AmerGen

A PECO Energy/British Energy Company

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June 21, 2000
5928-00-20140

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

Dear Sir or Madam:

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1
OPERATING LICENSE NO. DPR-50
DOCKET NO. 50-289
LICENSE CHANGE APPLICATION (LCA) NO. 287, REVISION 1

In accordance with 10 CFR 50.4(b)(1), enclosed is TMI Unit 1 Licensing Change Application (LCA) No. 287, Revision 1. The purpose of this LCA is to request approval of changes associated with operation with the Makeup and Purification System (MU)/High Pressure Injection (HPI) as requested by the NRC in a letter dated March 26, 1999. Technical Specification changes include: 1) the addition of operating limits for MUT level and pressure 2) the addition of surveillance requirements for the Makeup Tank (MUT) pressure instrument channel and 3) revision of the calibration frequency for the MUT level instrument channel from "Not to exceed 24 months" to "Refueling Interval (once per 24 months)" along with other instruments in the same table as appropriate.

The purpose of this revision is 1) to provide a response to the NRC's request for additional information (RAI) discussed in conference calls with the NRC on March 9, 2000 and May 5, 2000, 2) to reflect changes to the figure from that provided in the original submittal, and 3) to include one additional instrument where the same calibration frequency extension is appropriate.

Enclosure 1, "Safety Evaluation and No Significant Hazards Consideration Analysis," addresses the guidance contained in NRC Generic Letter (GL) 91-04, "Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle," dated April 2, 1991 for each of the instruments affected by this submittal (See Enclosure 1A). The AmerGen response to the NRC's RAI is provided as Enclosure 1B.

Using the standards in 10 CFR 50.92, AmerGen has concluded that these proposed changes do not constitute a significant hazards consideration, as described in the enclosed analysis performed in accordance with 10CFR50.91(a)(1).

A001

NRR-057

Pursuant to 10 CFR 50.91 (b)(1), a copy of this License Change Application is provided to the designated official of the Commonwealth of Pennsylvania, Bureau of Radiation Protection, as well as the chief executives of the township and county in which the facility is located.

Please contact Bob Knight of TMI Licensing at (717) 948-8554 if you have any questions regarding this submittal.

Very truly yours,

John B. Cotton

John B. Cotton
Vice President, TMI Unit 1

JBC/mrk

Enclosures:
1) Safety Evaluation and No Significant Hazards Consideration Analysis
2) Technical Specifications Revised Pages
3) Hand Markup of Technical Specifications Revised Pages

cc: USNRC Regional Administrator, Region I
USNRC TMI Senior Resident Inspector
USNRC TMI Unit 1 Senior Project Manager
Chairman, Board of Supervisors of Londonderry Township
Chairman, Board of County Commissioners of Dauphin County
Director, Bureau of Radiation Protection, PA Department of Environmental Resources
File No. 97062

AMERGEN ENERGY COMPANY, LLC

Three Mile Island Nuclear Station, Unit 1
Operating License No. DPR-50
Docket No. 50-289
License Change Application (LCA) No. 287, Revision 1

COMMONWEALTH OF PENNSYLVANIA)
) SS:
COUNTY OF DAUPHIN)

This LCA is submitted in support of Licensee's request to change Appendix A to Operating License No. DPR-50 for Three Mile Island Nuclear Station, Unit 1. This revision provides a response to NRC request for additional information as discussed in conference calls on March 9, 2000 and May 5, 2000. Also included are the proposed replacement pages for the Appendix A Technical Specifications. All statements contained in this submittal have been reviewed, and all such statements made and matters set forth therein are true and correct to the best of my knowledge.

AmerGen Energy Company, LLC

BY: John B Cotton
Vice President, TMI Unit 1

Sworn and subscribed to before me this
21st day of June, 2000.

SEAL:

Cynthia J McElwee
Notary Public

Notarial Seal
Cynthia J. McElwee, Notary Public
Londonderry Twp., Dauphin County
My Commission Expires June 5, 2003
Member, Pennsylvania Association of Notaries

Enclosure 1

TMI Unit 1 License Change Application No. 287, Revision 1
Safety Evaluation and No Significant Hazards Consideration Analysis

I. License Change Application (LCA) No. 287, Revision 1

(Changes from the original submittal of Enclosure 1 to LCA No. 287 are indicated by a margin bar.)

AmerGen requests that the following changed replacement pages be inserted into the existing TMI Unit 1 Technical Specifications (T.S.):

Pages vii, 3-21 through 3-24, 4-5a and 4-6 are being revised, and page 3-24a is a new page added to the TS.

Revised pages (showing the changes in bold) along with a markup of the current T.S. pages (with margin bars to show the changes in this revision) are provided in Enclosure 2.

II. Reason For Change

The purpose of this LCA is to request approval of changes associated with operation with Makeup and Purification (MU)/High Pressure Injection (HPI) system as requested by the NRC in reference 5. The T.S. changes include:

1) Addition of operating limits for MUT level and pressure in a new Figure 3.3-1;
2) An additional surveillance requirement for the MUT pressure instrument channel;
3) A change to the frequency of calibration for the MUT level instrument from "F," "Not to exceed 24 months," to "R", "Refueling Interval (once per 24 months)";
4) A similar change to the frequency of calibration for the HPI and Low Pressure Injection (LPI) flow instruments and the Borated Water Storage Tank (BWST) level instrument; and
5) Minor editorial changes.

Recent industry events, including TMI Unit 1 Licensee Event Report (LER) 98-09 (Reference 1) have highlighted the importance for Makeup Tank (MUT) level and pressure control to maintain the reliability of the High Pressure Injection (HPI) pumps. Consistent with the intent of Technical Specifications (T.S.) and NRC Administrative Letter (AL) 98-10, "Dispositioning of Technical Specifications That Are Insufficient To Assure Plant Safety," AmerGen is proposing that new limits be established in the TMI Unit 1 T.S. for MUT level and pressure.

The following lists the changes proposed for each of the pages affected by LCA No. 287, Revision 1 (referring to the existing T.S. page numbers):

Page vii

The table of contents is revised to include the new Figure 3.3-1, "Makeup Tank Pressure vs Level Limits." As an editorial change from the original submittal of LCA No. 287, this revision designates the new figure correctly as Figure 3.3-1 in keeping with the TMI-1 T.S. format rather than 3.3.1.

Also included is an editorial change to update the table of contents entries for Figures 3.1-1 and 3.1-2 for the Amendment No. 208 changes. That amendment incorporated new pressure/temperature limits for the reactor vessel pressurization heatup, cooldown, and inservice leak and hydrostatic test, to be effective for a period through 17.7 Effective Full Power Years (EFPY).

Page 3-21

A new section (3.3.1.1.g) is being added to the Limiting Condition for Operation for the Injection Systems of Emergency Core Cooling placing restrictions on operation to assure that MUT level and pressure parameters are maintained within limits.

The new section reads as follows:

"g. MU Tank (MUT) pressure and level shall be maintained within the Unrestricted Operating Region of Figure 3.3-1.
   1) With MUT conditions outside of the Unrestricted Operating Region of Figure 3.3-1, restore MUT pressure and level to within the Unrestricted Operating Region within 72 hours. Specification 3.0.1 applies.
   2) Operation with MUT conditions in the Prohibited Region of Figure 3.3-1 is prohibited. Specification 3.0.1 applies."

Editorial changes on this page include:

1) Consistent use of the acronyms: "BWST" for the Borated Water Storage Tank, a proper definition of the makeup pumps as the "Makeup and Purification (MU)/High Pressure Injection (HPI)" pumps, and "CFT" for the Core Flooding Tanks,
2) An additional dash, "-," is added to the valve nomenclature for the reactor building sump isolation valves "DH-V-6A/B" to be consistent with labeling of plant components, and
3) The term "operable" is shown in capital letters consistent with TMI Unit 1 T.S. convention for those terms defined in Chapter 1 of the T.S.
4) T.S. Section 3.3.1.2.c is moved to page 3-22

Page 3-22

Editorial changes on this page include:

1) The T.S. section heading is added for clarity to show that this page is a continuation of the Limiting Conditions for Operation for the Emergency Core Cooling, Reactor Building Emergency Cooling and Reactor Building Spray Systems,
2) Consistent use of the acronyms: "CFT" for Core Flood Tank and "NaOH" for sodium hydroxide,
3) An additional dash, "-," is added to the valve nomenclature for the CFT vent valves "CF-V-3A," and "CF-V-3B" to be consistent with labeling of plant components.
4) The term "operable" is shown in capital letters consistent with TMI Unit 1 T.S. convention for those terms defined in Chapter 1 of the T.S.
5) T.S. Section 3.3.2 is moved to page 3-23.

Page 3-23

A new paragraph is being added to the Bases pertaining to the MUT pressure and level limits. The new paragraph reads as follows: "Maintaining MUT pressure and level within the limits of Fig 3.3-1 ensures that MUT gas will not be drawn into the pumps for any design basis accident. Preventing gas entrainment of the pumps is not dependent upon operator actions after the event occurs. The plant operating limits (alarms and procedures) will include margins to account for instrument error."

Editorial changes on this page include:

1) The T.S. section heading is added for clarity to show that this page is a continuation of the Limiting Conditions for Operation for the Emergency Core Cooling, Reactor Building Emergency Cooling and Reactor Building Spray Systems,
2) Consistent use of the acronyms "CFT" for Core Flood Tank, and
3) The term "operable" is shown in capital letters consistent with TMI Unit 1 T.S. convention for those terms defined in Chapter 1 of the Technical Specifications.

Page 3-24

1) The new paragraph from page 3-23 is carried over onto page 3-24.
2) As an editorial change, a heading is added for clarity to show that this page is a continuation of the Bases for T.S. 3.3.

Page 3-24a

This revision of LCA No. 287 provides a new figure "Makeup Tank Pressure vs Level Limits" intended to preclude gas entrainment of the MU/HPI pumps. As a change from the original submittal of LCA No. 287:

1) The portion of the figure associated with Net Positive Suction Head (NPSH) has been deleted. The statements related to NPSH limits in the T.S. 3.3 Bases (page 3-23) and the supporting statements in Enclosure 1, "Safety Evaluation and No Significant Hazards Consideration Analysis," Section III.C have also been deleted.

   The following sentence, related to NPSH limits, has been deleted from the originally proposed Bases insert (page 3-23): "The NPSH limit is necessary only to preclude damage to an HPI pump if it started prior to an ES Actuation." Also, the following paragraph has been deleted from the safety evaluation in Enclosure 1, Section III.C: "The Abnormal Transient Procedure 1210-1, 'Reactor Trip,' includes direction to start a second MU/HPI pump after the reactor trips to minimize the pressurizer level decrease due to RCS cooldown. The NPSH limit will protect the running MU pump and a second MU pump (HPI selected) if started prior to ES action. Absent this procedure, the NPSH limit is not required to protect any ECCS equipment. The normally running MU pump is not required for the system to meet its ECCS performance requirements including consideration of a single active failure."

   Since the original submittal of LCA No. 287, it has been determined that NPSH limits are not appropriate for inclusion as a T.S. Limiting Condition of Operation (LCO). Operation of a MU/HPI pump below the manufacturer's recommended NPSH limits for a short period of time may affect pump performance while the NPSH shortfall exists, but would not render the pump inoperable. The existing plant procedures will continue to provide MUT pressure vs level operating limits that ensure the recommended NPSH would be available for the NPSH limiting event, a High Pressure Injection Line Break SBLOCA.

Additionally, Abnormal Transient Procedure 1210-1, "Reactor Trip," has been changed in Revision 41 (effective May 16, 2000) to eliminate the operational guidance that previously started a makeup pump immediately following the reactor trip.

2) A more restrictive region of the new figure has been added. The original submittal of LCA No. 287 had defined a single "Restricted Region" where operation within that region would be allowed for 4 hours. The addition of the "Prohibited Region" differentiates between the degraded MUT conditions where operation is limited to 72 hours from the more severely degraded MUT conditions where operation is prohibited. Specification 3.0.1 applies.

<u>Page 4-5a</u>
Item No. 27 in Table 4.1-1 is revised to identify two MUT instruments, the level channel and the pressure channel. The level channel calibration frequency is changed from F, "Not to exceed 24 months," to R, "Refueling Interval (once per 24 months)." The same surveillance requirements are added for the pressure instrument channel as for the level instrument with a refueling interval calibration requirement.

Item No. 29, High and Low Pressure Injection Systems, Flow Channels: The channel calibration frequency is changed from F, "Not to exceed 24 months," to R, "Refueling Interval (once per 24 months)."

<u>Page 4-6</u>
Item No. 30, Borated Water Storage Tank Level Instrument: The channel calibration frequency is changed from F, "Not to exceed 24 months," to R, "Refueling Interval (once per 24 months)."

III. Safety Evaluation Justifying the Change

A. Background

In LER 98-09 (Reference 1) GPU Nuclear, the previous owner of TMI Unit 1, reported that the analysis for operation with MU/HPI pump suctions cross-connected had been found to be non-conservative in that the analysis had not considered the most limiting single failure resulting in operation outside MUT pressure and level limits approximately 3% of the time since the procedure changes were implemented for Cycle 12 Operation. Subsequently, the NRC issued a Level IV Notice of Violation (Reference 2) of 10 CFR 50.59 for failure to identify an unreviewed safety question. The NOV stated that the change created the possibility for a malfunction of a different type than any previously evaluated in the UFSAR in that a new potential for failure of the "C" MU/HPI pump due to gas entrainment from the MUT was created. GPU Nuclear agreed to the violation and responded in references 3 and 4 that the violation was resolved after the MUT pressure and level limits were revised to correct the error. In a letter dated March 26, 1999 (Reference 5), the NRC concluded that GPU Nuclear had provided adequate justification for continued operation (References 3 and 4) and although there was no immediate safety concern, changing the configuration created the possibility of an accident of a different type than any previously analyzed in the UFSAR which requires a license change.

As described in the meeting summary (Reference 6), GPU Nuclear met with the NRC on July 13, 1999 to discuss the issue of a license change to resolve the NOV in Inspection Report 98-09 along with another separate issue involving proposed procedure changes for another system. In the meeting GPU Nuclear proposed to 1) establish Limiting Condition for Operation (LCO) limits for MUT pressure and level based on a more detailed model that was under development at that time along with an appropriate action statement and allowable outage time (AOT), 2) define the design and licensing basis with emphasis on the single failure criterion, 3) address the instrumentation for pressure and level measurement including their maintenance and calibration, and 4) provide the technical basis for the pressure/level limits. This LCA fulfills that commitment.

B. Benefits of Operation with MU/HPI Cross-Connect Valves Open

The following lists some of the benefits of the change to maintain the MU/HPI pump suction cross connect valves (MU-V-69A and MU-V-69B) open:

1. Concerns associated with maintaining an isolated MU/HPI pump suction header filled and vented are resolved. Maintaining cross-connect valves (MU-V-69A and MU-V-69B) open:

   a. Provides greater assurance that the MU/HPI pump MU-P-1C suction piping remains filled and vented at all times,

b. Precludes damage to MU/HPI pump MU-P-1C if it were inadvertently started during operation or testing without establishing a suction path from the MUT or the BWST,

c. Reduces the potential for damage to Makeup Pumps MU-P-1A & MU-P-1B due to a failure of MU-V-14A to open on emergency safeguards (ES) actuation, and

d. Reduces the probability of MU/HPI pump damage due to improper valve operations during testing.

2. Resolves concerns associated with over-pressurization of isolated MU/HPI pump suction piping and components during normal or emergency operation. The change eliminates the potential to over-pressurize the MU/HPI pump suction piping due to leakage through recirculation line check valves or other leakage paths on the pump discharge. With a common suction header, any flow back through an idle pump will be picked up by the operating pump without any significant pressure increase at the pump suction. This change resolves over-pressurization concerns during normal or emergency operating as identified in LER 97-03 (Reference 15).

3. Results in a lower calculated core damage frequency (CDF) due to a reduction in the probability of Makeup Pump damage and the resulting increase in MU/HPI System availability. This was the conclusion of the Probabilistic Risk Assessment (PRA) (Reference 25).

C. <u>MUT Level and Pressure Limits</u>

Analyses were performed to determine the operating limits for the pressure and level in the makeup tank (MU-T-1). These limits are proposed to preclude gas entrainment of the MU pumps when drawing from the MUT during any design basis accident if the MUT conditions are maintained within the Unrestricted Operating Region of the curve in Figure 3.3-1. The curves are based on analysis (Reference 7) of the full spectrum of RCS breaks including an HPI line break. The analysis used conservative assumptions based on limiting conditions for operation and maintenance. The system valve lineup is based on TMI Unit 1 Operating Procedure 1104-2, Revision 116, "MakeUp and Purification System." The system lineup includes a common MU pump suction header (MU-V-68A/B and MU-V-69A/B "OPEN"), isolation between HPI trains on the MU pump discharge header (MU-V-76A/B or 77A/B "CLOSED"), and MU-V-222 throttled.[1]

The analysis inputs included: minimum initial BWST level, maximum BWST level instrument error, un-throttled flow rates of reactor building spray (BS) and LPI from the BWST for events where these systems may be operating, no delay in procedure directed operator actions which might aggravate the

[1] The analysis to support the revised curve submitted as Figure 3.3-1 for LCA 287, Revision 1 has been revised to correct an error in the c_v assumed for MU-V222 in the locked throttled condition. The analysis now uses actual plant data to benchmark the calculations.

potential threat to the HPI pumps, no additions to the MUT are credited (including letdown or seal return and excluding MU pump recirculation flow), minimum or maximum valve stroke times based on IST limits, and no operator actions in response to the decrease in MUT inventory. The analysis for potential gas entrainment allowed margin to account for the potential formation of a vortex in the MUT, which could lead to air entrainment prior to emptying the tank.

To obtain the upper curve of the new Figure 3.3-1, the analysis considered the event specific limiting single active failure for potential gas entrainment. The failure of a MU pump suction isolation valve from the BWST (MU-V-14A or MU-V-14B) to open on ES actuation and all other available HPI pumps (3 MU pumps) operating was determined to be the most limiting scenario for potential gas entrainment. The lower curve defines the boundary of a more restrictive region where gas entrainment could occur without assuming the single failure of an MU-V-14 valve.

The plant operating limits will include margins to account for instrument error. The overall loop instrument errors were determined (References 8 and 9) assuming a 30 month interval between calibration checks. The operating procedure (Reference 10) specifies a normal operating band that is more restrictive than the limits from the analysis including maximum instrument errors. If the MUT conditions are outside of the normal operating band, a plant process computer alarm will annunciate. If the MUT conditions move further outside of the normal band, there are overhead annunciators, Main Annunciator Panel (MAP) modules D-3-2 and D-3-3, and additional plant process computer alarms if the error adjusted T.S. limit is approached. If the error adjusted T.S. limits are exceeded, an additional plant process computer alarm will be activated.

Experience with the present operating limits and the presence of multiple methods to adjust MUT conditions makes it unlikely that the T.S. limits would be exceeded. In the unlikely event that the MUT level and pressure were outside of the "Unrestricted Operating Region" of Figure 3.3-1, acceptable conditions would be restored within the required time or a plant shutdown would be required in accordance with T.S. 3.0.1.

The new Figure 3.3-1 is not corrected for instrument errors. The plant operating limits, as implemented in alarms and procedures, include margins supported by calculations to account for instrument error. Corrections for instrument errors were not included in the T.S. to permit the use of alternative instruments where appropriate margins are supported by calculations.

D. <u>MUT Level & Pressure Instruments</u>

MUT level indication design ensures that there is no credible common mode failure mechanism. There are redundant MUT level indicators available in the control room. There is a recorder (MU14-LR) and a digital indicator (MU-LT-778A). These instruments are independently powered from vital power. Both instrument loops are indicated and recorded on the plant process computer. The high pressure sensing line comes from a common level tap on the side of the tank (see Figure 1). The instruments are calibrated such that when the level is at the lower tap, the indicated level is zero. The low pressure sensing line comes from a single vent line on the top of the tank. The sensing line connection to each transmitter is routed to a drain pot. Any condensation in the sensing line is collected below the transmitter and does not affect the level indication. The daily operability check (Reference 20) will be performed by comparing the two control room indications.

There is an indicator (MU17-PI) for MUT gas pressure in the control room. This instrument loop is powered from vital power. MUT pressure indication from this instrument loop is indicated, recorded and alarmed on the plant process computer. The daily operability check (Reference 20) will be performed by comparing the control room indication with the local indications of MU pump suction header pressure (MU-PI-412, 413, or 414).

The MUT level and pressure instruments are used to maintain MUT conditions within acceptable limits. If MUT conditions are within the Unrestricted Operating Region when a LOCA occurs, no additional mitigating actions by the operator are required to prevent the MUT gas from being drawn into the MU pumps.

MUT pressure and level instruments are maintained in accordance with the AmerGen TMI Unit 1 Appendix B QA program. MUT level is categorized by Regulatory Guide (RG) 1.97 as a Type D, Category 2 instrument. The TMI-1 MUT level instruments meet the requirements for a Category 2 instrument. MUT pressure is not identified as a RG 1.97 parameter. The transmitters for MUT pressure and level are classified as nuclear safety related in the TMI-1 Quality Classification List.

An overall instrument loop error analysis was performed for each MUT instrument loop (References 8 and 9). The analysis considered the hardware installed, calibration methodology, accuracy of the test equipment, effects on electronics from variations in power supplies and ambient temperatures, systematic measurement errors (elevation of the transmitter, water temperature variation, boron concentration variation), indicator resolution and loss of accuracy over time (i.e., drift). The analysis assumed a 30 month period between calibrations to determine the overall loop accuracy and to determine the acceptable "AS FOUND" tolerances. NRC GL 91-04, "Changes in Technical Specification Intervals to Accommodate A 24-month Fuel Cycle," dated April 2, 1991 identifies the issues that should be addressed to provide an acceptable basis for increasing the calibration interval for instruments that are used to perform a safety function. These issues are addressed in Enclosure 1A for each of the instrument channel frequency extensions.

E. HPI & LPI Flow and BWST Level Instrument Surveillance Frequency

The performance requirements for the HPI and LPI flow instruments and the BWST level instrument are supported by the conclusions of the baseline calibration and instrument accuracy analysis (References 12, 13, and 22 respectively). These analyses assumed a 30 month interval between calibration checks when determining overall loop accuracy. The instrument design basis functions and instrument accuracy requirements for the HPI and LPI flow and BWST level instruments are addressed in references 16, 17, and 22, respectively.

T.S. Table 4.1-1, Item No. 29 provides the calibration frequency requirement for HPI and LPI flow instruments. T.S. Table 4.1-1, Item 30 provides the calibration frequency requirement for the BWST level instrument. Prior to TMI-1 T.S. Amendment No. 175, the HPI and LPI flow instruments and the BWST level instrument were calibrated each refueling interval. In Amendment No. 175, which approved 24 month operating cycles, the calibration frequency for the HPI and LPI flow instruments and the BWST level instrument was revised to F, "Not to exceed 24 months" since the analysis had not been completed to support a 30 month interval between calibration checks. That analysis has now been completed. Revision of the calibration frequency to "R, Refueling Interval (once per 24 months)" is needed to permit coordination of the instrument calibrations with biennially scheduled train outages. The 25% extension described in Tech Spec 1.25 would not permit extension of the surveillance interval beyond 30 months.

NRC GL 91-04, "Changes in Technical Specification Intervals to Accommodate A 24-month Fuel Cycle," dated April 2, 1991 identifies the issues that should be addressed to provide an acceptable basis for increasing the calibration interval for instruments that are used to perform a safety function. These issues are addressed in Enclosure 1A for each of the instrument channel frequency extensions.

F. Editorial Changes

The editorial changes described in Section II above are clarifying in nature to improve the consistency and readability of this T.S. section.

IV. No Significant Hazards Consideration

AmerGen has determined that this LCA involves no significant hazards consideration as defined by NRC in 10 CFR 50.92:

A. The proposed changes do not represent a significant increase in the probability or consequences of an accident previously evaluated.

The changes included in this LCA impose new requirements for MU/HPI system operation and testing and extension of calibration frequencies for the MUT level, HPI flow and LPI flow instruments and BWST level instrument. These changes could not result in initiation of any accident previously evaluated. Therefore, the probability of an accident could not be affected by changes to the MU/HPI and Decay Heat Removal (DHR) systems.

As described in the list of benefits for operation with MU/HPI cross-connect valves open, listed in Section III.B above, the purpose of changing the operation of the MU/HPI system was to preclude the possibility of HPI pump damage. The addition of surveillance requirements for the MUT pressure instrument and the addition of LCO limits on MUT level and pressure along with appropriate action statements and required action times will ensure that gas entrainment of the MUT does not occur. The proposed change in instrument calibration frequencies will continue to maintain the required accuracy of the MUT level, HPI flow, LPI flow, and BWST level instruments.

Minor editorial changes are included in this request to improve the clarity and readability of the T.S. and could not adversely affect plant operation.

Therefore, the proposed changes will not adversely impact the reliability of the MU/HPI system and could not represent a significant increase in the probability or consequences of an accident previously evaluated.

B. The proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

This LCA does not involve the addition of any new hardware. Along with minor editorial changes, the requested changes involve MU/HPI system operation and changes in instrument calibration frequency which have been reviewed in accordance with NRC guidance. Changes to MU/HPI System operation can only affect RCS coolant inventory changes during operation and the ability to provide protection in the event of a Loss of Coolant Accident (LOCA). The full spectrum of LOCAs has been evaluated in the FSAR. Therefore, no new accident scenarios have been created.

The additional controls on MUT level and pressure provided by this LCA will ensure that a malfunction of a different type, gas entrainment of the MU/HPI pumps, will not occur. These limits on MUT level and pressure ensure that the initial conditions assumed for ECCS operation are maintained. The T.S. limits maintain the accident analysis initial conditions such that no operator action is required to avoid gas entrainment during ECCS operation with the postulated single failure as required by the TMI-1 licensing basis (Reference 14).

Extension of the calibration frequencies for the HPI level, HPI flow, LPI flow, and BWST level will continue to maintain the accuracy of these instruments and could not create the potential for any new accident that has not been evaluated.

Minor editorial changes are included in this request to improve the clarity and readability of the T.S. and could not adversely affect plant operation.

Therefore, these changes do not create the potential for any accident different from those that have been evaluated.

C. These proposed changes do not involve a significant reduction in a margin of safety.

This LCA includes changes to MU/HPI system operation and testing and an extension of the calibration frequency for certain instruments. The requested changes will serve to maintain the proper system initial conditions to ensure the ability of the MU/HPI system to provide protection in the event of a Loss of Coolant Accident (LOCA) and maintain the required instrument accuracy for the instruments where changes to a refueling interval frequency are being requested. NRC guidance for addressing the effect on increased surveillance intervals on instrument drift and safety analysis assumptions presented in GL 91-04 has been addressed in enclosure 1A.

Minor editorial changes are included in this request to improve the clarity and readability of the T.S. and could not adversely affect plant operation.

These changes, which are consistent with the TMI-1 licensing and design basis requirements, do not result in a degradation of safety related equipment, and therefore, do not involve a significant reduction in a margin of safety.

V. <u>Environmental Impact Evaluation</u>

10 CFR51.22(c)(9) provides criteria for identification of licensing and regulatory actions eligible for categorical exclusion from performing an environmental assessment. A proposed amendment to an operating license for a facility requires no environmental assessment if operation of the facility in accordance with the proposed amendment would not:

(i) involve a significant hazards consideration,

(ii) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, and

(iii) result in a significant increase in individual or cumulative occupational radiation exposure.

AmerGen has reviewed this LCA and concludes that it meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(c), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the proposed license amendment for changes which, along with some editorial changes, provides additional operating restrictions on MUT level and pressure, provides an additional surveillance requirement for the MUT pressure instrument, and revises an existing surveillance calibration frequency for the MUT level instrument.

VI. Implementation

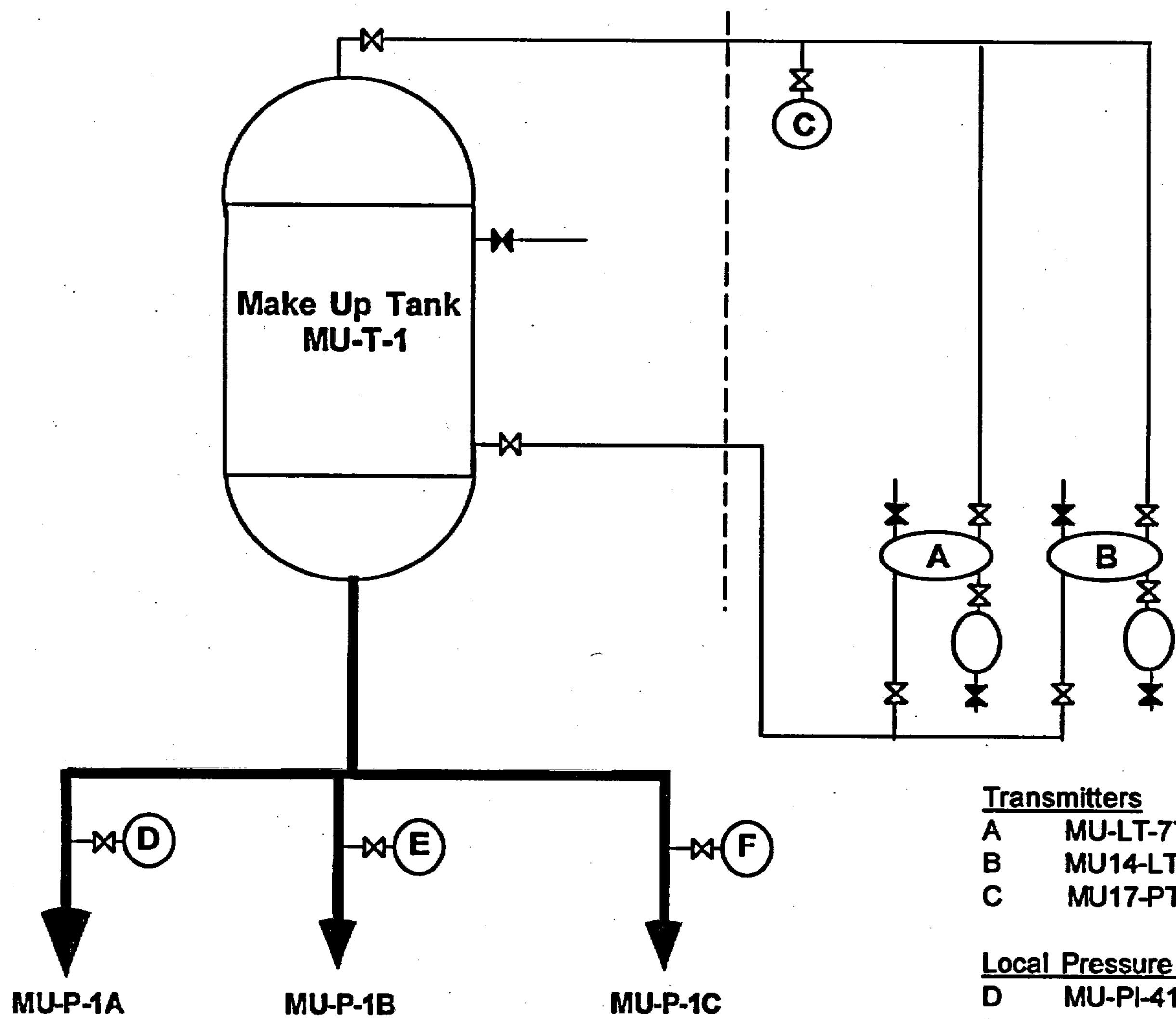
AmerGen requests that the amendment authorizing this change be effective immediately, with implementation within 30 days.

VII. References

1. GPU Nuclear letter (1920-98-20519) dated September 18, 1997, LER 98-09, Revision 1, "Potential Loss of High Pressure Injection During Postulated Loss of Coolant Accident Due to Misapplication or Interpretation of Design Inputs."
2. NRC letter (1920-98-30622) dated October 15, 1998, "NRC Inspection Report No 50-289/98-06 and Notice of Violation."
3. GPU Nuclear letter (1920-98-20654) dated November 12, 1998, "Reply to Notice of Violation."
4. GPU Nuclear letter (1920-98-20716) dated December 24, 1998, "Reply to Notice of Violation Dated October 15, 1998 – Supplement."
5. NRC letter (1920-99-30162) dated March 26, 1999, "NRC Inspection No. 50-289/98-06 (Reply)."
6. NRC letter (1920-99-30452) dated August 4, 1999, "Summary of July 13, 1999 Meeting with GPU Nuclear, Inc. Regarding Proposed Modifications to Reactor Building Spray and High Pressure Injection at TMI-1 (TAC Nos. MA5934 and MA5935)."
7. Calculation No. C-1101-211-E610-066, Revision 6, "MU Tank Pressure and Level Limits."
8. Calculation No. C-1101-624-5350-002, Revision 5, "MU Tank Level Loop Error & Baseline Calibration."
9. Calculation No. C-1101-624-E510-008, Revision 0, "MU Tank Pressure Loop Error."
10. TMI-1 Operating Procedure 1104-2, Revision 116, "MakeUp and Purification System."
11. Drawing No. 308-905, Revision 4, "Makeup Tank Level and Pressure Transmitter."
12. Calculation No. C-1101-211-E510-082 "HPI Flow Calibration and Instrument Loop Error."
13. Calculation No. C-1101-212-E510-074, "LPI/DHR Flow Calibration and Instrument Loop Error"
14. GPU Nuclear Safety Evaluation No. SE-000211-015, Revision 0, "Operation with MU X-Connect Valves OPEN."

15. GPU Nuclear letter dated September 29, 1997, LER 97-03, Revision 1, "Potential Overpressurization Of Makeup Pump Suction Piping Due To Inadequate Test And Operating Procedures."
16. GPU Nuclear Safety Evaluation No. SE-000211-027, Revision 0, "HPI Flow Instrument Design Basis."
17. GPU Nuclear Safety Evaluation No. SE-000212-036, Revision 0, "LPI Flow Instrument Design Basis."
18. TMI-1 Surveillance Procedure 1302-5.17, "Make-Up Tank Level Instrumentation."
19. TMI-1 Surveillance Procedure 1302-5.18, "HPI/LPI Flow Channel Calibration."
20. TMI-1 Surveillance Procedure 1301-1, "Shift and Daily Checks."
21. Calculation No. C-1101-212-5310-50, "TMI-1 BWST Vortex Determination."
22. Calculation No. C-1101-212-E510-57, "TMI BWST Level Loop Accuracy - DH-LT-0808, DH-LT-0809, DH-DPS-0914."
23. TMI-1 Surveillance Procedure 1302-5.19, "Borated Water Storage Tank Level Indicator."
24. TMI-1 Surveillance Procedure 1301-4.1, "Weekly Surveillance Checks."
25. GPU Nuclear Letter No. C311-89-2020, Hukill to NRC, "TMI-1 Level 1 Probabilistic Risk Assessment (PRA)," dated March 17, 1989.

FIGURE 1
MU TANK PRESSURE & LEVEL INSTRUMENTS



Transmitters

A MU-LT-778
B MU14-LT
C MU17-PT

Local Pressure Indicators

D MU-PI-412
E MU-PI-413
F MU-PI-414

Evaluation of Instrument Surveillance Frequency Changes As Described In Generic Letter 91-04

Generic Letter 91-04, Enclosure 2, "Guidance for Addressing the Effect of Increased Surveillance Intervals on Instrument Drift and Safety Analysis Assumptions," identified the issues to be addressed to provide an acceptable basis for increasing the calibration interval for instruments that are used to perform safety functions. Each of seven issues that were identified are addressed as follows:

1. Confirm that instrument drift as determined by as-found and as-left calibration data from surveillance and maintenance records has not, except on rare occasions, exceeded acceptable limits for a calibration interval.

   Response
   The history of instrument performance for the **BWST level,** MUT level, HPI Flow, and LPI Flow instruments has been reviewed. There were occasions where the instrument calibration was found outside of the tolerance required by procedure, however no incidents were identified where drift or time dependent variability resulted in the instrument being inoperable.

2. Confirm that the values of drift for each instrument type (make, model, and range) and application have been determined with a high probability and a high degree of confidence. Provide a summary of the methodology and assumptions used to determine the rate of instrument drift with time based upon historical plant calibration data.

   Response
   The historical data for instrument drift of the **BWST level,** MU tank level, HPI Flow & LPI Flow instruments were compared with the published manufacturer specifications. In each case the historical data were similar to or better than the published rate of drift. The manufacturer's published rate of drift for 95% statistical confidence was used in the determination of the overall loop accuracy.

3. Confirm that the magnitude of instrument drift has been determined with a high probability and a high degree of confidence for a bounding calibration interval of 30 months for each instrument type (make, model number, and range) and application that performs a safety function. Provide a list of the channels by TS section that identifies these instrument applications.

   Response
   The following instruments have been evaluated for extension of the calibration frequency from F, "Not to exceed 24 months," to R, "Refueling Interval (once per 24 months):

T.S. Table 4.1-1, Item No.	Instrument Channel Tag Nos.
27. Makeup Tank Level	MU14-LT MU-LT-778

T.S. Table 4.1-1, Item No.	Instrument Channel Tag Nos.
29. High and Low Pressure Injection Systems Flow Channels	MU-FT-1126 MU-FT-1127 MU-FT-1128 MU-FT-1129 DH-DPT-0802 DH-DPT-0803
30. Borated Water Storage Tank Level Indicator	DH-LT-0808 DH-LT-0809

Overall loop accuracy for each instrument loop (MU14-LT, MU-LT-778, DH-DPT-0802, DH-DPT-0803, MU-FT-1126, MU-FT-1127, MU-FT-1128 and MU-FT-1129) was determined based upon a 30 month period between surveillance checks. The overall loop error was determined based upon a maximum "AS LEFT" error and drift for 30 months. The safety analyses that are dependent upon these instruments used bounding values or have been revised using the overall loop errors based upon a 30 month interval. There are no explicit operability requirements in T.S., Section 3 for any of these instrument loops.

Overall loop accuracy for each BWST level instrument loop (DH-LT-0808 and DH-LT-0809) was determined based upon a 30 month period between surveillance checks. The overall loop error was determined based upon a maximum "AS LEFT" error and drift for 30 months. The safety analyses which are dependent upon these instruments used bounding values or have been revised using the overall loop errors based upon a 30 month interval. T.S. 3.3.1.1.e requires that both BWST level channels be operable when the reactor is critical.

4. Confirm that a comparison of the projected instrument drift errors has been made with the values of drift used in the setpoint analysis. If this results in revised setpoints to accommodate larger drift errors, provide proposed TS changes to update trip setpoints. If the drift errors result in a revised safety analysis to support existing setpoints, provide a summary of the updated analysis conclusions to confirm that safety limits and safety analysis assumptions are not exceeded.

Response

MUT Level:
The MUT level instrument is used to maintain the conditions in the MUT in order to preclude potential MU pump NPSH or gas entrainment problems as described in this LCA. The MUT level instrument also provides a primary indication of RCS leakage both as an early indicator of significant leaks which are within the MU system capability and for detection of very small leaks. In each of these functions the MUT instrument is used as a relative measurement, where the absolute level measurement is not critical. The surveillance interval extension does not affect the instrument error assumptions in the existing analysis.

HPI Flow:
The accuracy requirements for the HPI flow instruments are based on the need for the operator to throttle HPI flow to prevent pump runout in a specific LOCA scenario as described in reference 16. The Emergency Operating Procedure (EOP) direction that "HPI must be throttled to prevent pump runout (515 gpm/pump)" is based on the instrument accuracy at the end of 30 months.

LPI Flow:
The accuracy requirements for the LPI flow instruments are based on the need for the operator to throttle LPI flow to maintain adequate pump NPSH when taking suction from the Reactor Building (RB) sump as described in reference 17. All other safety analyses that account for LPI flow (LOCA analysis, EQ/Long term cooling, MHA dose consequence, etc.) have been reviewed and revised as required based on the revised instrument accuracy at 30 months.

BWST Level:
The accuracy requirements for the BWST level instruments are based on maintaining the minimum available inventory for ECCS and on providing the indication to control transfer of the LPI & BS pump suction source from the BWST to the RB sump. The operating limit for the BWST minimum required level and the analysis of the BWST switchover (Reference 21) both use an instrument accuracy based on a 30 month surveillance interval.

No Tech Spec setpoints or margins for setpoints in TS are affected by these surveillance extensions.

5. Confirm that the projected instrument errors caused by drift are acceptable for control of plant parameters to affect a safe shutdown with the associated instrumentation.

   Response
   As discussed in item No. 4 above, the critical instrument accuracy requirements for BWST **level**, LPI flow and HPI flow are based on post accident control functions. The MUT level instruments do not have a required post accident control function.

6. Confirm that all conditions and assumptions of the setpoint and safety analyses have been checked and are appropriately reflected in the acceptance criteria of plant surveillance procedures for channel checks, channel functional tests, and channel calibrations.

   Response
   The overall instrument loop accuracy was determined based on the "AS LEFT" tolerance requirements in the surveillance procedure. The surveillance procedure "AS FOUND" tolerance is based on the same methodology used to determine the "OVERALL" loop accuracy. The consistency between the instrument accuracy analysis (References 8, 12, **13, and 22**), and the surveillance procedures (References 18, 19, **and 23**) has been verified. The criteria for the operability checks for MUT level (References 20 **and 24**) are consistent with the overall loop accuracy required.

7. **Provide a summary description of the program for monitoring and assessing the effects of increased calibration surveillance intervals on instrument drift and its effect on safety.**

Response

The instrument surveillance program triggers evaluations of the instrument performance whenever the instrument is found outside the "AS LEFT" tolerance (i.e., anytime an adjustment is required). The maintenance assessment program records these events and repetitive occurrences are identified for further evaluation. These evaluations include consideration of the instrument function and its effect on safety.

Response to NRC Request for Additional Information Regarding the Original Submittal of LCA No. 287, Dated October 29, 1999

NRC Question No. 1:

How are the sources of gas connected to the make-up tank (MUT) disconnected from the tank during normal operation? How are normal gas additions performed? Are these sources of gas controlled administratively/physically by requirement? Is there any credible way that gas could be inadvertently injected to the MUT? [The regulatory basis for this question is to establish the adequacy of the TS curves proposed by the licensee in response to the NRC letter dated March 26, 1999.]

Response to Question No. 1:

There are two sources for gas additions to the MUT. Hydrogen is used to control Reactor Coolant System (RCS) dissolved oxygen and nitrogen is used as a dilution gas to transition between a hydrogen overpressure and air. During normal power operation both sources of gas are isolated from the tank by at least two valves in series - one is a manual valve and the other is a solenoid-operated valve which closes on loss of power.

The operating procedures for additions of hydrogen or nitrogen require that any time the gas addition valve is opened, a dedicated operator remain at the valve until it is closed.

1) Operating Procedure 1102-12, "Hydrogen Addition and Degassification," contains a caution statement in step 3.2.2 that reads: "At all times when the H_2 header is lined up to the H_2 bottle and the reactor is critical. An Operator in communication with the Control Room will be stationed at the H_2 bottle isolation valves. IF the addition is interrupted for any reason, the Operator will isolate the H_2 header from the bottle before leaving."

2) Operating Procedure 1104-26, "Nitrogen Supply System," contains a statement in the Limits and Precautions, Section 2.2.5 that reads: "At all times when the reactor is critical and NI-V-22 is open, an operator in Communication with the Control Room will be stationed in the vicinity of NI-V-22 (considering ALARA principlals[sic]). If the N_2 addition to the MU Tank is interrupted the operator will close NI-V-22 before leaving."

This precludes the potential for inadvertent additions of gas to the MUT.

NRC Question No. 2:

There is industry experience with gas binding and common-cause failure of the charging pumps associated with make-up tank level and pressure instrumentation problems and the introduction of gas into the pump suction. Some of these failures have been described in Information Notices (INs) 83-77 and 88-23 and their supplements, INs 94-29 and 97-38, and SECY-85-384 (regarding a 1985 Palo Verde event). How has this and other operating experience been considered for this proposed design and operational change? Explain why you believe that the design and proposed operation will prevent or minimize the likelihood of common cause failure such as described in the above references. [The regulatory basis for this question is to verify meeting GDC 35 single failure criteria.]

Response to Question No. 2:

The design was evaluated for the problems described in the following operating experience reports: NRC Information Notices (Ins) 88-23, 83-77, 94-29 & 97-38 and the Institute of Nuclear Power Operations (INPO) Significant Operating Experience Report (SOER) 97-1, "Potential Loss of High Pressure Injection and Charging Capability from Gas Intrusion." Each of the failure mechanisms described in the operating experience reports was considered. High Pressure Injection (HPI) is protected from these potential problems by control of the gas addition sources and control of the MUT gas volume. The MUT pressure vs. level curves proposed to be incorporated into the TMI Unit 1 technical specifications are designed to prevent the MUT gas from entering the pump suction in the most limiting design basis event. The analysis includes an assumed single failure.

Operating experiences as described in INs 83-77, 88-23 & 97-38 were summarized and addressed in response to SOER 97-1 as documented in the TMI Corrective Action Process (CAP T1997-0911). The SOER response addressed the reliability of the MUT instrumentation; training of operations, maintenance and engineering personnel on the concern with gas intrusion; control of gas intrusion pathways; a system design review for potential gas accumulation locations; and a review of operating, maintenance, surveillance and emergency procedures.

The TMI-1 response to SOER 97-1 stated that:

1. Gas intrusion is prevented by control of isolation valves for gas sources and by maintaining MUT pressure within the defined operating limits, and
2. Gas stripping or desorption can only occur where MU system pressure is less than MUT pressure. All sections of the MU system piping are maintained above MUT pressure, except:
   a) The fluid pressure immediately prior to entering a running MU pump may be less than MU tank pressure. In this condition there is no accumulation of gas due to the flow.
   b) The fluid pressure in the "C" & "D" HPI lines is slightly less than MUT pressure. There is not a continuous flow of water to this lower pressure piping; therefore the potential quantity of gas out of solution is small. This gas would not threaten HPI system performance.
   c) The MU pump minimum recirculation flowpath is back to the MU tank. Any gas coming out of solution would be carried back to the MUT by the recirculation flow.

IN 94-29 was concerned with inadequate suction pressure due to multiple pumps operating from a common suction supply. Operation of all three MU pumps from the MUT is prohibited by Operating Procedure 1104-2, "Makeup and Purification System," Limit and Precaution Section 2.1.2.10 which states: "Do not run three MU Pump taking suction from the MU tank alone, unless an evaluation to confirm adequate MU Pump NPSH has been performed." There would always be adequate NPSH for three MU Pumps taking suction from the BWST.

<u>NRC Question No. 3</u>:

The amendment requests approval of a Technical Specification (TS) for a curve that identifies the acceptable and unacceptable regions of the pressure vs. level curve in the MUT, however, the methodology used for deriving the curve is not presented. Please provide a description of the methodology including how the MUT cover gas is modeled to expand, how the gas is assumed to come out of solution from the MUT liquid, how the pressure drops for different flow resistances are calculated and what is the expected accuracy of the calculation. [The regulatory basis for this question is to establish the adequacy of the TS curves proposed by the licensee in response to the NRC letter dated March 26, 1999.]

<u>Response to Question No. 3</u>:

The MUT pressure vs level curve is based on a detailed analysis of the Makeup (MU) System with RELAP5. This model includes the normal injection path from the MUT to the Reactor Coolant System (RCS), all the High Pressure Injection (HPI) injection paths, and the MU pump recirculation path back to the MUT. In addition, the flow path from the Borated Water Storage Tank (BWST) to the MU pump suction header was also modeled. The RCS was modeled as a boundary condition, with the pressure profile supplied by existing Loss-Of-Coolant Accident (LOCA) analyses. The resistance values used in this model were obtained from a design-verified resistance calculation and the configuration is based on as-built drawings. The model was benchmarked against existing plant data. A series of Large-Break (LB) and Small-Break (SB) LOCA transients were run with various combinations of initial pressure and level in the MUT. The acceptable combinations of initial pressure and level were used to generate the limit curve.

The flow from the MUT is calculated from the applied boundary conditions. The MU system is dynamically modeled, i.e., decreasing RCS pressure, stroking of the various valves, MU pump coast-up, etc. The code determines the pressure drop based on the calculated flow conditions.

The gas in the MUT was modeled using the RELAP5 non-condensable model. In RELAP5, the non-condensable component is present only in the gaseous phase. The properties for the gaseous phase are calculated assuming a modified Gibbs-Dalton mixture of steam (real gas from steam table data) and an ideal non-condensable gas.

The RELAP5 model does not explicitly account for dissolved hydrogen gas in the MUT water coming out of solution as the tank pressure decreases for these various transients. Dissolved hydrogen is only a potential concern for the gas entrainment limits, because these limits are based on a minimum tank level at the time of recirculation. The effect of hydrogen coming out of solution is judged to be small compared to other conservatism in the evaluation of the gas entrainment limits. The approach used for determining the MUT limits used bounding and conservative assumptions such that this degree of conservatism would bound any non-conservative effects of hydrogen coming out of solution.

In order to evaluate the degree of conservatism, the calculation evaluated the conservatism resulting from the assumption of both LPI trains injecting at a rate of over 9,000 gpm for the entire transient. Using the LB LOCA transient with both the high HPI and Low Pressure Injection (LPI) flows to determine the gas entrainment limits is very conservative because HPI would not be required after there is sufficient LPI flow. It was demonstrated in the calculation that the effect of this conservative LPI flow assumption on the volume of liquid remaining in the MUT bounds the maximum liquid volume that could be potentially displaced by hydrogen coming out of solution. Therefore, it was concluded that the conservatism built into the model bounds any non-conservative effects resulting from gas coming out of solution.

A statistical accuracy evaluation was not done for the analysis. However, conservative values were used for the boundary conditions, the assumed LPI and Reactor Building Spray (BS) flows and the valve stroke times. Furthermore, conservative assumptions were made regarding operator actions. Therefore, it can be concluded that the resulting limit curve is conservative and bounding.

NRC Question No. 4:

The submittal indicates that the TS values do not include instrument uncertainties, however, the procedures used by the operators will. This could permit operation that is outside of the TS curve for safe operation. The allowable value in the TS should consider uncertainties and should be modified. Please describe how the instrument uncertainties will be calculated and how they will be accounted for in establishing the acceptable limits for operation. [The regulatory basis for this question is the Standard Review Plan which states that allowable values should include instrument uncertainties.]

Response to Question No. 4:

Instrument errors are not included in Figure 3.3-1 because instrument error has been incorporated the within the applicable plant operating procedure (Reference 10), and the determination of these errors meets the requirements of Regulatory Guide 1.105. The operating crew utilizes the limits provided in the operating procedure to evaluate and control the MUT conditions. The TS curve has been annotated to clarify that instrument errors are not included and ensure that values taken from the curve will not be used directly. Including multiple limits in the T.S. that are instrument string (loop) dependent could unnecessarily limit the licensee's ability to use new or alternate instrumentation.

Operating limits implemented by plant procedure include Instrument uncertainties that are supported by calculations (References 8 and 9). These calculations were performed in accordance with GPU Nuclear Engineering Standard ES-002, "Instrument Error Calculation and Setpoint Determination." This standard, currently AmerGen Engineering Standard ES-002T, is consistent with the methods and requirements of ISA-S67.04-1982, "Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants," in accordance with the clarifications and exceptions defined by Regulatory Guide 1.105, "Instrument Setpoints for Safety-Related Systems," Revision 2 (February 1986)[2]

[2] The definition of "allowable value" in the latest revision of Regulatory Guide 1.105, Revision 3 (December 1999) was compared with the revision referenced in ES-002T and found to be equivalent.

<u>NRC Question No. 5</u>:

Explain why the failure (drift out of tolerance) of the single pressure instrument is not credible. The submittal indicates that a daily operability check of the single MUT pressure instrument is performed with the local indicators at the make-up pump suction. How is the pressure at the pump suction compared (or adjusted) to the pressure in the cover gas of the tank? Is the accuracy of this measurement sufficient to detect an out of tolerance condition on the MUT pressure indicator? [The regulatory basis for this question is to establish the adequacy of the TS curves proposed by the licensee in response to the NRC letter dated March 26, 1999.]

<u>Response to Question No. 5</u>:

The MU pump suction pressure instrument is a 0 to 60 psig gauge with calibration tolerance of 0.3 psig. The calibration of the gauge is within the Appendix B QA program due to its use in the Inservice Test (IST) program. The daily check (Reference 20), which compares MUT pressure with MU pump suction pressure as an operability check, would detect any significant drift of the MUT pressure instrument. In this comparison, 3 psig is added to the MU pump suction indication of an idle MU pump (to account for elevation and line loss), and this value is then compared with MUT pressure indication in the control room.

The nominal 3 psig adjustment, which represents mostly static head, was determined empirically. The elevation difference between the indicators equates to 3.2 psig. This then allows line loss to be no more than a small fraction (< 10%) of the total head loss, which is consistent with the low flow conditions during the check.

<u>NRC Question No. 6</u>:

What is the basis for your proposed action statement? Specifically, why is a 4-hour LCO being applied for the situation when the plant is not operating within the acceptable region of the pressure vs. level curve? Generally, the standard technical specifications apply a 1-hour LCO when both trains of HPI are compromised. [The regulatory basis for this question is to establish the adequacy of the proposed allowed outage time associated with the proposed TS changes.]

<u>Response to Question No. 6</u>:

Being outside the unrestricted region of the MUT pressure vs. level limits curve in the proposed Figure 3.3-1 does not by itself compromise the HPI function. The MUT limits are based on a having a LOCA along with the occurrence of the most limiting single failure (failure of one of the MU-V-14 valves to open). With certain exceptions, T.S. 3.2.2 allows 72 hours to restore an ECCS train to operable if removed from service for maintenance. This time is based on the probability of the occurrence of an accident that would require the system and the probability of a single failure occurring in the operable train. Operating in the restricted portion of the MU tank pressure and level curve places the HPI system into a similar condition (an accident and most limiting single failure will cause the loss of function).

If MUT level and pressure were allowed to degrade sufficiently far into the restricted region, it could result in an initial condition where a loss of function could occur without the most limiting single failure. A four (4) hour AOT had been chosen to ensure that action would be taken promptly enough to recover MUT conditions in a timely fashion and preclude or greatly limit any operation in this region. An alternate approach would have been to establish two curves for analysis with and without assuming the most limiting single failure.

The required action time for operation outside of the "Unrestricted Operating Region" of Figure 3.3-1 has been revised from the original submittal of LCA No. 287 by providing two curves based on analysis with and without the most limiting single-failure. The two curves define three regions of the figure. Operation within the "Restricted Region" of Figure 3.3-1 assures that gas entrainment of the MU pumps will not occur without the occurrence the most limiting single failure, assuming no operator action. Inadvertent operation within the "Restricted Region" of Figure 3.3-1 requires that action be taken to restore MUT level and pressure to within the "Unrestricted Operating Region" within 72 hours or the shutdown provisions of T.S. 3.0.1 apply. A new curve has been added to Figure 3.3-1 to define a "Prohibited Region" where the HPI system function would not be maintained without operator action even without the occurrence of a single-failure. Operation within the "Prohibited Region" of Figure 3.3-1 is prohibited, requiring plant shutdown in accordance with T.S. 3.0.1.

The selected actions and times are within acceptable standards based on the low probability of occurrence of a LOCA during this period, the conservatism of the analysis used to generate these limits, the low likelihood of the most limiting single failure, alarms before exceeding the limits of T.S. Figure 3.3-1, and operating guidance to restore MUT level and pressure.

<u>NRC Question No. 7</u>:

The license amendment will allow the two redundant trains of the high pressure injection (HPI) system to be cross-connected. Cross-connecting the HPI system will transform the two separate and independent HPI trains to one train with redundant components. The loss of independence represents a reduction in a layer of defense-in-depth. The submittal states that the use of the cross-connection improves overall system reliability. However, operating experience indicates that a cross-connected system can be more vulnerable to common cause failures. Because the proposed cross-connection was not in your initial licensing basis, please evaluate the potential for common cause failure and provide a description of your evaluation to the staff. How much more (if any) is the system vulnerable to failure? Is the system more vulnerable to long-term passive failures? Can the system withstand a long-term passive failure? [The regulatory basis for this question is GDC 35 and the SRP which requires consideration of long term passive failures to demonstrate compliance with GDC 35.]

<u>Response to Question No. 7</u>:

As stated in the original Safety Evaluation dated July 11, 1973: "The Three Mile Island Unit 1 plant was designed and constructed to meet the intent of the AEC's General Design Criteria, as originally proposed in July 1967. The appropriate reference is TMI Unit 1 Updated FSAR Section 1.4.37 through 1.4.44. The licensing basis for TMI does not require consideration of a passive failure in the HPI system. Long term operation of HPI is only required as a result of an active failure in the short term. (Reference 14)

The reliability of HPI is improved by opening the suction cross connect valve between Makeup Pumps MU-P1B & MU-P1C. This assertion was evaluated using quantitative PRA techniques. The conclusion of the PRA is reasonable. The reliability of train "A" is improved. It was always subject to the potential problems associated with loss of control of MUT gas pressure. The reliability of train "A" is improved by having MU-V-14B as an optional HPI suction path.

The evaluation of the change in reliability of Train "B" shows an increase in reliability due to the elimination of potential active component failures and a decrease in reliability due to the probability of additional passive failures (initial conditions or pipe failures).

The probability of failure of HPI train "B" is improved by eliminating the reliance on operation of BWST suction valve MU-V-14B to protect the "B" train pump. The active failures are more of a threat and the overall reliability is improved by the change.

The following is a summary of the design changes and their effects on HPI reliability since the NRC Design Inspection (50-289/96-201), of late 1996 and early 1997:

1. MUT pressure and level limits analysis has been revised to include more limiting scenarios within the design basis (HPI line break vs. crack assuming a single failure), to correct errors associated with system resistance values, and to provide additional margin to account for potential MUT vortex formation.

2. The MU system valve lineup was changed to operate with MU-V-69A/B open.

3. The MU/HPI surveillance test procedures were revised to eliminate operation of MU-V-68A/B & MU-V-69A/B for system testing.

4. The surveillance program requirements were revised to incorporate the new instrument error analysis for MUT Level & Pressure instruments.

5. The MUT pressure instrument was added to the Appendix B calibration program.

6. Administrative controls were implemented to require two valve isolation of all gas sources to the MU tank.

7. Daily operability checks of MUT pressure indication were established (Reference 20).

8. This amendment application establishes Technical Specification limits for MUT pressure and level.

9. The Control Room overhead alarm limits were revised to alarm within the proposed MUT pressure and level limits.

10. The alarm response procedures were revised to incorporate actions to close the MUT isolation valve or shut down MU pumps if MUT level is very low.

The effects of the above changes has been evaluated based on the impact on HPI reliability. This evaluation shows that any decrease in HPI reliability due to the vulnerability of MU-P-1C to loss of control of MUT gas overpressure events is more than offset by increased HPI reliability resulting from the following:

1. A reduced potential for loss of control of MUT gas overpressure events resulting from:
   - multiple barriers (two valves) and strict administrative controls over MUT gas sources.

- improvements in MUT pressure & level instrumentation.
- nested alarm limits for MUT pressure & level (steady state alarm limits, abnormal alarm limits) within the proposed Technical Specification limits.
- The proposed Technical Specification limits for MUT pressure & level.
- Improved MUT analysis methodology and correction of previous errors.

2. The vulnerability of a MU pump (MU-P-1A/B/C) to a failure of either BWST suction valve (MU-V-14A or MU-V-14B) to open has been eliminated.

3. Periodic exposure of the MU suction piping to pressures in excess of design pressure has been eliminated. [Reference: LER 1997-03-01, "Potential Overpressurization Of Makeup Pump Suction Piping Due To Inadequate Test And Operating Procedures."]

4. The potential for Makeup pump (MU-P-1A/B/C) damage due to valve mis-positioning has been reduced.

5. Corrective actions have been added to the alarm response procedures for events beyond design basis.

6. The potential for voiding in the suction piping of a MU pump due to an isolated suction source has been eliminated.

Enclosure 2

TMI Unit 1 Technical Specification Revised Pages for LCA No. 287, Revision 1

LIST OF FIGURES

Amendment Nos. ~~11, 17, 29, 39, 45, 50, 59, 71, 106, 109, 120, 126, 134, 142, 150, 164, 167, 168, 184, 211~~

3.3 EMERGENCY CORE COOLING, REACTOR BUILDING EMERGENCY COOLING AND REACTOR BUILDING SPRAY SYSTEMS

Applicability
Applies to the operating status of the emergency core cooling, reactor building emergency cooling, and reactor building spray systems.

Objective
To define the conditions necessary to assure immediate availability of the emergency core cooling, reactor building emergency cooling and reactor building spray systems.

Specification

3.3.1 The reactor shall not be made critical unless the following conditions are met:

3.3.1.1 Injection Systems

a. The borated water storage tank (BWST) shall contain a minimum of 350,000 gallons of water having a minimum concentration of 2,500 ppm boron at a temperature not less than 40°F. If the boron concentration or water temperature is not within limits, restore the BWST to OPERABLE within 8 hrs. If the BWST volume is not within limits, restore the BWST to OPERABLE within one hour. Specification 3.0.1 applies.

b. Two Makeup and Purification (MU)/High Pressure Injection (HPI) pumps are OPERABLE in the engineered safeguards mode powered from independent essential buses. Specification 3.0.1 applies.

c. Two decay heat removal pumps are OPERABLE. Specification 3.0.1 applies.

d. Two decay heat removal coolers and their cooling water supplies are OPERABLE. (See Specification 3.3.1.4) Specification 3.0.1 applies.

e. Two BWST level instrument channels are OPERABLE.

f. The two reactor building sump isolation valves (DH-V-6A/B) shall be remote-manually OPERABLE.
Specification 3.0.1 applies

g. **MU Tank (MUT) pressure and level shall be maintained within the Unrestricted Operating Region of Figure 3.3-1.**
   1) **With MUT conditions outside of the Unrestricted Operating Region of Figure 3.3-1, restore MUT pressure and level to within the Unrestricted Operating Region within 72 hrs. Specification 3.0.1 applies.**
   2) **Operation with MUT conditions within the Prohibited Region of Figure 3.3-1 is prohibited. Specification 3.0.1 applies.**

3.3.1.2 Core Flooding System

a. Two core flooding tanks (CFTs) each containing 940 ±30 ft^3 of borated water at 600 ±25 psig shall be available. Specification 3.0.1 applies.

b. CFT boron concentration shall not be less than 2,270 ppm boron.

c. The electrically operated discharge valves from the CFT will be assured open by administrative control and position indication lamps on the engineered safeguards status panel. Respective breakers for these valves shall be open and conspicuously marked. A one hour time clock is provided to open the valve and remove power to the valve. Specification 3.0.1 applies.

d. One CFT pressure instrumentation channel and one CFT level instrumentation channel per tank shall be OPERABLE.

e. CFT vent valves CF-V-3A and CF-V-3B shall be closed and the breakers to the CFT vent valve motor operators shall be tagged open, except when adjusting core flood tank level and/or pressure. Specification 3.0.1 applies.

3.3.1.3 Reactor Building Spray System and Reactor Building Emergency Cooling System

The following components must be OPERABLE:

a. Two reactor building spray pumps and their associated spray nozzles headers and two reactor building emergency cooling fans and associated cooling units (one in each train). Specification 3.0.1 applies.

b. The sodium hydroxide (NaOH) tank shall be maintained at 8 ft. ±6 inches lower than the BWST level as measured by the BWST/NaOH tank differential pressure indicator. The NaOH tank concentration shall be 10.0 ±.5 weight percent (%). If the NaOH concentration is not within limits, restore to OPERABLE within 72 hours. If the BWST/NaOH tank level differential is not within limits, restore to OPERABLE within 72 hours.

c. All manual valves in the discharge lines of the NaOH tank shall be locked open.

3.3.1.4 Cooling Water Systems - Specification 3.0.1 applies.

a. Two nuclear service closed cycle cooling water pumps must be OPERABLE.

b. Two nuclear service river water pumps must be OPERABLE.

c. Two decay heat closed cycle cooling water pumps must be OPERABLE.

d. Two decay heat river water pumps must be OPERABLE.

e. Two reactor building emergency cooling river water pumps must be OPERABLE.

3.3.1.5 Engineered Safeguards Valves and Interlocks Associated with the Systems in Specifications 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.4 are OPERABLE. Specification 3.0.1 applies.

3.3 EMERGENCY CORE COOLING, REACTOR BUILDING EMERGENCY COOLING AND REACTOR BUILDING SPRAY SYSTEMS (Contd.)

3.3.2 Maintenance or testing shall be allowed during reactor operation on any component(s) in the makeup and purification, decay heat, RB emergency cooling water, RB spray, CFT pressure instrumentation, CFT level instrumentation, BWST level instrumentation, or cooling water systems which will not remove more than one train of each system from service. Components shall not be removed from service so that the affected system train is inoperable for more than 72 consecutive hours. If the system is not restored to meet the requirements of Specification 3.3.1 within 72 hours, the reactor shall be placed in a HOT SHUTDOWN condition within six hours.

3.3.3 Exceptions to 3.3.2 shall be as follows:

a. Both **CFTs** shall be **OPERABLE** at all times.

b. Both the motor operated valves associated with the **CFTs** shall be fully open at all times.

c. One reactor building cooling fan and associated cooling unit shall be permitted to be out-of-service for seven days.

3.3.4 Prior to initiating maintenance on any of the components, the duplicate (redundant) component shall be verified to be **OPERABLE**.

Bases

The requirements of Specification 3.3.1 assure that, before the reactor can be made critical, adequate engineered safety features are operable. Two engineered safeguards makeup pumps, two decay heat removal pumps and two decay heat removal coolers (along with their respective cooling water systems components) are specified. However, only one of each is necessary to supply emergency coolant to the reactor in the event of a loss-of-coolant accident. Both **CFTs** are required because a single **CFT** has insufficient inventory to reflood the core for hot and cold line breaks (Reference 1).

The operability of the borated water storage tank (BWST) as part of the ECCS ensures that a sufficient supply of borated water is available for injection by the ECCS in the event of a LOCA (Reference 2). The limits on BWST minimum volume and boron concentration ensure that 1) sufficient water is available within containment to permit recirculation cooling flow to the core, and 2) the reactor will remain at least one percent subcritical following a Loss-of-Coolant Accident (LOCA).

The contained water volume limit of 350,000 gallons includes an allowance for water not usable because of tank discharge location and sump recirculation switchover setpoint. The limits on contained water volume, NaOH concentration and boron concentration ensure a pH value of between 8.0 and 11.0 of the solution sprayed within containment after a design basis accident. The minimum pH of 8.0 assures that iodine will remain in solution while the maximum pH of 11.0 minimizes the potential for caustic damage to mechanical systems and components. Redundant heaters maintain the borated water supply at a temperature greater than 40°F.

Maintaining MUT pressure and level within the limits of Fig 3.3-1 ensures that MUT gas will not be drawn into the pumps. Preventing gas entrainment of the pumps is not

dependent upon operator actions after the event occurs. The plant operating limits (alarms and procedures) will include margins to account for instrument error.

The post-accident reactor building emergency cooling may be accomplished by three emergency cooling units, by two spray systems, or by a combination of one emergency cooling unit and one spray system. The specified requirements assure that the required post-accident components are available.

The iodine removal function of the reactor building spray system requires one spray pump and sodium hydroxide tank contents.

The spray system utilities common suction lines with the decay heat removal system. If a single train of equipment is removed from either system, the other train must be assured to be operable in each system.

When the reactor is critical, maintenance is allowed per Specification 3.3.2 and 3.3.3 provided requirements in Specification 3.3.4 are met which assure operability of the duplicate components. The specified maintenance times are a maximum. Operability of the specified components shall be based on the satisfactory completion of surveillance and inservice testing and inspection required by Technical Specification 4.2 and 4.5.

The allowable maintenance period of up to 72 hours may be utilized if the operability of equipment redundant to that removed from service is verified based on the results of surveillance and inservice testing and inspection required by Technical Specification 4.2 and 4.5.

In the event that the need for emergency core cooling should occur, operation of one makeup pump, one decay heat removal pump, and both core flood tanks will protect the core. In the event of a reactor coolant system rupture their operation will limit the peak clad temperature to less than 2,200 °F and the metal-water reaction to that representing less than 1 percent of the clad.

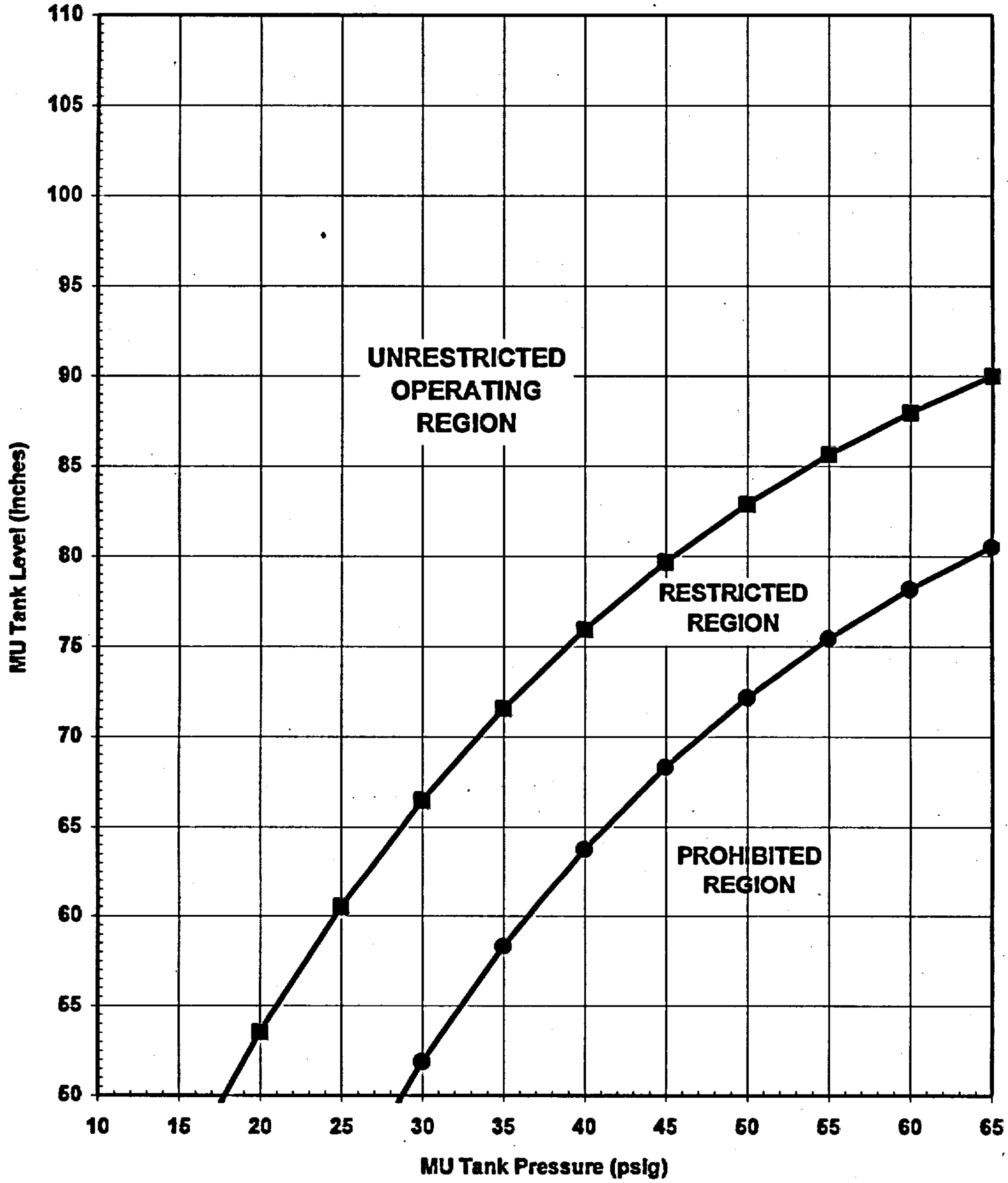
Two nuclear service river water pumps and two nuclear service closed cycle cooling pumps are required for normal operation. The normal operating requirements are greater than the emergency requirements following a loss-of-coolant.

REFERENCES

(1) UFSAR, Section 6.1 - "Emergency Core Cooling System"

(2) UFSAR, Section 14.2.2.3 - "Large Break LOCA"

FIGURE 3.3-1
Makeup Tank Pressure vs Level Limits
(Instrument Error NOT Included)



Amendment No.

TABLE 4.1-1 (Continued)

CHANNEL DESCRIPTION	CHECK	TEST	CALIBRATE	REMARKS
27. Makeup Tank Instrument Channels:				
a Level	D(1)	NA	R (1)	(1) When Makeup and Purification System is in operation.
b. Pressure	D(1)	NA	R	
28. Radiation Monitoring Systems*				
a. RM-G6 (FH Bridge #1 Aux)	W(1)(2)	M(2)	Q(2)	(1) Using the installed check source when background is less than twice the expected increase in cpm which would result from the check source alone. Background readings greater than this value are sufficient in themselves to show that the monitor is functioning.
b. RM-G7 (FH Bridge #2 Main)	W(1)(2)	M(2)	Q(2)	
c. RM-G9 (FH Bridge-FH Bldg)	W(1)(3)	M(3)	E(3)	
d. RM-A2P (RB Atmosphere particulate)	W(1)(4)	M(4)	E(4)	
e. RM-A2I (RB Atmosphere iodine)	W(1)(4)	M(4)	Q(4)	(2) RM-G6 and RM-G7 operability requirements are given in T.S. 3.8.1. Surveillances are be required to current only when handling irradiated fuel.
f. RM-A2G (RB Atmosphere gas)	W(1)(4)	M(4)	E(4)	
				(3) RM-G9 operability requirements are given in T.S. 3.8.1.
				(4) RM-A2 operability requirements are given in T.S. 3.1.6.8
29. High and Low Pressure Injection Systems: Flow Channels	N/A	N/A	R	

* Includes only monitors indicated under this item. Other T.S. required radiation monitors are included in specifications 3.5.5.2, 4.1:3, Table 3.5-1 item C.3.f, and Table 4.1-1 item 19e.

TABLE 4.1-1 (Continued)

CHANNEL DESCRIPTION	CHECK	TEST	CALIBRATE	REMARKS
30. Borated Water Storage Tank Level Indicator	W	NA	R	
31. Boric Acid Mix Tank:				
a. Level Channel	NA	NA	F	
b. Temperature Channel	M	NA	F	
32. Reclaimed Boric Acid Storage Tank:				
a. Level Channel	NA	NA	F	
b. Temperature Channel	M	NA	F	
33. Containment Temperature	NA	NA	F	
34. Incore Neutron Detectors	M(1)	NA	NA	(1) Check functioning: including function of computer readout or recorder readout when reactor power is greater than 15%.
35. Emergency Plant Radiation Instruments	M(1)	NA	F	(1) Battery Check.
36. (DELETED)				
37. Reactor Building Sump Level	NA	NA	R	

Enclosure 3

Hand Markup of the TMI Unit 1 Technical Specifications Revised Pages for License Change Application No. 287, Revision 1

LIST OF FIGURES

3.3 EMERGENCY CORE COOLING, REACTOR BUILDING EMERGENCY COOLING AND REACTOR BUILDING SPRAY SYSTEMS

Applicability
Applies to the operating status of the emergency core cooling, reactor building emergency cooling, and reactor building spray systems.

Objective
To define the conditions necessary to assure immediate availability of the emergency core cooling, reactor building emergency cooling and reactor building spray systems.

Specification

3.3.1 The reactor shall not be made critical unless the following conditions are met:

3.3.1.1 Injection Systems

a. The borated water storage tank (BWST) shall contain a minimum of 350,000 gallons of water having a minimum concentration of 2,500 ppm boron at a temperature not less than 40°F. If the boron concentration or water temperature is not within limits, restore the BWST to OPERABLE within 8 hrs. If the BWST volume is not within limits, restore the BWST to OPERABLE within one hour. Specification 3.0.1 applies.

b. Two ~~makeup~~ makeup and purification (MU)/High Pressure Injection (HPI) pumps are ~~operable~~ OPERABLE in the engineered safeguards mode powered from independent essential buses. Specification 3.0.1 applies.

c. Two decay heat removal pumps are ~~operable~~ OPERABLE. Specification 3.0.1 applies.

d. Two decay heat removal coolers and their cooling water supplies are ~~operable~~ OPERABLE (See Specification 3.3.1.4) Specification 3.0.1 applies.

e. Two BWST level instrument channels are ~~operable~~ OPERABLE.

f. The two reactor building sump isolation valves (DH-V6A/B) shall be remote-manually ~~operable~~ OPERABLE. Specification 3.0.1 applies.

g. See Insert Next Page

3.3.1.2 Core Flooding System

a. Two core flooding tanks (CFTs) each containing 940 ± 30 ft³ of borated water at 600 ± 25 psig shall be available. Specification 3.0.1 applies.

b. ~~Core flooding tank~~ CFT boron concentration shall not be less than 2,270 ppm boron.

c. The electrically operated discharge valves from the ~~core flood tank~~ CFT will be assured open by administrative control and position indication lamps on the engineered safeguards status panel. Respective breakers for these valves shall be open and conspicuously marked. A one hour time clock is provided to open the valve and remove power to the valve. Specification 3.0.1 applies.

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MU Tank (MUT) pressure and level shall be maintained within the Unrestricted Operating Region of Figure 3.3-1.

1) **With MUT conditions outside of the Unrestricted Operating Region of Figure 3.3-1, restore MUT pressure and level to within the Unrestricted Operating Region within 72 hrs. Specification 3.0.1 applies.**
2) **Operation with MUT conditions within the Prohibited Region of Figure 3.3-1 is prohibited. Specification 3.0.1 applies.**

d. One ~~core flood tank~~ CFT pressure instrumentation channel and ~~one core flood tank~~ CFT level instrumentation channel per tank shall be ~~operable~~ OPERABLE.

e. ~~Core flood tank (CFT)~~ vent valves CF-V3A and CF-V3B shall be closed and the breakers to the CFT vent valve motor operators shall be tagged open, except when adjusting core flood tank level and/or pressure. Specification 3.0.1 applies.

3.3.1.3 Reactor Building Spray System and Reactor Building Emergency Cooling System

The following components must be OPERABLE:

a. Two reactor building spray pumps and their associated spray nozzles headers and two reactor building emergency cooling fans and associated cooling units (one in each train). Specification 3.0.1 applies.

b. The sodium hydroxide (NaOH) tank shall be maintained at 8 ft. ±6 inches lower than the BWST level as measured by the BWST/NaOH tank differential pressure indicator. The NaOH tank concentration shall be 10.0±.5 weight percent (%). If the NaOH concentration is not within limits, restore to OPERABLE within 72 hours. If the BWST/NaOH tank level differential is not within limits, restore to OPERABLE within 72 hours.

c. All manual valves in the discharge lines of the ~~sodium hydroxide~~ NaOH tank shall be locked open.

3.3.1.4 Cooling Water Systems - Specification 3.0.1 applies.

a. Two nuclear service closed cycle cooling water pumps must be OPERABLE.

b. Two nuclear service river water pumps must be OPERABLE.

c. Two decay heat closed cycle cooling water pumps must be OPERABLE.

d. Two decay heat river water pumps must be OPERABLE.

e. Two reactor building emergency cooling river water pumps must be OPERABLE.

3.3.1.5 Engineered Safeguards Valves and Interlocks Associated with the Systems in Specifications 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.4 are OPERABLE. Specification 3.0.1 applies.

3.3.2 Maintenance or testing shall be allowed during reactor operation on any component(s) in the makeup and purification, decay heat, RB emergency cooling water, RB spray, CFT pressure instrumentation, CFT level instrumentation, BWST level instrumentation, or cooling water systems which will not remove more than one train of each system from service. Components shall not be removed from service so that the affected system train is inoperable for more than 72 consecutive hours. If the system is not restored to meet the requirements of Specification 3.3.1 within 72 hours, the reactor shall be placed in a HOT SHUTDOWN condition within six hours.

3.3.3 Exceptions to 3.3.2 shall be as follows:

a. Both ~~core flood tanks~~ CFTs shall be ~~operable~~ OPERABLE at all times.

b. Both the motor operated valves associated with the ~~core flood tanks~~ CFTs shall be fully open at all times.

c. One reactor building cooling fan and associated cooling unit shall be permitted to be out-of-service for seven days.

3.3.4 Prior to initiating maintenance on any of the components, the duplicate (redundant) component shall be verified to be ~~operable~~ OPERABLE.

Bases

The requirements of Specification 3.3.1 assure that, before the reactor can be made critical, adequate engineered safety features are operable. Two engineered safeguards makeup pumps, two decay heat removal pumps and two decay heat removal coolers (along with their respective cooling water systems components) are specified. However, only one of each is necessary to supply emergency coolant to the reactor in the event of a loss-of-coolant accident. Both ~~core flooding tanks~~ CFTs are required because a single ~~core flooding tank~~ CFT has insufficient inventory to reflood the core for hot and cold line breaks (Reference 1).

The operability of the borated water storage tank (BWST) as part of the ECCS ensures that a sufficient supply of borated water is available for injection by the ECCS in the event of a LOCA (Reference 2). The limits on BWST minimum volume and boron concentration ensure that 1) sufficient water is available within containment to permit recirculation cooling flow to the core, and 2) the reactor will remain at least one percent subcritical following a Loss-of-Coolant Accident (LOCA).

The contained water volume limit of 350,000 gallons includes an allowance for water not usable because of tank discharge location and sump recirculation switchover setpoint. The limits on contained water volume, NaOH concentration and boron concentration ensure a pH value of between 8.0 and 11.0 of the solution sprayed within containment after a design basis accident. The minimum pH of 8.0 assures that iodine will remain in solution while the maximum pH of 11.0 minimizes the potential for caustic damage to mechanical systems and components. Redundant heaters maintain the borated water supply at a temperature greater than 40°F.

see Insert Next page

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Maintaining MUT pressure and level within the limits of Fig 3.3-1 ensures that MUT gas will not be drawn into the pumps for any design basis accident. Preventing gas entrainment of the pumps is not dependent upon operator actions after the event occurs. The plant operating limits (alarms and procedures) will include margins to account for instrument error.

Bases (cont'd.) CONTROLLED COPY

The post-accident reactor building emergency cooling may be accomplished by three emergency cooling units, by two spray systems, or by a combination of one emergency cooling unit and one spray system. The specified requirements assure that the required post-accident components are available.

The iodine removal function of the reactor building spray system requires one spray pump and sodium hydroxide tank contents.

The spray system utilities common suction lines with the decay heat removal system. If a single train of equipment is removed from either system, the other train must be assured to be operable in each system.

When the reactor is critical, maintenance is allowed per Specification 3.3.2 and 3.3.3 provided requirements in Specification 3.3.4 are met which assure operability of the duplicate components. The specified maintenance times are a maximum. Operability of the specified components shall be based on the satisfactory completion of surveillance and inservice testing and inspection required by Technical Specification 4.2 and 4.5.

The allowable maintenance period of up to 72 hours may be utilized if the operability of equipment redundant to that removed from service is verified based on the results of surveillance and inservice testing and inspection required by Technical Specification 4.2 and 4.5.

In the event that the need for emergency core cooling should occur, operation of one makeup pump, one decay heat removal pump, and both core flood tanks will protect the core. In the event of a reactor coolant system rupture their operation will limit the peak clad temperature to less than 2,200°F and the metal-water reaction to that representing less than 1 percent of the clad.

Two nuclear service river water pumps and two nuclear service closed cycle cooling pumps are required for normal operation. The normal operating requirements are greater than the emergency requirements following a loss-of-coolant.

REFERENCES

(1) UFSAR, Section 6.1 - "Emergency Core Cooling System"

(2) UFSAR, Section 14.2.2.3 - "Large Break LOCA"

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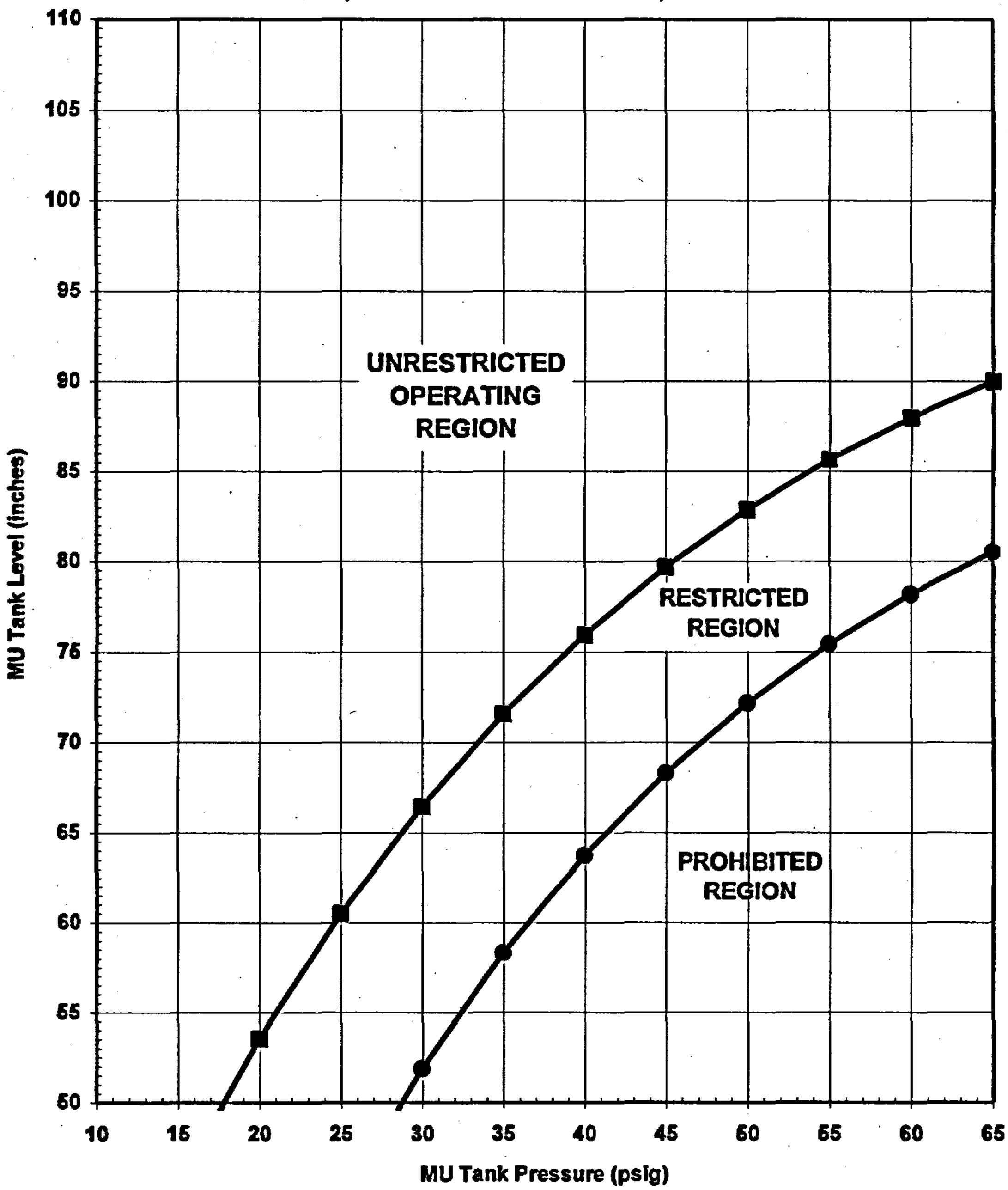
FIGURE 3.3-1
Makeup Tank Pressure vs Level Limits
(Instrument Error NOT Included)



Amendment No.

TABLE 4.1-1 (Continued)

CHANNEL DESCRIPTION	CHECK	TEST	CALIBRATE
27. Makeup Tank Instrument Channels:			
a. Level	D(1)	NA	R
b. Pressure	D(1)	NA	R
28. Radiation Monitoring Systems*			
a. RM-G6 (FH Bridge #1 Aux)	W(1)(2)	M(2)	Q(2)
b. RM-G7 (FH Bridge #2 Main)	W(1)(2)	M(2)	Q(2)
c. RM-G9 (FH Bridge-FH Bldg)	W(1)(3)	M(3)	E(3)
d. RM-A2P (RB Atmosphere particulate)	W(1)(4)	M(4)	E(4)
e. RM-A2I (RB Atmosphere iodine)	W(1)(4)	M(4)	Q(4)
f. RM-A2G (RB Atmosphere gas)	W(1)(4)	M(4)	E(4)
29. High and Low Pressure Injection Systems: Flow Channels	N/A	N/A	R

REMARKS

Item 27:

(1) When Makeup and Purification System is in operation.

Item 28:

(1) Using the installed check source when background is less than twice the expected increase in cpm which would result from the check source alone. Background readings greater than this value are sufficient in themselves to show that the monitor is functioning.

(2) RM-G6 and RM-G7 operability requirements are given in T.S. 3.8.1. Surveillances are required to be current only when handling irradiated fuel.

(3) RM-G9 operability requirements are given in T.S. 3.8.1.

(4) RM-A2 operability requirements are given in T.S. 3.1.6.8

*Includes only monitors indicated under this item. Other T.S. required radiation monitors are included in specifications 3.5.5.2, 4.1.3, Table 3.5-1 item C.3.f, and Table 4.1-1 item 19e.

TABLE 4.1-1 (Continued)

	CHANNEL DESCRIPTION	CHECK	TEST	CALIBRATE	REMARKS
30.	Borated Water Storage Tank Level Indicator	W	NA	~~F~~ R	
31.	Boric Acid Mix Tank				
	a. Level Channel	NA	NA	F	
	b. Temperature Channel	M	NA	F	
32.	Reclaimed Boric Acid Storage Tank				
	a. Level Channel	NA	NA	F	
	b. Temperature Channel	M	NA	F	
33.	Containment Temperature	NA	NA	F	
34.	Incore Neutron Detectors	M(1)	NA	NA	(1) Check functioning; including functioning of computer readout or recorder readout when reactor power is greater than 15%.
35.	Emergency Plant Radiation Instruments	M(1)	NA	F	(1) Battery check.
36.	(DELETED)				
37.	Reactor Building Sump Level	NA	NA	R	