

TECHNICAL EVALUATION REPORT  
THREE MILE ISLAND NUCLEAR STATION, UNIT 1  
SEISMIC QUALIFICATION OF AUXILIARY FEEDWATER SYSTEM

1. INTRODUCTION

Since the accident at Three Mile Island, considerable attention has been focused on the capability of nuclear power plants to reliably remove decay heat. The NRC has recently undertaken Multiplant Action Plan C-14 "Seismic Qualification of AFW Systems" [Ref. 1], which is the subject of this evaluation.

To implement the first phase of Action Plan C-14, the NRC issued Generic Letter No. 81-14 "Seismic Qualification of AFW Systems" [Ref. 2], dated February 10, 1981, to all operating PWR licensees. This letter requested each licensee (1) to conduct a walk-down of non-seismically qualified portions of the AFW system and identify deficiencies amenable to simple actions to improve seismic resistance, and (2) to provide design information regarding the seismic capability of the AFW system to facilitate NRC backfit decisions.

The licensee of Three Mile Island Nuclear Station, Unit 1, responded with letters dated September 29 and December 8, 1981, and February 16, 1982 [Refs. 3, 4 & 5]. The licensee's responses were found not to be complete and a Request for Additional Information (RAI) was issued by the NRC, dated April 5, 1982 [Ref. 6]. The licensee provided supplemental responses in letters dated July 7, September 14, September 29, and December 20, 1982 [Refs. 7, 8, 9 and 10]. The information in Ref. 10 substantially altered the conclusion from our evaluation of the information provided in Refs. 3 to 5 and 7 to 9. For this reason, a meeting was held between the NRC staff and licensee on January 7, 1983, in order to clarify certain issues on the seismic capability and operating procedures of the AFW system at this plant [Ref. 11]. The licensee responded with additional letters dated February 4, March 22, and May 2, 1983 [Refs. 12, 13 & 14].

This report provides a technical evaluation of the information provided in the licensee's responses to the Generic Letter, and includes a recommendation regarding the need for additional analysis and/or upgrading modifications of this plant's AFW system.

## 2. EVALUATION

Information provided in licensee's responses included:

- o Specification of the overall seismic capability of the AFW system.
- o Identification of AFW system components that are currently non-seismically qualified for SSE.
- o Description of procedure for switchover to a seismically qualified secondary water source.
- o Discussion of levels of seismic capability of non-seismically qualified components.
- o Description of the AFW system boundary.
- o Status of compliance with seismic related NRC Bulletins and Information Notices.
- o Results of walk-down of non-seismically qualified areas.
- o Additionally, schematic sketch of the AFW system.
- o Additionally, description of methodologies and acceptance criteria for seismically qualified components.

We have reviewed the licensee's responses, and a point-by-point evaluation of licensee's responses against Generic Letter's requirements is provided below.

### (1) Seismic Capability of AFW System

Except for those items identified in the following, the AFW system has been designed, constructed and maintained to withstand an SSE utilizing methods and acceptance criteria consistent with that applicable to other safety-related systems in the plant. Presently, those items identified by the licensee as not being

fully seismically qualified are evaluated below:

- o Pumps/Motors - None
- o Piping - (a) The portion of the recirculation lines for the AFW pumps between the manual isolation valves (EFV-20 A & B and EFV-22) and the condensate storage tank (CST) "B" were not seismically designed. However, we believe that according to the licensee's statement a failure of these lines would cause only an inplant spill and not a loss of safety function. In addition, the licensee indicated that these lines will be upgraded to seismic Class I at the next refueling outage. (b) The condenser hotwell supply lines are non-seismic Class I. However, we believe that according to the licensee's statement a postulated break of these lines does not cause a safety concern because the plant operating procedures will be revised to assure the closure of the isolation valves between the hotwell and AFW suction line (CO-V-14 A & B) and the valves on the cross-tie line between the two CST's (CO-V-111 A & B); hence, the condenser hotwell supply lines will be isolated when the water level of either CST reaches the technical specification limit during the interim period before the long term modifications are completed. (c) Based on the submitted sketches, not all connected branch lines from the AFW system are seismic Class I beyond the first valve and up to a point of three orthogonal restraints. However, we believe that according to licensee's walk-down of these branch lines they are seismically adequate. (d) The instrument air supply line from valve IA-V27 to the AFW system is not seismically qualified. However, the licensee indicated that seismically qualified check valves are provided to maintain the integrity of the Class I two-hour air backup supply (bottled) for EFW 30 A/B, EFV 8 A/B/C, MSV 6 and 4A/B. Based on the given

information above, we judge that the AFW system piping presently possesses an SSE level of seismic capability.

- o Valves/Actuators - All valves were designed such that the OBE stresses would be below yield and SSE stresses would be within ultimate strength. The valve functional operability during and after an SSE has been assured based on calculations. Based on the given information, we judge that the valves/actuators presently have a seismic capacity equivalent to the SSE level.
- o Power Supplies - Portions of the power supplies have been identified by the licensee as non-seismic Class I in a recent evaluation. They include: (a) Power supplies for auxiliary steam to EF turbine pump and motor operators for condensate storage tanks A & B isolation valves (CO-V-10 A & B) were not designed to seismic requirements; however, the licensee indicated that they are not part of the emergency power supply system and, therefore, are non-essential items. (b) The power supply from the motor operated valves (CO-V-111 A & B) in the cross tie between the condensate storage tanks (CST) A and B will be changed from the existing non-vital power sources to Class 1E vital power sources. (c) Cable routing for the power supply to motor operated valves (CO-V-14 A & B) between the hotwell and the AFW suction line will be upgraded to meet seismic Class I requirement. Upgrading modifications to items (b) and (c) have been proposed by the licensee, and are planned to be implemented before the startup from the next (Cycle No. 6) refueling. Also, we believe that according to the licensee's statement a failure of the power supplies noted in (b) and (c) will not prevent the AFW system from initially performing its safety function and adequate time exists for manual action to be taken to preserve minimum CST inventory. Based on the given information above, we conclude that the present level of seismic capability of the power supplies to be equivalent to the SSE.
- o Water Source(s) - None

- o Initiation/Control Systems - Firstly, items identified by the licensee as non-seismically qualified but judged by us as non-essential include: (a) Cable routing of motor operators for main steam supply isolation valves to the turbine driven pump (MS-V2 A & B) and for the main steam bypass to the condensate valves (MS-V8 A & B); (b) Solenoid valves and limit switch which control the valves (MS-V113 A & B) for providing main steam to the turbine; (c) Cable routing of motor operators for main steam isolation valves MS-V1 A, B, C & D; (d) Cable routing of motor operators of main steam to EF turbine pump valves MS-V10 A&B; (e) Local starter for MS-V10 A&B motor operators; (f) Limit switch on EF turbine pump steam supply regulating valve; and (g) Flow switches and control circuitry of recirculation flow control valves (EF-V8 A, B & C). Items (a) to (f) are judged non-essential based on licensee's statement that the AFW system safety function can be achieved with the electric pumps and without relying on the turbine-driven pump, and Item (g) is judged non-essential because of licensee's commitment to lock-open the recirculation line valves EF-V8 A, B & C. Secondly, those non-seismically qualified items with modifications to be completed by the first refueling after the restart include: (h) Converter EP-V-5A for control valve EF-V-30A; and (i) Low and low low level alarms for CST A&B. Based on the given information above, we conclude that the initiation/control systems will possess an SSE level of seismic capability upon completion of the planned modifications at the next refueling outage.
- o Structures - The turbine building is Class II, and with some stiffening it could withstand an OBE. However, we believe that according to licensee's statement those AFW power supplies and initiation/control systems routed through this building could fail without impairing the safety function of the AFW system. We therefore judge that the turbine building is non-essential and, hence, all the structures supporting



or housing the AFW system components possess an SSE level of seismic capability.

Based on our evaluation described above, those areas of the AFW system judged not to possess an SSE level of seismic capability are identified below.

o	<u>Pumps/Motors</u>	None
o	<u>Piping</u>	None
o	<u>Valves/Actuators</u>	None
o	<u>Power Supplies</u>	None
o	<u>Water Source(s)</u>	None
o	<u>Initiation/Control Systems</u>	None*
o	<u>Structures</u>	None

Note:

- \* Will be fully qualified when the licensee's planned upgrade/modifications are completed at the next refueling outage.

In summary, our evaluation indicated that the licensee's AFW system will possess an SSE level of overall seismic capability when their planned modifications are completed at the next refueling outage.

The primary water source is the condensate storage tank. This tank and the suction piping to the AFW pumps are seismic Class I. However, in two cases, there is only a single isolation valve (CO-V-14) between the seismic Class I water supply piping and the non-seismic Class I piping to the condenser hotwell. In either case, failure of that valve to isolate the condensate storage tank from the non-seismic Class I piping could result in that particular condensate storage tank draining to the condenser hotwell or turbine building. The licensee had therefore conducted an evaluation of the condensate system and identified

some necessary modifications and changes of operating procedures, as discussed earlier, that will be implemented prior to startup from the next (Cycle No. 6) refueling. Modifications recommended by the licensee include: (a) Power supply modifications that have been mentioned under the power supplies evaluation. (b) Plant operating procedures for AFW system would be changed to provide guidance to the operator to isolate the CST from the AFW system by closing valves CO-V-111 A & B and CO-V-14 A & B from the control room whenever the CST reaches the technical specification limit following AFW system initiation. Additionally, the licensee stated that a secondary water supply of river water is available from the reactor building emergency cooling pumps and it is entirely seismic Class I. This water supply enters the AFW pump common suction header between two sectionalizing valves EF-V-1 A & B. Manual actions are required to access this backup water supply. Two series motor operated valves (EF-V-4 & 5) to the river water system are normally kept locked closed and the motor control center breakers for these valves are locked open. If the backup supply of river water to the AFW system is needed, these locks will be removed and the breakers closed. The switchover procedure to use the backup water sources is still under review by the licensee.

Seismic qualification information for any alternate decay heat removal system was requested by the Generic Letter 81-14 if substantial lack of seismic qualification of the AFW system is indicated. We believe such information for any alternate decay heat removal system is not required because the AFW system will possess an SSE level capability by next refueling outage.

Regarding the AFW system boundary, the schematic sketches provided by the licensee show that there are branch lines without a second isolation valve which is normally closed or capable of automatic closure. However, we believe that according to the licensee's statement [Ref. 14], the lack of the double valve isolation is acceptable. We therefore conclude that the AFW system boundary does not fully conform to the definitions of

GL 81-14, but the deviation is non-essential.

The AFW system was included within the scope of IE Bulletin 79-02, 79-04, 79-07, 79-14, 80-11 and IE Information Notice 80-21.

(2) Walk-Down of Non-Seismically Qualified Portion of AFW System

Walk-down has been performed in conjunction with IE Bulletins 79-02 and 79-14. The licensee identified six deficiencies which have been corrected: (a) Support EF-8, repair completed on 4/7/81, (b) Support EF-72, repair completed on 7/27/81, (c) Support EF-125, repair completed on 7/31/81, (d) Conduit to MSV-6 has loose clamp which needs to be tightened, (e) Conduit to EFW 8B had no clamps to hold it to existing steel and needs clamp for security, (f) Unistrut supporting conduit to EF-V-8C is loose at the base and needs to be tightened. The licensee stated that items (d) to (f) have been or will be completed prior to restart.

(3) Additional Information

The licensee provided schematic sketches of the AFW system including the water sources, heat sink, suction and discharge piping, major mechanical equipment, and structures supporting and housing the AFW system items.

Additionally, licensee's responses provided a description of the methodologies, loading combinations and acceptance criteria that were used in the design of the seismically qualified portions of the AFW system, by referring to the appropriate sections of the FSAR.



### 3. CONCLUSIONS

The information contained in licensee's responses to the Generic Letter 81-14 is complete. The licensee conducted the required walk-down of the non-seismically qualified areas of the AFW system. The valve arrangement in the AFW system branch lines does not fully conform to the boundary definitions specified in the Generic Letter 81-14, but we judge the deviation acceptable.

Based on the submitted information, we conclude that the AFW system will possess an SSE level of seismic capability when the scheduled modifications are completed by the Cycle No. 6 refueling outage. Therefore, we recommend that no further action be initiated regarding upgrading of the AFW system of this plant under NRC Multiplant Action Plan C-14.

## REFERENCES

1. D. G. Eisenhut, U. S. Nuclear Regulatory Commission, memorandum to H. R. Denton, "Multiplant Action Plan C-14; Seismic Qualification of Auxiliary Feedwater Systems," February 20, 1981.
2. U. S. Nuclear Regulatory Commission, Generic Letter No. 81-14 to all operating pressurized water reactor licensees, "Seismic Qualification of Auxiliary Feedwater Systems," February 10, 1981.
3. H. D. Hukill, Metropolitan Edison Company, letter to D. G. Eisenhut of U. S. Nuclear Regulatory Commission, September 29, 1981.
4. H. D. Hukill, Metropolitan Edison Company, letter to D. G. Eisenhut of U. S. Nuclear Regulatory Commission, December 8, 1981.
5. H. D. Hukill, Metropolitan Edison Company, letter to D. G. Eisenhut of U. S. Nuclear Regulatory Commission, "EFW Seismic Qualification - Electrical," February 16, 1982.
6. U. S. Nuclear Regulatory Commission, letter to Metropolitan Edison Company, "Request for Additional Information on Seismic Qualification of the Auxiliary Feedwater System, Three Mile Island Nuclear Station, Unit 1," April 5, 1982.
7. H. D. Hukill, Metropolitan Edison Company, letter to J. F. Stolz of U. S. Nuclear Regulatory Commission, July 7, 1982.
8. H. D. Hukill, General Public Utility Nuclear Corporation, letter to J. F. Stolz of U. S. Nuclear Regulatory Commission, September 14, 1982.
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10. H. D. Hukill, General Public Utility Nuclear Corporation, letter to J. F. Stolz of U. S. Nuclear Regulatory Commission, December 20, 1982.
11. Minutes of Meeting between U. S. Nuclear Regulatory Commission and General Public Utility Nuclear Corporation on January 7, 1983.
12. H. D. Hukill, General Public Utility Nuclear Corporation, letter to J. F. Stolz of U. S. Nuclear Regulatory Commission, February 4, 1983.
13. H. D. Hukill, General Public Utility Nuclear Corporation, letter to J. F. Stolz of U. S. Nuclear Regulatory Commission, March 22, 1983.
14. H. D. Hukill, General Public Utility Nuclear Corporation, letter to J. F. Stolz of U. S. Nuclear Regulatory Commission, May 2, 1983.