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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

August 23, 1994

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Ajit Gwal

SUBJECT: Report on Trip to Pantex - Building 12-84 and 12-44

1. **Purpose:** This memorandum provides a report of a visit by the Defense Nuclear Facilities Safety Board (DNFSB) Staff members, Ajit Gwal and Jim McConnell, to the Pantex Plant Building 12-84 West and Building 12-44 on June 6-10, 1994, to review the electrical, instrumentation and control systems.

2. **Summary:** The review identified the following major issues and observations:

   a. Electric power to certain critical safety systems (CSS) is not always supplied from an emergency bus, as required. The CSSs have not been evaluated to identify effects of potential deficiencies or failures in the power supply.

   b. Some electrical equipment operates at temperatures exceeding their thermal rating.

   c. Some electric cables are more than 40 years old and age related degradation of cable resulting in the embrittlement of insulation and jacket material could be expected. There is no plan to assess and monitor the condition of these cables and replace deteriorated cables, as is required in the commercial nuclear industry as part of the renewal process of an operating license. Code of Federal Regulations: 10 CFR 54 is the NRC regulation applicable to license renewal.

   d. Several deficiencies exist in the coordination of the protective devices for certain electrical distribution systems. Mason and Hanger (M&H) plans to identify and correct all the deficiencies.

3. **Background:** Many of the installed electrical, instrumentation and control systems at Pantex are old and showing the effects of aging. The Staff performed an initial review of various topics listed in the attachment to this report.

4. **Discussion:** DNFSB Staff observations and findings from this review are as follows:

a. Safety Systems: The Continuous Alpha Air Monitoring (CAAM) system is a critical safety system at Pantex. While the CAAM system receives most of its electric power from an emergency bus, its vacuum air pump is fed from a normal bus of the electrical distribution system. Basic design requirements of CSS's, set forth in DOE Order 6430.1A, *General Design Criteria*, and industry standard IEEE-308, *Standard Criteria for Class IE Power Systems for Nuclear Power Generating Station*, require that components and subsystems of the CSS receive power from an emergency bus. Pantex will evaluate the CAAM system and other CSSs to determine the extent of this condition and to identify corrective actions.

b. Ambient Conditions: During a tour of selected substations, the DNFSB Staff observed that several 15 KV vacuum switchgears and one Motor Control Center (MCC) have been operating in an environment that exceeds their thermal rating (117-124°F versus rated 104°F). If not corrected, this condition may result in an increased number of power outages due to spurious operation or failure of electrical components of emergency and normal buses.

c. Cables: In a commercial nuclear industry, electrical cables are limited to a 40-year design life and any life extension beyond 40 years requires substantial justification, including condition assessment in accordance with the Code of Federal Regulations 10 CFR 54, *Requirements for Renewal of Operating Licenses for Nuclear Power Plants.* Although there was no visible age-related degradation of the cables behind certain MCC cabinets, the condition of cables inside conduits and other inaccessible areas could not be determined. Since some of these cables are more than 40 years old, the Staff believes it is prudent to monitor their condition by assessing the adequacy of insulation and jacket material and replacing deteriorated cables. M&H has presented no plans to do so.

Maintaining electrical circuits has traditionally been viewed as a reactive process at Pantex. However, the desire to increase availability, improve maintenance efficiency, and improve electrical safety, has led several commercial nuclear industries to supplement their existing maintenance program with various condition-based technologies. The Electric Power Research Institute (EPRI) has completed a test program on aging and the condition monitoring of cables. This work was supported by the U.S. Nuclear Regulatory Commission (NRC) and performed at Sandia Laboratories.

Final reports have been published in a paper by EPRI. This paper presents a list of references, along with abstracts for each reference. The Staff believes that M&H could use this as a guide for finding references to any desired information on the test program in varying levels of detail.

d. Electrical Calculations: A comprehensive short circuit voltage profile and coordination study in accordance with IEEE STD-141, *IEEE Recommended Practice for Electric Power Distribution for Industrial Plants* and STD-242, *IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* is essential to safeguard personnel and maintain a safe and reliable power system. M&H presented several past studies to the DNFSB Staff.

Several deficiencies in the coordination of protective devices were noted in the short circuit and coordination studies performed by M&H. M&H plans to completely evaluate the protective device coordination study. This study will be performed by an outside contractor using the latest available computer software. The estimated completion date is September 30, 1994.

A voltage profile for building loads does not exist.

e. Engineering Management: M&H does not have an electrical engineering division. Three individuals assigned to the project management group perform required electrical tasks through outside consultants and contractors. Considering the size and type of facility, the number of electrical engineering personnel seems inadequate when compared to other DOE sites, and this inadequacy may pose engineering problems during multiple failure of electrical safety systems. The Staff believes that Pantex would benefit from the creation of a dedicated electrical engineering group.

f. Lightning: Compliance of current design and installation of lightning rods in Building 12-84 East to NFPA-780, *Lightning Protection Code*, could not be verified due to unavailability of documentation. A visual inspection indicated that the spacing of the lightning rods may not be adequate.

g. Preventive Maintenance of Electrical Equipment: Although Pantex presented a good framework for preventive maintenance, the Staff review of detailed maintenance procedures revealed a number of technical inadequacies and weaknesses, especially for electrical equipment such as batteries and diesel generators. For example, *IEEE Standard - 450, Recommended Practice for Maintenance, Testing and Replacement of Large Lead Storage Batteries*, is not referenced or used in the PM of batteries.

5. **Future Actions:** The DNFSB Staff intends to perform the following, as identified in this memorandum.

a. Reviews of voltage profile, final short circuit and protective device coordination studies and any resulting design modification.

b. Review the test program for aging and condition monitoring of cables.

c. Reviews of design modification or justification of the existing electric power distribution to critical safety systems, e.g. CAAM.

d. Reviews of the resolution of the potential deficient condition in the lightning protection system design.

e. Reviews of actions to prevent electrical equipment from operating in a higher ambient temperature than their thermal rating.

f. Reviews of revised PM procedures for electrical equipment.

g. Reviews of two reports prepared by Sandia National Laboratory on lightning protection.

The following topics were reviewed and discussed on June 6-10, 1994

Electrical Distribution System:

Overview of electrical distribution system
- System description - design criteria
- Normal and emergency power
- One line diagrams
- Discussion/definition of safety systems and loads
- Compliance with DOE Orders and industry standards (IEEE 141, 242, 308, 279, 384, etc.) and the National Electric Code
- Calculations (voltage profile, short circuit analysis, cable sizing)

Protective device coordination study

Loss of electrical power scenario discussion
- Emergency response procedure
- Maintainability of safety systems and loads

Preventive maintenance and surveillance of electrical, I&C equipment

Electrical Systems and Components:

HVAC system
- Electrical power supply
- Electrical equipment (fans, motors, etc.)

Lighting and grounding system
- Compliance to IEEE-80
- Compliance to UL standards

Electrical equipment
- Diesel generators
- Transformers
- Cables
- Motors
- Switchgear
- MCC

Emergency lighting

Instrumentation and Control Systems (safety-related):

Air/Radiation monitoring systems
- Tritium
- Plutonium

Interlock door/exit system

HEPA filter system

Fire Protection System:
- Fire detection and alarm system
- Fire panels, electrical supply
- Fire pump design review including motor cable sizes

Occurrence reporting for the last three years (1992, 1993, and 1994)
- Trending
- Root cause, corrective action and re-occurrence control

USQDs in electrical, I&C systems