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U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: Limerick Generating Station, Units 1 and 2
Response to a Request for Additional Information
Main Steam Safety Relief Valve and Emergency Core
Cooling Systems Action Plans

Attached is PECO Energy Company's response to the NRC's January 31, 1996 Request for Additional Information concerning the Limerick Generating Station (LGS), Units 1 and 2, action plans for monitoring Main Steam Safety Relief Valve (MSRV) tail pipe temperatures, Emergency Core Cooling System (ECCS) pump suction strainer differential pressures, and suppression pool cleanliness. The action plans were submitted to the NRC by letter dated October 6, 1995. The NRC has concluded that additional information is needed to complete their review. The attachment to this letter provides a restatement of the NRC's questions followed by our response to each question.

The attached response discusses changes to: 1) the MSRV tail pipe temperature monitoring action plan as originally described in our October 6, 1995 letter, and 2) the exclusion of the High Pressure Coolant Injection (HPCI) pump from the ECCS pump suction strainer differential pressure monitoring as originally described both in our October 6, 1995 letter and in our November 16, 1995 response to NRC Bulletin 95-02, "Unexpected Clogging of a Residual Heat Removal (RHR) Pump Suction Strainer While Operating in Suppression Pool Cooling Mode," for LGS, Units 1 and 2. The bases for these changes are provided in the attached response.

If you have any questions, please do not hesitate to contact us.

Very truly yours,

Walter G. MacFarland

Attachment

cc: T. T. Martin, Administrator, Region I, USNRC w/attachment
N. S. Perry, USNRC Senior Resident Inspector, LGS "

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Response to a Request for Additional Information
Main Steam Safety Relief Valve and Emergency
Core Cooling Systems Action Plans

Limerick Generating Station, Units 1 and 2

1. Alert and Action level tail pipe temperatures are provided by the licensee which would determine the proper action necessary regarding the occurrence of MSRV leakage. Please describe how the tail pipe temperature is correlated to MSRV leakage for Limerick 1 and 2? Is this correlation based on actual test data or is it analytical? If it is analytical, what are the correlation parameter sensitivities and what is the overall uncertainty in the correlation? What are some of the key parameter values assumed, and what are their expected variabilities?

RESPONSE

The MSRV tailpipe temperature action levels are based on the combination of: 1) General Electric (GE) testing and experience with Limerick Generating Station's (LGS's) Main Steam Safety Relief Valve (MSRV) leakage, 2) Target Rock industry experience with MSRV pilot valve leakage, and 3) LGS's recent experience with MSRV pilot valve leakage.

Regarding the recent experience at LGS, subsequent testing of the five MSRVs replaced after the September 11, 1995, spurious opening event revealed pilot valve leakage on three of the five valves that exhibited high tailpipe temperatures. These were the only three MSRV pilot valves in LGS history that leaked enough to cause elevated tailpipe temperatures. The normal amount of pilot valve leakage identified during as-found MSRV testing, i.e., droplets on a mirror or minor whisping of steam, does not result in elevated tailpipe temperatures.

The 1M MSRV pilot valve had leaked for 18 months prior to spuriously opening. The MSRV tailpipe temperature was 295°F when the MSRV opened. The 1M MSRV main valve did not leak. The leakage of the pilot valve could not be measured but was estimated at 3000 lb/hr. The opening was caused by the erosion of the pilot rod which transmits setpoint spring force to the pilot disc.

The 1F MSRV main valve did not leak, but the pilot valve had significant leakage which could not be measured. The leakage prevented performance of as-found testing for setpoint verification. The MSRV tailpipe temperature was 247°F at the time the 1M MSRV opened. Severe pilot erosion had occurred but the pilot disc was intact. The pilot rod had indications that erosion had started.

The 1D MSRV main valve did not leak, but the pilot valve leaked at 7 lb/hr. The MSRV tailpipe temperature was 215°F at the time the 1M MSRV opened. As-found setpoint testing showed an initial lift pressure at 2.5% above the setpoint pressure. The Technical Specification (TS) limit is +/- 1% of the setpoint pressure. Subsequent lift pressures were at 1.3% below the setpoint pressure. This behavior indicates that the initial lift pressure was affected by corrosion bonding of the pilot disc.

Future as-found testing of the MSRVs will quantify the leakage where possible on a routine basis. There are many variables in plant configuration, such as thermocouple location and local drywell temperature, that prevent exact correlation of leakage with tailpipe temperature. This conclusion is consistent with the experience of the BWR Owner's Group.

2. The licensee's Alert level for the tail pipe temperature begins at 225°F which would require that the temperature be trended in order to project when 275°F would be reached. The Action level begins at 250°F and would require that a planned outage be scheduled for when the temperature is projected to reach 275°F. However, at 250°F, the licenses states that the leakage is in the range of 500 to 1000 pounds per hour (lbm/hr). Leakage tests performed on Target Rock 2-Stage MSRVs in 1983, indicated that at 1000 lbm/hr leakage, the setpoint of the valves would be reduced by more than 10%, resulting in little or no simmer margin for normal operating system pressure. In addition, at some leakage less than 1000 lbm/hr, these tests indicate that the setpoint would drift downward to less than that required by the plant Technical Specifications (TS). Therefore, discuss why 250°F was chosen as the Action level when a significantly lower temperature would appear to be necessary to prevent the spurious opening of a MSRV at power and assure that plant TS are met?

RESPONSE

There is no widespread agreement within the industry that pilot valve leakage causes a reduction in MSRV setpoint. Experience at some plants indicates that MSRV setpoints may increase due to pilot valve leakage. The spurious opening of the 1M MSRV that occurred at LGS, Unit 1, was caused by a mechanistic failure of the MSRV pilot rod assembly, not by setpoint drift. The BWR Owner's Group has evaluated the issues of MSRV setpoint drift versus leakage and pilot valve leakage versus MSRV tailpipe temperature, and concluded that no exact correlations exist at the present time. The MSRV tailpipe temperature versus pilot valve leakage, in particular, is dependent upon each MSRV's unique configuration.

However, the results of a visual inspection of the 1F MSRV and the condition of the associated pilot valve led PECO Energy to be concerned about the ability of the MSRV to self actuate within the required TS setpoint pressure limits since the loss of pilot disc geometry is assumed to have some affect on MSRV setpoint. As a result, the October 6, 1995 MSRV tailpipe temperature action plan was modified.

The modified plan requires evaluating MSRV operability at a tailpipe temperature of 225°F rather than 250°F. This evaluation includes setpoint considerations, taking into account the MSRV tailpipe temperature trending data, the unique configuration of the MSRV and the MSRV leakage history. The appropriate TS action will be taken based on the results of this evaluation considering that the LGS TS require at least 11 of 14 MSRVs to be operable in Operational Conditions 1, 2, and 3. Until instrumentation is available to distinguish between pilot valve leakage and main valve leakage, all leakage is conservatively considered to be pilot valve leakage.

In addition, because of the concern over the possible impact of pilot valve leakage, LGS will not continue to operate for an extended period of time with any MSRV tailpipe temperature above 250°F. Based on experience with the 1M and 1F MSRVs, PECO Energy expects that a spurious MSRV opening will not occur before any MSRV tailpipe temperature reaches 275°F.

3. The licensee's action plan indicates that a leaking MSRV would be replaced before the associated tail pipe temperature is expected to reach 275°F. The licensee also states that on September 11, 1995, the Unit 1 'M' MSRV lifted at 295°F and that it took 6 months for the tail pipe temperature to rise from 275°F to 295°F. However, examination of photographs of the 'M' MSRV pilot disk reveals that the disk was completely eroded into two pieces and that steam had cut completely through the disk wall thickness and was actually eroding the pilot stem for some time prior to the sudden opening of the valve. It appears that significant damage to the pilot disk may have already occurred prior to reaching a tail pipe temperature of 275°F. Therefore, what would be the maximum tail pipe temperature and maximum operating time criteria which would prevent significant erosion damage of the pilot disk?

RESPONSE

PECO Energy anticipates, based on previous experience, that tailpipe temperature increases for leaking MSRVs will slowly trend upward. Erosion of a pilot rod to the point of causing inadvertent opening of an MSRV takes a long time; approximately 18 months in the case of the 1M MSRV which had operated with an elevated tailpipe temperature since the beginning of the operating cycle. As indicated in the response to Question No. 1, this elevated tailpipe temperature was caused solely by pilot valve leakage. Although significant erosion had occurred on the 1F MSRV pilot disc, the erosion was not as severe as the 1M MSRV even though the 1F MSRV pilot valve had also leaked since the beginning of the operating cycle, and failure of the 1F MSRV pilot was not imminent. Therefore, erosion damage of the pilot disc is not a concern for spurious MSRV opening over a short period of time.

As a result of the possible impact of severe erosion on the setpoint of an MSRV, PECO Energy has modified the action plan for high MSRV tailpipe temperatures as indicated in the response to Question No. 2 such that the evaluation of MSRV operability will occur at a lower tailpipe temperature than originally identified in the October 6, 1995 letter. The modified action plan now requires the evaluation to be performed at 225°F rather than at 250°F. This evaluation will include MSRV setpoint considerations and the likelihood that an inadvertent MSRV spurious opening would occur.

As indicated in our October 6, 1995 letter, plans for replacing a leaky MSRV before the tailpipe temperature reaches 275°F would be in place and executed appropriately, although, continued plant operation over long periods of time with any MSRV tailpipe temperature above 250°F would not be permitted. The leaky MSRV would be replaced during a planned maintenance outage or during a forced outage (i.e., for other reasons), whichever occurs first.

A rapid increase in MSRV tailpipe temperature has not been experienced at LGS and is not expected to occur. Such an occurrence would require a more urgent implementation of a maintenance outage to replace the affected MSRV.

4. The licensee stated that the ECCS pump suction strainer differential pressure acceptance criteria will be available by November 1, 1995. Please submit the acceptance criteria, including the maximum allowable differential pressure, for staff review.

RESPONSE

Emergency Core Cooling System (ECCS)/Reactor Core Isolation Cooling (RCIC) pump suction strainer differential pressure acceptance criteria has been developed and is provided in the table below. At this time, the acceptance criteria has been incorporated into the quarterly pump, valve and flow test for each ECCS/RCIC pump as indicated in our October 6, 1995 letter and in our November 16, 1995 response to NRC Bulletin 95-02, "Unexpected Clogging of a Residual Heat Removal (RHR) Pump Suction Strainer While Operating in Suppression Pool Cooling Mode," for LGS, Units 1 and 2, with the exception of the High Pressure Coolant Injection (HPCI) pump.

	Design Basis Conditions			Test Conditions		Acceptance Criteria	
	Q (gpm/pump)	T (°F)	Z_{sp} (feet)	Q (gpm/pump)	T (°F)	Max.[1]	ALERT[2]
RCIC	600	170	201.47	$\geq$600	$\leq$105	4.0	3.75
RHR	11,000	212	199.96	$\geq$10,000	$\leq$95	3.3	1.70
Core Spray	3,950	212	199.96	$\geq$3,175	$\leq$95	2.9	2.30

Notes: 1 Maximum allowable change in suction pressure between static conditions (with suction aligned to the suppression pool) and Test Conditions. This maximum allowable change includes a maximum pressure drop across the suction strainer at the test conditions such that the pressure drop across the strainer under indicated Design Basis Conditions is not greater than 2.0 psid, as stated in the LGS Updated Final Safety Analysis Report (UFSAR), Section 6.2.2.2.

2 Maximum value of the measured change in suction pressure between static conditions and flow conditions, beyond which engineering evaluation is required.

HPCI pump suction strainer differential pressure testing has been determined to be of little benefit based on the inability to attain full flow conditions in the suppression pool to suppression pool mode. The reduced flowrates (nominally 1000 gpm versus rated flow of 5600 gpm) specified during previous tests are consistent with the system design and minimize the rate of flow accelerated corrosion (FAC) in the HPCI system flush line. The HPCI system flush line is too small (i.e., 4 inches) to pass full HPCI system flow. The low test flowrate results in low acceptance criteria, poor repeatability, and data that is easily distorted due to constant changes in suppression pool conditions (i.e., suppression pool level and temperature). Data from the tested ECCS/RCIC pump suction strainers will be used as an indicator of HPCI pump suction strainer cleanliness.

Use of RHR, Core Spray (CS), and RCIC pump suction strainer differential pressure test data as an indicator of HPCI pump suction strainer performance is adequate since strainer clogging is accelerated by pump operating time and the HPCI system is normally aligned to the condensate storage tank. As a result, the HPCI system is nominally aligned to the suppression pool for less than eight (8) hours per cycle. Also, data obtained from tested ECCS/RCIC pump suction strainers will be capable of identifying a change in suppression pool conditions and possible degradation of the HPCI pump suction strainers. Therefore, as evidenced by recent suppression pool inspections/cleaning on both units, HPCI suction strainers are and should remain in a very clean condition throughout normal plant operation.

5. RHR pumps are used for Suppression Pool cooling when the Suppression Pool temperature increases due to MSRV leakage. Therefore, it appears that the RHR pumps are required to run more frequently than originally designed. Describe how the capability and reliability of the RHR pumps are affected due to the frequent Suppression Pool cooling. Describe the licensee's action plan to assure the capability and reliability of the RHR pumps.

RESPONSE

The RHR pumps which have suppression pool cooling capability (i.e., the 1A, 1B, 2A, 2B), have accumulated a greater number of operating hours than the dedicated Low Pressure Coolant Injection (LPCI) pumps (i.e., the 1C, 1D, 2C, 2D). Reviews of heavy operating periods show the 1A RHR pump has significantly more operating hours and is used as the bounding example in this discussion.

The operating hours accumulated since initial plant startup on the 1A RHR pump are estimated at 8000 hours and are approximately 25% greater than the next closest RHR pump.

The LGS UFSAR indicates that the expected operating hours for a 40 year plant life are 31892 hours. This was based on BWR operating experience and engineering judgement at the time the plant was designed. Subsequent information developed for the ECCS Motor Qualification Program (GE Document 22A4722) estimates the lifetime operating hours to be greater than 61,000 hours. This information was utilized in the current analysis detailing preventive maintenance under the Reliability Centered Maintenance (RCM) program.

The lifetime operating hours are estimates provided to ensure the life expectancy of the equipment exceeds the estimated required operating time. However, these estimates are not bounding and the component condition is monitored and trended by the following programs:

Quarterly Performance Testing (including Inservice Testing)
Vibration Monitoring
Ferrography
Motor Electrical Testing
Environmental Qualification/RCM (Partial Disassembly)
Thermography

A review of these programs indicates no adverse trends. Comparisons were made between the 1A RHR pump data and the 1D RHR pump data. There are no differences which would indicate that an adverse trend exists. The 1D RHR pump was chosen for comparison because its condition is well documented by a partial disassembly performed in October, 1995, and provides a good baseline.

In summary, the 1A RHR pump/motor is in good condition. Programs are in place to continually monitor and assess the condition of the RHR pumps and provide indication of adverse trends indicative of fatigue or imminent failure.