Attachment

SAFETY EVALUATION
CONTAINMENT SYSTEMS AND SEVERE ACCIDENTS BRANCH
DIVISION OF SYSTEMS SAFETY AND ANALYSIS

1.0 INTRODUCTION

In a licensee event report (LER) dated September 11, 1995 (LER 94-040-02), Northeast Nuclear Energy, operator of the Millstone Nuclear Power Station, submitted information describing the December 6, 1994, discovery of a "deficiency in the original design" of the Unit 2 facility. The design deficiency relates to potential single failure scenarios that could have resulted in an unfiltered fission product release path from the Enclosure Building in the event of a Design Basis LOCA coincident with Enclosure Building purging operations.

2.0 DISCUSSION

2.1 ENCLOSURE BUILDING AND ASSOCIATED SYSTEMS

Millstone-2 is a dual-containment PWR facility. The primary containment is a large, dry, prestressed concrete structure that encloses the Nuclear Steam Supply System. It is designed to withstand peak accident pressures and temperatures with very low leakage (i.e., ≤0.5%/day for the first 24 hrs and ≤0.25%/day after 24 hours). The primary containment, penetration rooms and ESF spaces are enclosed by a steel-framed, metal-siding secondary containment fission product control structure called the Enclosure Building. The Enclosure Building is designed to contain the (0.5%/day) primary containment leakage (except for a limited amount of leakage which might escape via certain bypass leakage pathways identified in the Technical Specifications). The Enclosure Building provides a means for the non-bypass leakage to be directed to and treated by the Enclosure Building Filtration System (EBFS).

The EBFS is a safety-grade, redundant filtration system, each train having a fan, HEPA/charcoal filter bank, heating elements, ductwork, and isolation dampers. In the event of an accident, the EBFS establishes and maintains a negative pressure in the Enclosure Building, filters the exhaust flow, and discharges the filtered effluent to the Unit 1 stack. The analysis of radiological consequences of a Design Basis LOCA assumes that a -0.25"w.g. negative pressure is established, and filtration begins, one minute after the accident begins (Ref: SER dated May 10, 1974). During normal operation the EBFS may be used in conjunction with the CEBPS (described below) for containment radiological cleanup. During fuel handling the EBFS serves as an emergency ventilation system for the fuel handling area.

The Millstone-2 dual containment system is also provided with a Containment and Enclosure Building Purge System (CEBPS). The CEBPS consists of a supply fan, glass fiber filter train, associated supply ductwork and air-operated isolation valves. Another system, the main ventilation exhaust system, serves as the normal exhaust pathway for the CEBPS. The CEBPS is normally not in use during plant operation, but is used as necessary to reduce primary or

secondary containment airborne radiation levels for personnel access (e.g., ≈600 hrs/yr.). This is done in conjunction with the EBFS. With the exception of containment penetration isolation provisions, the CEBPS and main ventilation system are not safety-grade and do not provide accident mitigation functions. It is noted that during the early PSAR design stage, there was no CEBPS. Instead, there were two separate purge supply fans, one for the primary containment and one for the Enclosure Building (Ref: PSAR Fig 9-9).

The Enclosure Building was designed as a seismic structure. However, certain Enclosure Building penetrations were originally designed and installed to non-seismic criteria and were not provided with single-failure proof isolation devices. It is also noted that the Enclosure Building was not designed with double-door personnel accesses (Ref: Licensee letter dated November 21, 1977). In 1977 the Enclosure Building design basis was clarified and certain penetrations were upgraded to seismic status (Ref: NU letter dated March 1, 1979).

Attachment 1 of the LER states that the Enclosure Building was not part of the 1973 Millstone Unit 2 design. Although the Enclosure Building may not have been included as part of the initial Millstone 2 design, it was a planned fission product control feature at least as early as the February 28, 1969, the date of issue of the Preliminary Safety Analysis Report which mentions the Enclosure Building in its Section 5.1.

The enclosed figure depicts the functional arrangement of the systems described above.

2.2 SINGLE-FAILURE VULNERABILITIES

2.2.1 SINGLE FAILURE CRITERION

A detailed discussion of use of the "Single Failure Criterion" as a deterministic design and analysis tool is provided in SECY-77-439 of August 17, 1977 (NUDOCS 7812180291). Simply stated, it is a requirement that a system designed to perform a defined safety function be capable of performing that function in spite of the failure of any single component within the system or within any associated support system. The Single Failure Criterion is codified in Appendices A and K to 10 CFR 50. The SFC is also invoked in various Code and Standards. Appendix K specifies requirements for ECCS systems whereas Appendix A identifies general staff review criteria applied to all systems important to safety. For primary containment isolation systems, GDC 55, 56, and 57 identify specific acceptable redundant valve arrangements that encompass the single-failure criterion. However, applicability of these GDC to secondary containment isolation systems is not discussed in the Regulations.

Since the SFC and GDC are not expressly invoked in the Regulations for application to secondary containment penetrations, they are "requirements" only to the extent that they were used and documented as design and licensing criteria during the facility's Construction Permit and Operating License acceptance reviews.

2.2.2 MILLSTONE 2 SINGLE FAILURE VULNERABILITIES

In 1994, several Enclosure Building isolation system single-failure vulnerabilities were discovered by the licensee and reported to the NRC. One, which is not discussed in this evaluation related to the hydrogen analyzer cabinet hood vent. The others relate to penetrations used during containment purging.

Of the single failure vulnerabilities related to purging, the first relates to safety-related air operated damper AC-1 which is controlled from the Unit 2 main control board. AC-1 is designed to close upon initiation of a Channel #1 Containment Isolation Actuation Signal (CH1-CIAS). It lacks a second solenoid that would enable it to automatically close on a CH2-CIAS. A CH1-CIAS actuation also causes startup of EBFS exhaust fan F-25A. In the event of a LOCA or MSLB during purging, with failure of actuation signal CH1-CIAS, damper AC-1 would fail to close and fan F-25A would fail to start. This combination of lack of isolation (AC-1) and reduced filtered exhaust capability (loss of one train of exhaust/cleanup) would prevent the secondary containment from functioning properly as a fission produce cleanup system for primary containment leakage as the single operating F-25 fan would not have sufficient capacity to establish and maintain the necessary negative pressure in the unisolated Enclosure Building.

The second single failure vulnerability involves air operated main exhaust damper AC-11. If an accident should occur during power operation while the Enclosure Building is being purged and AC-11 fails to close (due to either a mechanical failure or failure of CH2-CIAS), the main exhaust fans F-34A/B/C, would have a direct suction on the Enclosure Building atmosphere and could discharge unfiltered primary containment leakage to the Unit 2 stack.

These scenarios were overlooked during the original operating license review. Although the licensee claims that corrective action is not required by the original licensing basis, a modification has been proposed to eliminate the AC-1 vulnerability. A gravity damper would be installed as shown in the drawing. It would be weighted such that operation of purge fan F-23 opens it, but a -0.25w.g. vacuum due to operation of an EBFS fan would not cause it to open. This action would eliminate the AC-1 single failure condition.

For the AC-11 vulnerability, no corrective modification is proposed by the licensee, based on (1) insufficient safety benefit and (2) the lack of a licensing basis requirement for single failure reliability. The staff attempted to determine from record documents whether single failure was indeed a licensing requirement for acceptance of the Millstone-2 Enclosure Building.EBFS design. From a review of early docket records, it was determined that the staff performed an extensive review of secondary containment isolation system and clearly accepted the licensee's decision to reclassify valves AC-3 and AC-8 from fail-closed to fail-open on the basis that should AC-1 or AC-11 fail to close, the Enclosure Building would nevertheless perform as designed (Ref: Utility responses to OL Review Questions 5.63 and 6.15.40). However, there is insufficient record information available as to whether such single failure reliability was or would have been considered necessary for the enclosure Building during purging of the

Enclosure Building. In view of this uncertainty, imposition of a corrective action requirement should be considered a backfit action.

3.0 NEED FOR BACKFIT CORRECTIVE ACTION

The licensee and staff have given due consideration to the probability and consequences of the AC-11 accident scenario. The fact that the vulnerability exists only during purging of the Enclosure Building reduces the probability of occurrence by at least an order of magnitude. The fact that the potential release path is monitored for radioactivity provides a high degree of confidence that manual action would be quickly taken to terminate the release by shutting off the main ventilation exhaust fans. Existing plant procedures prescribe the necessary actions. Based on these considerations, the staff accepts the licensee's position that correction of the AC-11 single failure vulnerability is unnecessary. It is also noted that the licensee has performed an Integrated Safety Assessment Program cost-benefit analysis for correction of the AC-11 deficiency and determined that the potential safety benefit is insignificant.

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Date:

Enclosure

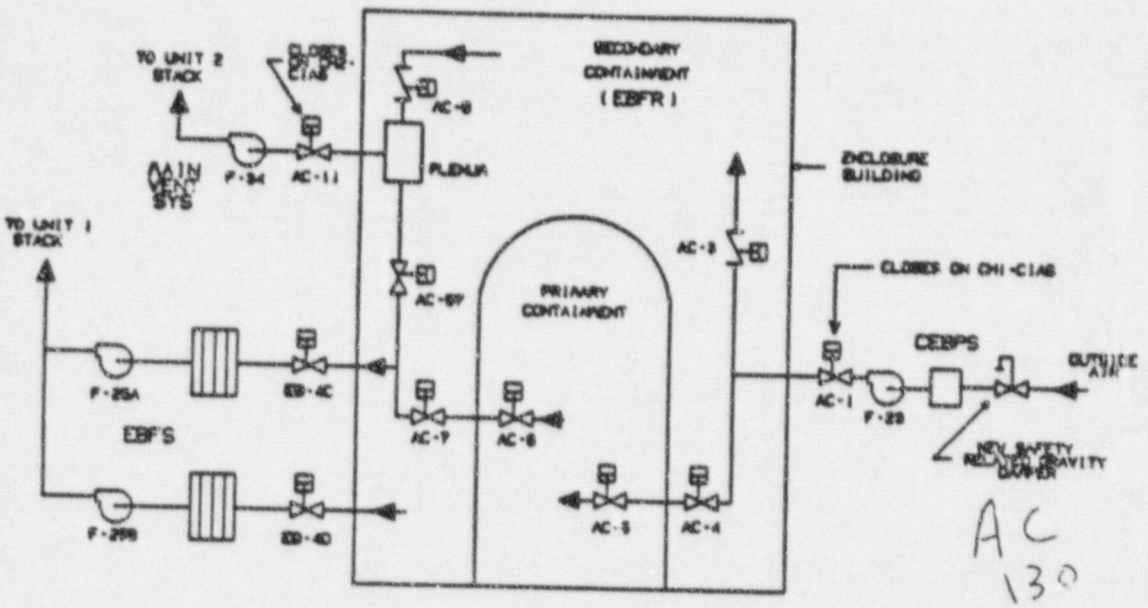

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FIGURE - MILLSTONE 2 DUAL CONTAINMENT SYSTEMS