentally turned off or failed to operate. These rooms do not have alarm systems for loss of ventilation, as required by industry standards. DOE/MMES has issued design modifications to the ventilation systems for the thirteen battery rooms at Y-12 plant, to be completed by the end of this year. The modifications include:

alarms on loss of exhaust fan; horns and status lights as parts of annunciators, with acknowledge and reset features; and future connection to the Supervisory Control and Data Acquisition (SCADA) system. The DNFSB staff believes that these modifications, when fully implemented, will adequately address the issue of battery room ventilation.

- e. High Transformer Failure Rate: Y-12 transformers that were manufactured by Southern Transformer Company have had high failure rates. The primary contributing causes of the failures appear to be due to possible moisture contamination, poor quality construction, inadequate support to windings to withstand overvoltage transients, and lack of space heaters. Replacement transformers have been obtained and their installation is in progress. The DNFSB staff considers the replacement plan to be adequate.
 - f. Emergency Diesel Generators: There are 56 emergency diesel generators at Y-12. There have been 36 failures during the past year. Many failures are due to age-related degradation. DOE/MMES is presently in the process of identifying non-safety loads connected to diesel generators. After completion of this task, MMES will either remove non-safety loads from the diesel generator or provide isolation devices between non-safety loads and diesel generator busses.
 - g. Supervisory Control and Data Acquisition (SCADA): SCADA is designed to monitor and control the operating condition of the electrical distribution system for 13 . 8 kv and up. It will monitor voltage, current, power, alarm points, and breaker and switch status. SCADA is expected to be operational by September 1995. The DNFSB staff previously had expressed concerns related to redundancy of the SCADA front-end processor. The original drawing showed only one front-end processor connected to two redundant control processor stations. During the November briefing we were informed that the SCADA vendor will supply two front-end processors to meet the redundancy criteria. The DNFSB staff intends to review the SCADA design, installation, and operation when it is completed.
5. Future Staff Actions: The DNFSB staff plans the following actions in the future:
- a. A review of the open technical issues of the fire protection system discussed above.
 - b. A review of the reliability analysis which estimates the probability of the unavailability y of CAAS and its conformance to single failure criterion
 - c. A review of the loads on safety busses fed from diesel generators.
 - d. A review of SCADA design installation and operation.
 - e. A review of the ELZAI switchyard design and installation.

- f. A review of the documentation of independent reviews performed by Factory Mutual Corporation and DOE Headquarters.
- g. A review of the fire hazard analysis.

Attachment A

Topics and Issues at Y-12

Electrical System Safety and Reliability:

- Followup of issues raised during electrical review conducted on March 22-25, 1993.

Status of the Facility Capability Assurance Program (FCAP)

Trend review of emergency diesel generator occurrence rate

Status of isolation of non-safety loads from the safety busses

Review of high transformer failure rate.

Battery room ventilation alarm

Fire hazard of PVC cable jackets

Design of the Supervisory Control and Data Acquisition system (SCADA)

- Criticality Alarm System

Single failure analysis

Reliability

Power supply

Fire Protection Systems

- Overview of fire protection systems
- Detection and alarm systems and power supplies
- Water supply systems (pump motor, power supplies, etc.)
- Fire pump design details
- Fire protection system improvements
- Independent review of the fire protection program (including reviews performed by Factory Mutual)
- DOE Order compliance and exemption requests
- Fire hazard analysis
- Lithium fire hazards/fire fighting standards