



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO AMENDMENT NO. 208 TO FACILITY OPERATING LICENSE NO. DPR-50

METROPOLITAN EDISON COMPANY

JERSEY CENTRAL POWER & LIGHT COMPANY

PENNSYLVANIA ELECTRIC COMPANY

GPU NUCLEAR, INC.

THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

1.0 INTRODUCTION

By letters dated March 23 and June 30, 1998, GPU Nuclear, Inc., submitted a request to amend the pressure and temperature (P-T) limits in the Technical Specifications (TS) for the Three Mile Island Station, Unit 1 (TMI-1) (Refs. 1 and 2). The amendment was intended to update the TMI-1 P-T curves for 17.7 effective full power years (EFPY). In addition, the licensee proposed changes to the bases of the P-T limits in the TS for consistency. While the June 30, 1998, letter provided an updated TS page 3-5, the page update specifically updated a reference to a more recent revision of the reference and did not impact the staff's proposed no significant hazards determination published in the Federal Register on April 22, 1998 (63 FR 19970).

The staff evaluates the P-T limits based on the following NRC regulations and guidance: 10 CFR Part 50, Appendix G; Generic Letter (GL) 88-11; GL 92-01, Revision 1; GL 92-01, Revision 1, Supplement 1; Regulatory Guide (RG) 1.99, Revision 2 (Rev. 2); and Standard Review Plan (SRP) Section 5.3.2. GL 88-11 advised licensees that the staff would use RG 1.99, Rev. 2 to review P-T limit curves. RG 1.99, Rev. 2 contains methodologies for determining the increase in transition temperature and the decrease in upper-shelf energy (USE) resulting from neutron radiation. GL 92-01, Rev. 1 requested that licensees submit their reactor pressure vessel (RPV) data for their plants to the staff for review. GL 92-01, Rev. 1, Supplement 1 requested that licensees provide and assess data from other licensees that could affect their RPV integrity evaluations. These data are used by the staff as the basis for review of P-T limit submittals, and as the basis for review of pressurized thermal shock (PTS) assessments (10 CFR 50.61 assessments). Appendix G to 10 CFR 50 requires that P-T limits for the RPV be at least as conservative as those obtained by applying the methodology of Appendix G to Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

SRP 5.3.2 provides an acceptable method of calculating the P-T limits for ferritic materials in the beltline of the RPV based on the linear elastic fracture mechanics (LEFM) methodology of Appendix G to Section XI of the ASME Code. The basic parameter of this methodology is the stress intensity factor  $K_I$ , which is a function of the stress state and flaw configuration. The methods of Appendix G postulate the existence of a sharp surface flaw in the RPV that is normal

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to the direction of the maximum stress. This flaw is postulated to have a depth that is equal to 1/4 of the RPV beltline thickness and a length equal to 1.5 times the RPV beltline thickness. The critical locations in the RPV beltline region for calculating heatup and cooldown P-T limit curves are the 1/4 thickness (1/4T) and 3/4 thickness (3/4T) locations, which correspond to the depth of the maximum postulated flaw from the inside and outside surfaces of the RPV, respectively.

The Appendix G, ASME Code methodology requires that licensees determine the adjusted reference temperature (ART or  $RT_{NDT}$ ) at the maximum postulated flaw depth. The ART is defined as the sum of the unirradiated reference temperature, or  $RT_{NDT(U)}$ , the mean value of the adjustment in reference temperature is caused by irradiation ( $\Delta RT_{NDT}$ ), and a margin (M) term.

The  $\Delta RT_{NDT}$  is a product of a chemistry factor and a fluence factor. The chemistry factor is dependent upon the amount of copper and nickel in the material and may be determined from tables in RG 1.99, Rev. 2 or from surveillance data. The fluence factor is dependent upon the neutron fluence at the maximum postulated flaw depth. The margin term is dependent upon whether the  $RT_{NDT(U)}$  is a plant-specific or a generic value and whether the chemistry factor was determined using the tables in RG 1.99, Rev. 2 or surveillance data. The margin term is used to account for uncertainties in the values of  $RT_{NDT(U)}$ , copper and nickel contents, fluence and calculational procedures. RG 1.99, Rev. 2 describes the methodology to be used in calculating the margin term.

## 2.0 EVALUATION

The purpose of this amendment request is to provide P-T limits acceptable for 17.7 EFPY. To evaluate this request, the staff verified the acceptability of the limiting ART and assured that the submitted P-T curves derived with this ART are acceptable.

The beltline of TMI-1 is composed of two circumferential welds, six axial welds, four plate heats, and a forging. All of the welds were fabricated using the submerged arc process with Linde 80 flux. The plates were fabricated in accordance with SA302 Grade B Modified; the forging was fabricated in accordance with SA508 Class 2.

Consistent with prior submittals, the limiting ART was identified by the licensee as occurring for circumferential weld WF-25, which is located between the upper shell and the lower shell. This weld used the same weld wire heat number, 299L44, as the lower shell axial weld SA-1526. Weld WF-25 is limiting in comparison to SA-1526 due to the higher neutron fluence of WF-25, and hence a greater neutron embrittlement of this weld.

The staff confirmed that WF-25 is the limiting material through a review of the information for TMI-1 contained in the Reactor Vessel Integrity Database (RVID).

As indicated in Table 1, the ART is determined at the 1/4T and 3/4T vessel thickness locations. Based on a 1/4T neutron fluence of  $0.311 \times 10^{19}$  neutrons/cm<sup>2</sup>, the limiting 1/4T ART is determined to be 212 °F. Based on an EFPY 3/4T neutron fluence of  $0.113 \times 10^{19}$  neutrons/cm<sup>2</sup>, the limiting 3/4T ART is determined to be 160 °F. These ART values are determined using the procedures of RG 1.99, Rev. 2, with the chemistry factor (220.6) from Table 1 and the margin term in accordance with Regulatory Position 1.1.

Surveillance data for the limiting weld wire heat number 299L44 are available from irradiations at Surry Unit 1, TMI Units 1 and 2, and Crystal River Unit 3 as part of the Babcock & Wilcox Owners Group (B&WOG) integrated surveillance program (Ref. 3). The surveillance data available from these plants can be evaluated in several ways, making appropriate adjustments for differences in chemistry for the surveillance welds and operating characteristics of the plants (e.g., irradiation temperature of the surveillance capsule). As indicated in Reference 3, evaluations of the available surveillance data in accordance with RG1.99, Rev. 2, indicate that the chemistry factor determined from the surveillance data is in agreement with that from Table 1 of RG 1.99, Rev. 2, and the data do not satisfy the credibility criteria of the guide. Therefore, the use of Table 1 from RG 1.99, Rev. 2, with no reduction in margin term is an acceptable method for determining the ART for TMI-1.

The licensee also addressed pressurized thermal shock (PTS), in particular the limiting  $RT_{PTS}$  values for TMI-1. The PTS Rule (10 CFR 50.61) has a screening criterion of 300 °F for circumferential weld materials, and 270 °F for axial weld, plate and forging materials. Ref. 1 provides the limiting values of  $RT_{PTS}$  for each criterion. As indicated in Table 2, the limiting  $RT_{PTS}$  value relative to the screening criterion of 300 °F is 268 °F for weld WF-25, and that relative to the screening criterion of 270 °F is 262 °F for weld SA-1526. These values satisfy the requirements of the PTS Rule through the end of the current license period.

The staff concludes that the proposed P-T limits for the reactor coolant system for heatup and cooldown, and inservice leak and hydrostatic tests are valid as indicated on the curves. The P-T limits satisfy the requirements of Appendix G of 10 CFR 50 for 17.7 EFPY. Hence, the proposed P-T limits may be incorporated into the TMI-1 TS. The proposed changes to the bases in the TS are consistent with the proposed P-T limits, and are also acceptable.

Further, the staff concludes that the RPV of TMI-1 satisfies the requirements of the PTS Rule (10 CFR 50.61) for the current license period.



Table 1 Limiting Adjusted Reference Temperatures at 17.7 EFPY for WF-25 at TMI-1

	ART @ 1/4T	ART @ 3/4T
EFPY	17.7	17.7
Fluence	$0.311 \times 10^{19}$	$0.113 \times 10^{19}$
Fluence Factor	0.6794	0.4416
$RT_{NDT(U)}$	-7°F	
Wt. % Cu	0.34	
Wt. % Ni	0.68	
Chemistry Factor	220.6°F	
$\sigma_U$	20.6°F	
$\sigma_\Delta$	28°F	
Margin Term	69.5°F	
$\Delta RT_{NDT}$	149.9°F	97.4°F
ART	212°F	160°F

Table 2 Limiting  $RT_{PTS}$  Values for TMI-1

	WF-25 (Circumferential Weld)	SA-1526 (Axial Weld)
EFPY	28.77	28.77
Fluence	$0.783 \times 10^{19}$	$0.706 \times 10^{19}$
Fluence Factor	0.9314	0.9025
$RT_{NDT(U)}$	-7°F	
Wt. % Cu	0.34	
Wt. % Ni	0.68	
Chemistry Factor	220.6°F	
$\sigma_U$	20.6°F	
$\sigma_\Delta$	28°F	
Margin Term	69.5°F	
$\Delta RT_{NDT}$	205.5°F	199.1°F
$RT_{PTS}$	268°F	262°F

### 3.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendment. The State official had no comments.

### 4.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (63 FR 19970). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

5.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

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Date: October 5, 1998



6.0 REFERENCES

1. March 23, 1998, letter from J. W. Langenbach, (GPU) to USNRC Document Control Desk (1920-98-20127), Subject: "Three Mile Island Nuclear Station, Unit 1 (TMI-1), Operating License No. DPR-50, Docket No. 50-289, Technical Specification Change Request (TSCR) No. 270, RPV Pressure and Temperature (PT) Limits."
2. June 30, 1998, letter from J. W. Langenbach, (GPU) to USNRC Document Control Desk (1920-98-20326), Subject: "Three Mile Island Station Unit No. 1 Nuclear Generating Station (TMI-1), Docket No. 50-219, Facility Operating License No. DPR-16, Response to Request for Additional Information - Technical Specification Change Request (TSCR) No. 270 to RPV Pressure/Temperature Limits."
3. October 8, 1997, letter from B. C. Buckley (USNRC) to J. W. Langenbach, GPU, Subject: "Three Mile Island Station Nuclear Generating Station, Unit 1 (TMI-1) - Request for Additional Information Concerning Pressure-Temperature Limit Curves and Low Temperature Overpressure Limits (TAC No. M99319)."