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REVIEW OF OPERATING HISTORY AT THE PALISADES NUCLEAR PLANT*

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The Systematic Evaluation Program Branch (SEPB) of the Nuclear Regulatory Commission (NRC) is conducting the Systematic Evaluation Program whose purpose is to determine the safety margins of the design and operation of the eleven oldest operating commercial nuclear power plants in the United States. A portion of the SEP includes the compilation and interpretation of operational occurrences at these plants. This summary describes the methodology and results of the operational experience review of Palisades Nuclear Plant. The review includes a detailed examination of the operating experience in two segments — plant shutdowns and power reductions, and reportable events.

The first segment of the Palisades operating experience review examined 129 forced shutdowns and twenty-two forced power reductions. The consequence of some of these events was solely the inability to produce power. However, many of the events had safety implications. Some of the shutdowns were design basis events[1] (DBE). DBEs are postulated failure events which result in system transients, challenging one or more safety systems. Because they challenge safety systems and are the initiating events in postulated accident sequences, DBEs warrant special attention. In addition, the compilation of data (date, duration, power level, description, cause, shutdown method, system involved, and component involved) revealed safety significant trends.

The final segment of the Palisades operational experience reviewed 341 reported abnormal occurrences to find those occurrences which represented significant threats to continued safe operation or to systems designed to mitigate transient conditions. Reportable events were therefore significant if they met one of these criteria:

1. an event in which the failure or failures initiated a design basis event (DBE), or
2. an event in which the failure or failures compromised a function of the engineered safety features.

From the compilation of reportable event data (event date, plant status, system, equipment, component status, abnormal condition, and cause) additional trends were evident.

The results of this analysis are in three forms — DBEs, significant reportable events, and trends. The analysis identified fifty-three DBEs falling into eight categories:

1. feedwater malfunctions resulting in increased feedwater flow (1),
2. loss of external electric load (6),
3. turbine trip (4),
4. inadvertent MSIV closure (4),
5. loss of normal feedwater flow (30),
6. reactor coolant pump trip (1),
7. control rod maloperation (6), and
8. inadvertent opening of pressurizer relief valve (1).

The significant reportable events identified by a loss of safety function included:

1. loss of offsite power in coincidence with loss of onsite power,
2. loss of high pressure safety injection (HPSI) capability,
3. loss of containment integrity, and
4. loss of component cooling capability.

Using the information compiled from each forced shutdown, power reduction, and reportable event, the safety significant trends identified were:

1. loss of offsite power,
2. control rod drive anomalies,
3. steam generator tube failures,
4. charging system vibration-induced cracking,
5. reactor internals movement,
6. containment purge isolation valve leakage, and
7. procedural and human errors.

Two of the identified failure types had the potential to satisfy both of the criteria used to indicate potential safety problems. The remaining problems met only one criterion.

The first failure type satisfying both criteria was procedural and human errors. These failures had the potential of not only starting a DBE (inadvertent tripping of a reactor coolant pump on February 1, 1979). but also defeating a safety functions (leaving containment exhaust valves open on September 14, 1979).

The second failure type was electric power interruptions that resulted in a loss of generator load DBE. Palisades experienced ninety-eight partial or total losses of offsite power. In itself, the loss of offsite power did not cripple the supply of electric power to engineered safety features. However, coupled with the large number of failures in the emergency diesel power system, the loss of offsite power has the potential for loss of electric power to all safety functions. The large number of failures in the diesel generator power source was not attributable to a single failure source; rather, they simply exemplified the unreliability experienced in diesel generator power sources industrywide.

The only DBE experienced with regular frequency was the loss of normal feedwater flow. Of these occurrences, only one was a total loss of normal feedwater. In all cases, engineered safety features performed their intended functions to mitigate the effect of the feedwater loss and bring the reactor to a safe shutdown.

Other potentially significant system failures included failures in the control rod drive system, the containment isolation system and the HPSI system. The CRDM problems were nonexistent during 1979, indicating that they may have been solved. Containment isolation difficulties have been solved by both hardware and administrative changes. The HPSI problems have mainly been those of design and other human errors.

REFERENCES

1. Nuclear Regulatory Commission, "Accident Analysis for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 15 of *Standard Review Plan*, NUREG-0800 (July 1981).