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TECHNICAL EVALUATION OF THE ALTERNATE TO THE KEYLOCK CONTROL TO THE BYPASS VALVES FOR THE DAVIS-BESSE NUCLEAR POWER PLANT, UNIT 1

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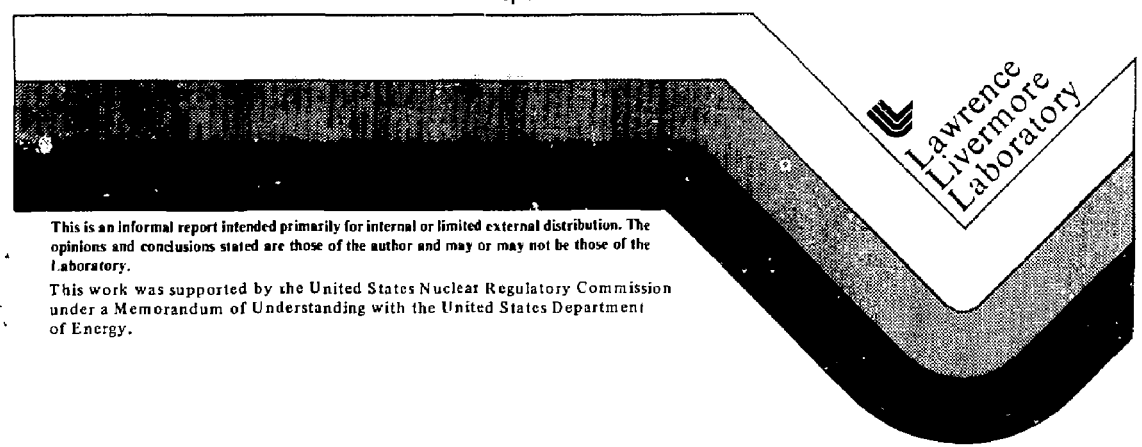

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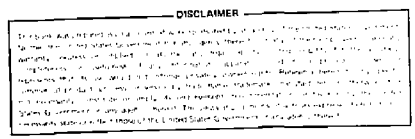
ABSTRACT

This report documents the technical evaluation of the alternate to the keylock control to the bypass valves for the Davis-Besse nuclear power plant, Unit 1. The review criteria are inferred from the NRC Reactor Safety Study (WASH-1400) and the Safety Evaluation Report for Davis-Besse. This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues Program being conducted for the U. S. Nuclear Regulatory Commission by Lawrence Livermore Laboratory.



FOREWORD

This report is supplied as part of the Selected Electrical, Instrumentation, and Control Systems Issues (SEICSI) Program being conducted for the U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Division of Operating Reactors, by Lawrence Livermore Laboratory, Field Test Systems Division of the Electronics Engineering Department.

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1. INTRODUCTION

In its Safety Evaluation Report[1] (SER) dated April 1977 for the operation of Davis-Besse nuclear power plant, Unit 1, the U. S. Nuclear Regulatory Commission (NRC) requested that the Toledo Edison Company (TECO) make a reliability study for a spectrum of hypothesized design modifications to be compared with the present design of the low-pressure residual heat removal (RHR) system. The NRC would evaluate the design modifications to determine if the modifications enhance the safety of the system and that the final system is acceptable to minimize the potential for an inadvertent opening of the bypass valves during high-pressure operations. By letter[2] dated January 11, 1979, TECO transmitted to NRC a technical report entitled "Reliability Study of Davis-Besse Unit No. 1 Decay Heat Removal System Suction Bypass"[3] and dated January 5, 1979.

The purpose of this report is to evaluate the proposed design modifications for the present keylock controls in the manual bypass valves based on the information provided (see References) and to define how well they meet the criteria and requirements established in the NRC SER[1] for Davis-Besse and inferred in the NRC Reactor Safety Study (WASH-1400).[4]

2. EVALUATION OF THE DAVIS-BESSE NUCLEAR POWER PLANT, UNIT 1

2.1 INTRODUCTION

Licensee condition 2.C(3)(p), stated in SER Supplement No. 1 (p.5-5 and p.E-3),[1] requires that

(1) The licensee submit an analysis of the design modification alternatives for the present keylock control in the manual bypass valves (DH21 and DH23) around the decay heat removal (DHR) suction line valves in order to decrease the likelihood of the bypass path being opened inadvertently when isolation of the DHR loop is required (see Figure 1).

(2) The submitted analysis and installation of the approved design modifications shall be completed prior to startup following the first scheduled refueling outage.

The bypass loop contains two manually operated valves around the DHR suction line valves. The two manual isolation valves are in series on the bypass line. The normally closed bypass valves would be opened in the event of a spurious closure of one of the DHR system suction line isolation valves during system operation. The NRC requires that

(1) Further attention be given to the means employed for isolation of the low-pressure RHR system from the primary system while the latter is pressurized.

(2) Reliable means be developed to ensure such isolation.

Present control procedures utilize a chain and padlock. The padlock key opens no other valves, but it does open certain restricted-area doors.

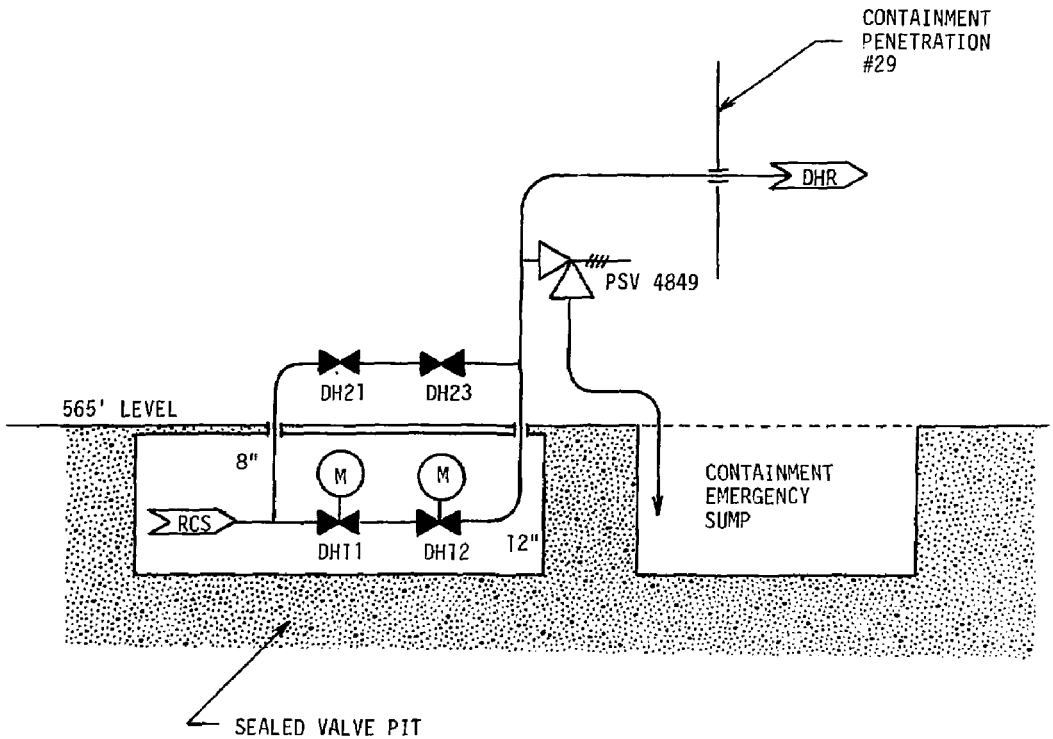

Figure 1. DHR Suction Line Diagram.

2.2 LICENSEE EVALUATION AND PROPOSED MODIFICATIONS

The TECO technical report[3] for Davis-Besse nuclear power plant, Unit 1, evaluates the following:

(1) The rate of occurrence of incidents in which the DHR system is exposed to overpressure due to the improper opening of the DHR suction bypass.

(2) Design options for the bypass, including:
   (a) Present design.
   (b) Present design plus a warning sign.
   (c) Present design plus a flange.

(3) Procedural methods, including:
   (a) No lock.
   (b) A lock.
   (c) A lock with a unique key.
   (d) A lock with two unique locks.

Four categories of events leading to an inadvertent opening of the bypass while the unit is above cold shutdown were considered as follows:

(1) Maintenance activities in the vicinity of the bypass may result in the inadvertent opening of the bypass.

(2) Startup from a cold shutdown might be attempted with the bypass left open.

(3) Personnel dispatched to enter containment to check or realign valves might select the wrong valves.

(4) Personnel near the bypass at the time of what they perceive to be a loss of coolant accident (LOCA) or severe transient might panic, become irrational, and realign the valves.

The results and conclusions for the frequency of DHR overpressure incidents are presented. The dominant problem is maintenance on the pressure relief valve (PSV 4849) which is located on the DHR suction line downstream of the tee at which the bypass line rejoins the principal DHR

suction line. The relief valve must be removed occasionally for bench testing, and it is possible for the maintenance personnel to inadvertently open the bypass after reinstalling the pressure relief valve. Maintenance on PSV 4849 can only be performed while the reactor coolant system (RCS) is between hot shutdown and cold shutdown. Therefore, the risk of exposing the DHR system to damaging overpressure or of initiating a severe interfacing-systems LOCA is much less than for accident sequences applicable to periods of power generation.

2.3 REVIEW OF LICENSEE'S EVALUATION AND PROPOSED MODIFICATIONS

The TECO technical report[3] on the DHR system suction bypass gives the results for the occurrence rate of incidents in which an inadvertent opening of the bypass exposes the DHR system to pressures greater than the design pressure for each of the 12 design and procedural options. For all 12 options, the dominant accident sequence is associated with maintenance on PSV 4849. The presence of the pressure relief valve is useful in reducing the risk posed by startup with the bypass left open and to protect against RCS overpressure if high-pressure injection occurs while the RCS is in cold shutdown. TECO does not recommend the elimination of the pressure relief valve. It does recommend one of several more stringent administrative procedures applied to the present design which would reduce the probability of DHR system overpressurization to a very low level, i.e., less than 4.0×10^{-7}/year.

The TECO technical report[3] also states that the NRC has no clear-cut policy on a probabilistic criterion for the acceptability of design provisions to avoid an interfacing-systems LOCA. A criterion can be inferred, however, from the disposition of the overpressurization event leading to the interfacing-systems LOCA problem that arose in the Reactor Safety Study (WASH-1400).[4] In that study, the frequency of an interfacing-systems LOCA at the low-pressure safety injection (SI) check valves was estimated at 4×10^{-6}/year. The NRC responded by suggesting design changes which would reduce the probability of this event by a factor of 10, i.e., to about 4×10^{-7}/year, and by promulgating Section 6.3 of the NRC Standard

Review Plan, "Emergency Core Cooling System,"[5] which endorses the fix at the Surry nuclear power plant as adequate. Therefore, by implication, a frequency of 4×10^{-7}/year for this type of event is sufficiently safe.

3. CONCLUSIONS

The TECO technical report[3] concludes that the present design and procedures for Davis-Besse nuclear power plant, Unit 1, offer sufficient protection for the health and safety of the public. However, the present design and procedures do not meet the criterion inferred from the Reactor Safety Study (WASH-1400)[4] that the accident sequence fails to meet the criterion associated with shutdown when the risk is much reduced. In order to improve safety and meet the inferred acceptance criterion without question, TECO is prepared to implement Procedural Option (c), proposed in Section 2.2, which will require the use of one unique key and lock to secure the bypass valves.

We conclude that the TECO technical report[3] fulfills the NRC SER[1] requirements for an analysis of the design modification alternatives for the present keylock control of the manual bypass valves (DH21 and DH23) for Davis-Besse nuclear power plant, Unit 1. The licensee's proposed procedural change requiring the use of one unique key and lock to secure the bypass valves decreases the likelihood of the bypass being opened inadvertently when isolation of the DHR system loop is required.

REFERENCES

1. U. S. NRC, Safety Evaluation Report Related to the Operation of Davis-Besse Nuclear Power Station, Unit 1, NUREG-0136, Supp. 1 (April 1977).

2. TECO letter to NRC (Reid), dated January 11, 1979.

3. TECO, Reliability Study of Davis-Besse Unit No. 1 Decay Heat Removal System Suction Bypass, dated January 5, 1979.

4. U. S. NRC, Reactor Safety Study (WASH-1400), NUREG-75-014 (October 1975).

5. U. S. NRC, Standard Review Plan, "Emergency Core Cooling System," NUREG-75/087, Section 6.3 (n.d.).

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