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FACIL;50-220 Nine Mile Point Nuclear Station, Unit 1, Niagara Powe 05000220
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SUBJECT: LER 96-013-01:on 961213,potential overpressurization of containment penetrations occurred due to thermal expansion. Affected penetrations & vents,drains, & test connections have been completed in accordance w/GL 91-18.W/970228 ltr.

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NIAGARA MOHAWK
GENERATION
BUSINESS GROUP

NINE MILE POINT NUCLEAR STATION/LAKE ROAD, P.O. BOX 63, LYCOMING, NEW YORK 13093

February 28, 1997
NMP1L 1188

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

RE: LER 96-13, Supplement 1
Docket No. 50-220

Gentlemen:

In accordance with 10CFR50.73(a)(2)(ii), we are submitting LER 96-13, Supplement 1, "Potential Overpressurization of Containment Penetrations Due to Thermal Expansion." On January 29, 1997, additional penetrations were identified as being susceptible to overpressurization. In addition, on February 11, 1997, various vents, drains, and test connections were found to be susceptible to overpressurization.

Very truly yours,

Norman L. Rademacher
Plant Manager - NMP1

NLR/GJG/kap
Enclosure

xc: Regional Administrator, Region I
Mr. B. S. Norris, Senior Resident Inspector
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NRC FORM 366 U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Nine Mile Point Unit 1	5000220	1 OF 9

TITLE (4)
Potential Overpressurization of Containment Penetrations Due to Thermal Expansion

EVENT DATE (5)			LER NUMBER (6)					REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
12	13	96	96		013		01	02	28	97	N/A	05000
											N/A	05000

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check one or more of the following)* (11)			
POWER LEVEL (10) 100	1	☐ 20.402(b) ☐ 20.405(a)(1)(i) ☐ 20.405(a)(1)(ii) ☐ 20.405(a)(1)(iii) ☐ 20.405(a)(1)(iv) ☐ 20.405(a)(1)(v)	☐ 20.405(c) ☐ 50.36(c)(1) ☐ 50.36(c)(2) ☐ 50.73(a)(2)(i) ☒ 50.73(a)(2)(ii) ☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(iv) ☐ 50.73(a)(2)(v) ☐ 50.73(a)(2)(vii) ☐ 50.73(a)(2)(viii)(A) ☐ 50.73(a)(2)(viii)(B) ☐ 50.73(a)(2)(x)	☐ 73.71(b) ☐ 73.71(c) ☐ OTHER *(Specify in Abstract below and in Text, NRC Form 366A)*

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Mr. William Yaeger, Manager Engineering NMP1	(315) 349-7834

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
☐ YES *(If yes, complete EXPECTED SUBMISSION DATE)*	☒ NO				

ABSTRACT *(Limit to 1400 spaces, i.e., approximately fifteen single space typewritten lines)* (16)

Between December 13, 1996 and December 20, 1996, Niagara Mohawk identified six penetrations at Nine Mile Point Unit 1 (NMP1) which could have been overpressurized during post-accident (large break LOCA and LOOP) conditions. This was discovered during Niagara Mohawk's evaluations in accordance with GL 96-06, "Assurance of Equipment Operability and Containment Integrity During Design-Bases Accident Conditions." On January 29, 1997, additional penetrations were identified as being susceptible to overpressurization during post-LOCA conditions. On February 11, 1997, NMPC determined that various vents, drains, and test connections inside Primary Containment could be subjected to overpressurization.

The cause of this event is that the piping code of record used during the original design of NMP1 did not explicitly require analysis for thermal expansion due to entrapped fluids for accidents. The extent to which heatup and pressurization of penetrations was considered during the original design is not known. There was a lack of clear design criteria for NMP1 for the specific heat sources that needed to be analyzed. Thus, the apparent cause of this event is an original design error.

Operability determinations have been performed on the affected penetrations to verify operability in accordance with station procedures and guidance provided in GL 91-18 "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability." Corrective actions are being taken in accordance with GL 96-06.

I. DESCRIPTION OF EVENT

In October 1996, Niagara Mohawk began an evaluation of NMP1 containment penetrations in accordance with GL 96-06, "Assurance of Equipment Operability and Containment Integrity During Design Basis Accident Conditions." As a result of that review, six penetrations were identified between December 13, 1996 and December 20, 1996, as being subjected to temperatures following a Loss of Coolant Accident (LOCA) which could cause pressurization in excess of design pressure. On January 29, 1997, additional penetrations were identified as being susceptible to overpressurization. On February 11, 1997, NMPC determined that various vents, drains, and test connections inside primary containment could be subjected to overpressurization during design basis accidents. Operability determinations of the penetrations have been completed in accordance with station procedures and guidance provided in GL 91-18.

Following are the affected penetrations, the systems affected, and the design pressures.

PENETRATION	SYSTEM	DESIGN PRESSURE (psi)
X7	Shutdown Cooling (to the Reactor)	1200
X8	Shutdown Cooling (from the Reactor)	1200
X25	Drywell Equipment Drain	150
X26	Drywell Floor Drain	150
X139	Post-Accident Sampling	1200
X238	Core Spray High Point Vent	1200
X13A	Core Spray	1200
X14	Core Spray	1200

II. CAUSE OF EVENT

The piping code of record for NMP1 is the B31.1 1955 edition including some nuclear interpretations. The 1955 edition of the code does not explicitly identify the need to consider the effects of heating of fluid trapped in an isolated section of piping. However, in general terms it requires that the expected variations in pressure be analyzed and references the ASME boiler and pressure vessel code for conditions which exceed corresponding requirements. The ASME Section VIII 1965 edition is the code of record. Section VIII requires that the effects of external heat sources be considered with regard to the need for safety or relief devices. Therefore, the GL 96-06 conditions are design basis requirements for NMP1. The extent to which heatup and pressurization of penetrations was considered during the original design is not known. There was a lack of clear design criteria for NMP1 for the specific heat sources that needed to be analyzed. Thus, the apparent cause of this event is an original design error.

III. ANALYSIS OF EVENT

This condition is reportable in accordance with 10CFR50.73(a)(2)(ii), "Any event or condition that resulted in a condition at a nuclear power plant, including principle safety barriers, being seriously degraded, or that resulted in a nuclear plant being: (B) in a condition that is outside the design basis of the plant."

We have utilized a conservative estimate to calculate the penetration pressurization transient. The conditions to analyze expansion of penetrations conservatively combines design basis LOCA with Emergency Operating Procedure (EOP) actions which exacerbate the overpressurization. Specifically, the analysis was performed in accordance with Section XV, 5.2 and 5.3 of the NMP1 SAR and the most limiting case was used to draw our conclusion, for the penetrations described herein.

The following is a discussion of each penetration.

Penetration X7: Shutdown cooling returned to the reactor

The heatup transient for the penetration increases from an assumed initial fluid temperature of 120°F to 160°F within 10 minutes and slowly increases to 180°F as the drywell heats up during long-term torus cooling following the EOP required actions. The result of the heatup would cause stresses in excess of piping yield stress (i.e., deformation), if there were no leakage past the isolation valves. However, 10CFR50, Appendix J measured leakage in the penetration is 3 gpm and the required evaluated leakage to maintain the pressure below yield is 0.3 gpm. Our review of available leakage data did not reveal any period where leakage was below 0.3 gpm. Finally, even in a worst case, stresses would not have exceeded ultimate hoop stress (i.e., failure). Therefore, while the penetration was not designed for this condition, the existing configuration would not have been overstressed after a LOCA.

Penetration X8: Shutdown Cooling from the reactor

The heatup transient for the penetration increases from an assumed initial fluid temperature of 120°F to 160°F within 10 minutes and slowly increases to 180°F as the drywell heats up during long-term torus cooling following EOP required actions. The results of the heatup would cause stresses in excess of piping yield stress (i.e., deformation), if there were no leakage past the isolation valves. However, measured leakage in the penetration is 0.672 gpm and the required evaluated leakage to maintain the pressure below yield is 0.3 gpm. Our review of available historic leakage data did not indicate any data below 0.3 gpm. Finally, even in a worst case, stresses would not have exceeded ultimate hoop stress (i.e., failure). Therefore, while the penetration was not designed for this condition, the existing configuration would not have been overstressed after a LOCA.

III. ANALYSIS OF EVENT (Cont'd)

Penetration X25 and X-26: Drywell Equipment and Floor Drain

The heatup transient for these penetrations increases the temperature from an assumed initial fluid temperature of 120°F to 160°F within 10 minutes and slowly increases the 180°F as the drywell heats up during long-term torus cooling following the EOP required actions. This heatup would cause stresses in excess of the piping yield stress, but below ultimate stress, if there were no leakage paths through the isolation valves. For these lines the outside isolation valves are globe valves with an air operator. These isolation valve operators are air to open - spring to close. The pressure under the seat required to lift the valves off their seat is approximately 100 to 150 psi and the valves are oriented such that the pressurization is under the seat. This configuration will limit the peak pressure to approximately the initial lift pressure of 150 psi for this heatup transient which would maintain the piping stresses to less than design allowable. In addition, the latest 10CFR50 Appendix J leakage data shows that adequate leakage exists to maintain the stresses below yield for the piping. Therefore, while the penetration was not designed for this condition, the existing configuration would not have been overstressed after a LOCA.

Penetration X139: Post-Accident Sampling

The calculated maximum temperature for this penetration is 255°F. This maximum temperature occurs within the initial 300 seconds of the design basis accident. The calculated leakage to maintain piping below yield stress (i.e., deformation) is .112 gpm which is equivalent to 1.6 scfh. The 10CFR50 Appendix J leak rate data for the penetration is approximately .05 scfh. Consequently, adequate leakage does not exist for this penetration to assure that yield does not occur. However, an evaluation shows that the stress remains below the ultimate for hoop stress (i.e., failure). Therefore, pipe functional integrity can be assured.

Penetration X238: Core Spray High Point Vent

Following a LOCA, the piping fluid temperature increases from 135°F to a calculated maximum temperature for this penetration of 255°F. This maximum temperature occurs in the initial 300 seconds of the DBA.

Evaluation of the outboard AOVs 40-32 and 40-33 has determined that these valves are globe valves which are air to open, spring to close. These evaluations have determined that the valves are oriented such that the pressure buildup would create a force which tends to act against the closure spring. The calculations show that the pressure under the seat required to equal the full closed spring force is 4921

III. ANALYSIS OF EVENT (Cont'd)

psi. Calculations of the piping and valves between 40-31 and 40-33 and the piping between 40-30 and 40-32 have concluded that the ASME level C allowable stresses would not be exceeded for the design basis accident provided the pressure remains below 6200 psi. The pressure gage installed on the line is not the weak link. The gauge has a burst pressure of 20,000 psi per telecon with the vendor, which assures integrity of the gage and no breach of the pressure boundary. The associated isolation valves were evaluated and the maximum pressure of 6,000 psi was determined to be within level C allowables.

The piping design basis for this system is ASME III Class 2. The DBA loading on the containment penetration piping and isolation valves is a result of a faulted event. Since the normal function of the containment is to mitigate the LOCA, a conservative interpretation of the code would dictate that level A or B allowables be used for design basis analyses. However, relative to operability, GL 91-18 guidance allows the use of Appendix F to ASME III. Consistent with this guidance, ASME faulted allowable limits establish operability. The analysis shows that the AOVs begin to lift prior to stresses exceeding level C allowables. The analysis of the valve opening force shows that at 6,200 psi the valve is 11% open.

The leakage evaluations which were performed have demonstrated that leakage on the order of 0.15 gpm is sufficient to terminate a pressure rise. Based on the valve stem position versus Cv, an 11% open 1 in. valve with a differential pressure of 6200 psi would provide the required 0.15 gpm flow rate with excess margin. In addition, significant margin remains since level D allowables provide for a maximum pressure of 8,200 psi. The margin between level C and level D allowable stresses provide adequate margin to account for uncertainties associated with the definition of flow rate and valve open position versus pressure.

To maintain this penetration operable the valve alignment has been changed to assure the AOV can function as a relief device. Specifically, the drain valves downstream of the AOV are locked open per a Design Document Change and Operations procedural requirements.

Therefore, the penetration is operable.

Core Spray System (Penetration X-13A, X-14)

The volume of piping between the inboard injection valves (Loop 11: 40-10 and 40-11; Loop 12: 40-01 and 40-09) and the outboard test valve (Loop 11: 40-06; Loop 12: 40-05) and outboard high pressure check valve (Loop 11: 40-13; Loop 12: 40-03) is fluid-filled and potentially susceptible to thermally-induced overpressurization.

III. ANALYSIS OF EVENT (Cont'd)

a. For the DBA LOCA with concurrent LOOP scenario no significant heatup of this piping will occur since core spray injection occurs within 35 seconds. For the small break conditions the drywell temperature is not as severe, but the time delay prior to core spray injection can be significant. During this time period the line will experience a heatup and the potential for overpressurization. The pressure locking modification relief line from the bonnet is adequate to relieve the potential pressure due to thermal expansion of the trapped fluid. A qualitative assessment of the leakage past the outer disc based on the seat area is applied to determine operability. The differential pressure required to reach a seat stress of zero is approximately 687 psid (pipe pressure 1,717 psig). The level D allowable stress for the piping in these penetrations would be reached at a pressure of 3,200 psi. The available seat area circumference is large (approximately 35 inches) and therefore leakage would be expected over the entire disc seating area. Since the leakage required is small (less than 0.3 gpm is sufficient to relieve the pressure) the available leakage flow path is sufficient to ensure that the pressure would be relieved prior to the piping exceeding the ASME level D allowable stress.

b. This core spray piping segment has 5 isolation valves. The potential pressure buildup would act against two injection valves which have the pressure relief feature discussed above, a 12 inch check valve, a 1" globe valve, and a 6" flex wedge disc with the same type of pressure locking pressure relief. Operability of this piping segment is adequately assured based on the seat stress evaluation and multiple pressure relief paths available.

The pressure in the system will remain within ASME level D allowable stress. Therefore, the penetrations are operable.

Vents, Drains, and Test Connections

An operability determination has been completed which shows that even in the unlikely event that vents, drains, and test connections failed, there is no impact on the ability of the plant systems, structures, or components to perform their safety function. If piping between vent, drain, or test connection valves or end caps failed, it is expected that the failure would be longitudinal rather than circumferential which precludes any concern with missile impact. The limited volume of fluid contained in vent, drain, or test connection piping segments eliminates any jet impingement concerns. Finally, the impact of leakage on safety-related electrical equipment is insignificant since components inside the primary containment are designed for protection against water intrusion. Therefore, there is no operability concern with regard to failure of vents, drains, or test connections.

III. ANALYSIS OF EVENT (Cont'd)

In addition, insensible leakage in the order of 5×10^{-4} gpm would eliminate the potential for overpressurization. NMPC does not have leakage data to determine actual values of leakage. However, it is highly likely that leakage of this magnitude would exist to prohibit overpressurization. Based upon the preceding, it has been determined that there were no adverse consequences of general public or plant personnel as a result of this event.

Based upon the above analysis, the structural integrity of the containment was assured. Further had a failure occurred of only one side of the containment penetration with both isolation valves closed (normal position), primary containment integrity would have been assured. This single failure would relieve pressure and prevent further failure in that penetration. Finally, had both sides of the containment penetration failed (with both isolation valves closed normal position) significant margin exists prior to exceeding 10CFR100 releases.

As described in the Bases of the NMP1 Technical Specifications Section 3.3.3/4.3.3, the allowable test leak rate limit could be raised to about 3.0 weight percent per day before the 10CFR100 guideline thyroid dose limit would be exceeded. The NMP1 maximum allowable test leakage rate (L_a) has been conservatively established at 1.5 weight percent per day to maintain an adequate safety margin to assure the health and safety of the public. The NMP1 Technical Specification combined leak rate test limit is 0.6 (L_a) for penetrations and valves subject to Type B and C testing. The NMP1 allowable value for 0.6 L_a is 388.4 SCFH. The total NMP1 measured leakage is now 130.322 SCFH. Therefore, even if the penetrations failed on both sides, significant leakage as described above would be required before exceeding the 10CFR100 guideline thyroid dose limit.

Based upon the preceding discussion of each of the penetrations, structural integrity assuming valve leakage would have been maintained in the event of a design base accident. In addition, even in the worst event of a penetration failure and subsequent release, it is unlikely that 10CFR100 guideline thyroid dose limits would have been exceeded. Therefore, there were no adverse consequences to the general public or plant personnel as a result of this event.

IV. CORRECTIVE ACTIONS

Corrective Actions for this event are:

1. Administrative controls have been implemented to assure that penetration X139 is drained to provide an expansion volume or that the piping temperature is maintained above 281°F when the system is in operation. This precludes the potential for overstressing the piping beyond code allowable stress in the unlikely event of a design basis accident. The remaining penetrations have either measured leakage or relief capability which precludes the need for additional administrative controls.

IV. CORRECTIVE ACTIONS (Cont'd)

2. Operability determinations for the affected penetrations and vents, drains, and test connections have been completed in accordance with GL 91-18 and station procedures.

3. Longer term resolution of these concerns will require additional detailed analysis to identify the potential need for plant modifications. Design changes, if required on each item, will be implemented as committed in our response to GL 96-06 dated February 7, 1997.

4. The appropriate containment penetration design temperature will be incorporated into design criteria documents by May 31, 1997.

5. The root cause of this problem was a failure to include appropriate design requirements into the penetration(s) by the original designers. A Training lesson plan will be developed to address the requirements for containment penetration pressurization and provided in continuing training. Mechanical Design Engineers will receive specific training on this LER and the code requirements by December 31, 1997.

6. An Engineering evaluation will be performed to determine if other safety-related design(s) did not appropriately include pressure buildup in isolated piping due to surrounding area temperature increases by December 31, 1997.

V. ADDITIONAL INFORMATION

A. Failed components: none.

B. Previous similar events: none

C. Identification of components referred to in this LER:

COMPONENT	IEEE 803 EIIS FUNCTION	IEEE 805 SYSTEM ID
X7 and X8	PEN	BO
X139	PEN	IP
X238	PEN	BM
X25 and X26	PEN	VB
X13A and X14	PEN	BM
Drains	DRN	Various
Vents	VTV	Various
Test Connections	TV	Various