DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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MEMORANDUM TO: G.W. Cunningham, Technical Director

COPIES TO: Board Members

FROM: Ajit K. Gwal A. K. Gwal

SUBJECT: Y-12 - Electrical Systems Trip Report

1. Background: This memorandum provides information on the electrical systems at the Y-12 Plant in Oak Ridge, Tennessee. This information was obtained in connection with a trip to Y-12 conducted by Derek Barboza, Jim McConnell, Ajit Gwal and William White of the DNFSB staff during the period of March 22-25, 1993. Martin Marietta Energy Systems, Inc. (MMES) operates the Y-12 Plant.

2. Summary:

Oak Ridge National Laboratory (ORNL) presently has excellent software capability for power systems analysis. It appears that the Y-12 Plant is using this resource in very few cases.

On March 13, 1993, five Southern transformers failed bringing the total number of Southern transformer failures to nine. Fifty-two units of this manufacturer were installed in 1987 and 1988. The expected life of the units is thirty years and these units have failed in three to five years. Southern, the manufacturer of the transformers, has limited involvement in the investigation of the failures.

There is a potential for hydrogen buildup in several battery rooms at the Y-12 Plant. This could occur if the ventilation fan were accidentally turned off or failed to operate. The switch for the fan is located next to the light switch for the battery room. Although there is an indication lamp on the fan switch, it was too dim to determine its status. Procedures do not include hydrogen monitoring, nor are there any hydrogen monitors in the room. There is a concern that hydrogen generated by the batteries may accumulate and create a potential explosion hazard.

The procurement specifications for the cables at Y-12 specifically call for cross linked polyethylene (XLP) or an ethylene propylene rubber (EPR) insulation with a polyvinyl-chloride (PVC) jacket. In a fire, the PVC jacket will melt, and the drippings may propagate the fire. This type of cable does not meet IEEE 383, "Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations" and is prohibited in commercial nuclear power plants. The specifications do not require the

investigation of the failures.

3. DC Power

During a tour of the chiller building, the staff identified the possibility for hydrogen buildup in the battery room. Hydrogen buildup in the battery room would present a potential explosion hazard. The ventilation system for the room is controlled by a switch that is located adjacent to the light switch for the battery room. There is an indication lamp for the ventilation switch, but it was too dim to determine its status. There are no other alarms or controls to prevent the buildup of hydrogen if the ventilation system is turned off. There are no procedures to monitor for hydrogen, nor are there any hydrogen monitors/alarms in the battery room. MMES personnel told the staff that a similar situation may exist in other battery rooms.

The batteries are not tested to IEEE-450, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations". MMES personnel stated that they were planning to procure the proper test equipment to perform load testing according to IEEE-450.

4. Cables

Cables used at Y-12 are procured according to the Martin Marietta Engineering Technical Specifications. Specification 16121, "medium-voltage cable 5 kV insulated" and specification 16122, "medium voltage cable 15 kV insulated" each require either cross linked polyethylene (XLP) or an ethylene propylene rubber (EPR) insulation with a polyvinyl chloride (PVC) jacket. In a fire, PVC will melt and the drippings may propagate the fire. These types of cables do not meet IEEE-383 requirements and are prohibited in commercial nuclear power plants.

The procurement specifications for the cable do not reference IEEE-383, "Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."

C. Supervisory Control and Data Acquisition (SCADA)

This system will remotely monitor and control the operating condition of the electrical distribution system for 13.8 kV and up. SCADA will monitor voltage, current, power (real and reactive), alarm points and switch and breaker status. The system is in the procurement stage. Further review by the DNFSB staff will be necessary when design of the system is complete.

D. Criticality Alarm System

The criticality alarm system (CAS) at Y-12 is classified as a safety class item. DOE Order 6430.1a, Section 1300-3.3 states that:

procurement of the cables to meet IEEE-383.

There is a concern that the emergency generators at Y-12 have non-safety loads hooked up to their safety busses. Proper isolation must be provided between non-safety loads and safety busses so that a fault with a non-safety load does not isolate a safety bus.

An adequate system is not in place to incorporate generic industry issues and industry lessons learned into the systems at Y-12. Publications such as the NRC's I.E. Bulletins, I.E. Circulars, and I.E. Information Notices provide useful information about current problems and lessons learned in the nuclear field.

The criticality alarm system (CAS) at Y-12 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." Redundancy is not provided for the control relay matrix and a single failure in the matrix could result in the failure of the system. Since the CAS is classified as a safety class item, the system should comply with DOE Order 6430.1a and IEEE-379.

3. Discussion:

A. Systems

1. Upgrade Status

Martin Marietta is upgrading the electrical distribution system at the Y-12 site. The program, titled Facilities Capability Assurance Program (FCAP), includes the following projects:

Phase I

(1) Provide a new 13.8 kV underground cable system to Area 5 (Area 5 consists of six major weapons production facilities)
(2) Provide an emergency 161 kV feed from Ft. Loudon via the Elza 2 switchyard
(3) Provide increased lightning protection for the 13.8 kV overhead distribution system
(4) Replace auxiliary current transformers with external primary bushing-type current transformers
(5) Modify west reserve ties by adding a 13.8 kV tie breaker

Phase II

(1) Refurbish the 161 kV ELZA 1 substation
(2) Install a supervisory control and data acquisition system (SCADA)
(3) Refurbish the 480 V power distribution system.

Phase I of FCAP has been completed and Phase II is in progress. Construction in the ELZA 1 switchyard is expected to begin during the winter of 1993 or the spring of 1994.

The SCADA system is presently in the procurement stage. The secondary distribution system is still in the planning stage. This upgrade will include the replacement of twenty-one transformers, ten switchgear units, forty-six motor control centers, and thirteen 480 V circuit breakers.

2. Software Analysis Capability

Oak Ridge National Lab (ORNL) has excellent software analysis capability for power systems analysis. The Y-12 plant, however, is using the software on a very limited scale for their power systems.

3. Generic Industry Issues

There is not an adequate system in place to incorporate generic industry issues into the systems at Y-12. Commercial publications such as NRC's I.E. Bulletins, I.E. Circulars, and I.E. Information Notices provide useful information about problems and lessons learned in the nuclear industry.

B. Equipment

1. Emergency Generators

There are 56 emergency generators at Y-12. There have been seventeen occurrences (14 off-normal, 3 unusual) related to emergency generators since June 1992. The Safeguards and Security Division manages the emergency generators. In a November 6, 1992 letter addressed to Mr. D.J. Bostock, Vice President and Y-12 Plant Manager, DOE Y-12 Site Manager Robert Spence expressed his concerns over the performance of the generators and the unwillingness of the S&S Division to manage the problems associated with the generators. The letter provided ten points of guidance including the implementation of a trending program for the generators and strict testing instructions.

It appears that the attention given to the generators at Y-12 has increased substantially. MMES personnel have identified five "immediate need" generators for replacement. Two have been replaced and the remaining three are scheduled to be completed in fiscal year 1993. Sixteen additional generators have been identified to be replaced. In addition, several areas of consolidation have been identified. One of the proposed consolidation efforts is for Building 9212 which houses the enriched uranium operations. The effort consists of transferring several kilowatts of safety related loads on generator #74-7430 to a 230 kW generator, #74-7495, which powers process related loads. Adequate electrical isolation must be provided to maintain the safety related loads in the event of a fault with a non-safety process related load.

2. Transformers

On March 13, 1993, five Southern transformers failed bringing the total number of Southern transformer failures to nine. A total of 52 units were installed at Y-12 during 1987 and 1988. The expected life of these units is 30 years. An investigation into these failures is currently underway, but Southern does not appear to be heavily involved in the

> The design shall ensure that a single failure does not result in the loss of capability of a safety class system to accomplish its required safety functions.

It is further stated in section 1660-99.0.2 that:

> Safety class instrumentation shall sense abnormal conditions affecting safety and subsequently provide an alarm, e.g., low differential pressure between HVAC zones, criticality monitoring ...
>
> The design of safety class instrumentation and controls shall provide suitable redundancy and diversity to ensure that safety functions can be completed, when required, and that no single failure will result in the loss of the protective functions.

The CAS consists of two stations with two detectors per station. For the system to alarm, both detectors from either station must send an alarm signal. The detectors are fail safe such that if one detector is inoperable, an alarm signal from the second detector of the same station will alarm the system. Both stations feed the signals into a single control relay matrix. The control relay matrix is not redundant, and a single failure in the matrix could result in the failure of the entire system. The CAS at Y-12 does not meet the single failure requirements of DOE Order 6430.1a and IEEE-379.