Entergy

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Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360

February 3, 2010

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

SUBJECT: Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
Docket No.: 50-293
License No.: DPR-35

Request for Exemption from 10 CFR 50 Appendix R Section III.L.2.b, Performance Goal for Satisfying the Reactor Coolant Make-up Function

Reference:
(1) NRC Regulatory Issue Summary (RIS) 2006-10, "Regulatory Expectations with Appendix R Paragraph III.G.2 Operator Manual Actions," June 30, 2006
(2) Entergy Letter, "Request for Exemption from 10 CFR 50 Appendix R Section III.G.2 to allow Hot Shutdown Manual Operator Actions," dated March 6, 2009.
(3) Entergy Letter, "Response To NRC RAI For Exemption To Allow Hot Shutdown Manual Actions At Pilgrim Nuclear Power Station (TAC NO. ME831)," dated December 8, 2009.

LETTER NUMBER: 2.10.011

Dear Sir or Madam:

In accordance with the provisions of 10 CFR Part 50.12, Pilgrim Nuclear Power Station (Entergy) hereby requests an exemption from certain provisions of 10 CFR Part 50.48, Appendix R to Part 50.48, Section III.L "Alternative and dedicated shutdown capability." Specifically, an exemption from paragraph III.L.2.b is requested to permit the use of our Automatic Depressurization System (ADS) safety relief valves (SRVs) in conjunction with either the Core Spray (CS) System or Residual Heat Removal (RHR) System in the Low Pressure Coolant Injection (LPCI) mode to achieve and maintain safe shutdown for fires in certain fire areas and fire zones. Reliance on the manual operation of ADS and low pressure systems may result in short term core uncovery which does not meet the III.L.2.b requirement for ensuring that the reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for Boiling Water Reactors (BWRs).

This exemption is necessary based on a re-examination of Appendix R compliance strategies resulting from NRC guidance identified in Regulatory Information Summary (RIS) 2006-10 (Reference 1), Regulatory Guide (RG) 1.189 R2, and our pending exemption request documented in Entergy Letter dated March 6, 2009, (Reference 2), as revised by Entergy Letter dated December 8, 2009 (Reference 3).

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This letter submits Entergy's request for exemption in accordance with 50.12(a)(2)(ii) which states, "application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

This letter contains no new commitments.

Please do not hesitate to contact Mr. Joseph R. Lynch, (508) 830-8403, if there are any questions regarding this submittal.

Sincerely,

Joseph R. Lynch
Licensing Manager

FXM
Enclosure

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Enclosure 1 to Entergy Pilgrim Letter 02.10.011

Request for Exemption from 10 CFR 50, Appendix R, Section III.L.2.b for allowing reactor water level to drop below the Top of Active Fuel (TAF)

20 Total pages

Request for Exemption from 10 CFR 50 Appendix R Section III.L.2.b for allowing reactor water level to drop below the Top of Active Fuel (TAF)

1.0 EXEMPTION REQUESTED

In accordance with the provisions of 10 CFR Part 50.12, Pilgrim Nuclear Power Station (PNPS) hereby requests an exemption from certain provisions of 10 CFR Part 50.48, Appendix R to Part 50.48, Section III.L "Alternative and dedicated shutdown capability." Specifically an exemption from paragraph III.L.2.b is requested to permit the use of our Automatic Depressurization System (ADS) safety relief valves (SRVs) in conjunction with either the Core Spray (CS) System or Residual Heat Removal (RHR) System in the Low Pressure Coolant Injection (LPCI) mode to achieve and maintain safe shutdown for fires in certain fire areas and fire zones. Reliance on the manual operation of ADS and low pressure injection systems may result in short term core uncovery which does not meet the III.L.2.b requirement for ensuring that the reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for Boiling Water Reactors (BWRs).

2.0 BACKGROUND

The initial PNPS response to 10 CFR 50, Appendix R was submitted for NRC review in 1982 (Reference 1). This submittal enclosed our initial Appendix R analysis report which identified the systems and support systems that would be utilized to accomplish safe shutdown in the event of fire in any plant area. This report identified methods and assumptions used in the safe shutdown analysis as well as a detailed fire zone summary for each fire zone. The fire zone summary identified fire hazards and fire protection features for each fire zone.

The initial Appendix R analysis report also identified the primary systems relied on for safe shutdown. These systems included the Automatic Depressurization (ADS) System, the High Pressure Coolant Injection (HPCI) System, the Reactor Core Isolation Cooling (RCIC) System, and the Residual Heat Removal (RHR) System. HPCI and RCIC were identified as systems which would be relied on for reactor coolant inventory control. As an alternative to the use of the high pressure HPCI and RCIC Systems, reactor depressurization via manual operation of the ADS valves and use of the low pressure injection systems (Core Spray or RHR-LPCI) was identified.

The initial Appendix R analysis report identified seventeen (17) of sixty-nine (69) fire zones did not comply with Section III.G.2 compliance. The report proposed specific modifications and/or procedure actions (i.e, operator manual actions outside the Control Room) to resolve the identified non-compliance issues. These fire zones were identified based on lack of cable separation between redundant safe shutdown systems. The availability or unavailability of high pressure systems used for reactor coolant injection was not used as a basis to identify III.G.2 compliance or non-compliance.

NRC review of the initial Appendix R analysis report resulted in issuance of a safety evaluation in 1983 (Reference 2). This safety evaluation approved the conceptual design for the proposed modifications and/or procedure actions applicable to the 17 fire zones identified as not meeting III.G.2 requirements. This safety evaluation also identified that the use of low pressure systems in conjunction with ADS for reactor inventory control was acceptable for use to demonstrate safe shutdown capability.

Due to subsequent industry concerns and the fact that the safety evaluation was issued for approving the proposed design for III.G.3 and III.L, it is not clear if the NRC intended to approve the use of procedure actions or the use ADS and low pressure injection systems for III.G.2 compliance.

With respect to procedure actions (i.e., operator manual actions (OMAs) outside the Control Room to support Hot shutdown), the NRC issued RIS 2006-10 (Reference 3) which clearly indicated that OMAs are not allowed to demonstrate III.G.2 compliance, unless an exemption is requested and approved. In response to RIS 2006-10 instructions, PNPS submitted an exemption (Reference 4) from III.G.2 requirements to address the previously approved OMAs for specific fire zones. PNPS has subsequently revised the exemption (Reference 5) based on NRC information requests and recently issued NRC guidance contaned in RG 1.189, R2 (Reference 6). This exemption is still under review.

With respect to III.G.2 compliance and use of ADS and low pressure injection systems for reactor inventory control, NRC and industry concerns were reviewed subsequent to the 1983 safety evaluation. In 1999, the BWR Owners Group submitted information to the NRC which demonstrated that one train of ADS and low pressure injection systems is adequate to demonstrate redundant safe shutdown capability (i.e., acceptable for III.G.2 compliance). NRC review of these submittals is documented in NRC Letter dated December 12, 2000 (Reference 7).

Based on NRC review, use of ADS and low pressure systems is acceptable as "redundant" safe shutdown systems under Appendix R and therefore, may be used to demonstrate III.G.2 compliance. This information is also reflected in RG 1.189 R2 which was issued in October 2009. As a result, Appendix R III.L requirements do not apply to areas that comply with III.G.2 and no III.L.2.b exemption is needed for III.G.2 areas that rely on ADS and low pressure injection systems.

The following exemption request applies to the specific the fire zones that credit Alternative Shutdown (i.e., III.G.3 and III.L compliance) and also rely on ADS and low pressure injection systems for reactor inventory control. The focus of this exemption is to obtain an exemption from 10 CFR 50, Appendix R, Section III.L.2.b for maintaining reactor coolant above the top of active fuel (TAF).

3.0 EXEMPTION BASES

3.1 Plant Specific Analysis of using ADS and Low Pressure Injection Systems

Prior to the NRC's review and acceptance of using ADS and low pressure injection systems for post fire safe shutdown in 2000 (Reference 7), PNPS contracted General Electric to perform a plant specific analysis of a post fire safe shutdown event where ADS and low pressure injection systems are relied on to demonstrate safe shutdown capability. This analysis (Reference 8) modeled a postulated Appendix R event where offsite power was lost; HPCI and RCIC systems were not available; two SRVs are manually operated to depressurize the reactor; and one train of low pressure systems (either CS or RHR) used for reactor injection. After reactor inventory is recovered one train of RHR (one pump) is operated in the suppression pool cooling mode.

Key assumptions and initial conditions included the following:

1. The reactor is operating at full operating power at normal water level at the start of the event.
2. The reactor is scrammed either from a loss of off-site power (LOOP) or from manual initiation from the Control Room.
3. MSIVs begin to close at event initiation either as a result of LOOP or due to manual closure.
4. Feedwater flow will ramp to zero within 5 seconds after event initiation.
5. The 1979 American Nuclear Society (ANS) decay heat correlation is used to realistically model decay heat.
6. The initial temperature of the suppression pool is 80 degrees F and containment pressure is 14.7 psia.
7. Water level in the suppression pool is the lowest level allowed by Technical Specifications.
8. The suppression pool air space is pressure is in equilibrium with the drywell pressure.
9. The suppression pool and the drywell are conservatively assumed to be insulated volumes.
10. No HPCI or RCIC is available during the event.
11. The Core Spray System for core cooling is available after reactor depressurization.
12. The RHR System for suppression pool cooling is assumed available at one hour after event initiation in the initial analysis. Suppression pool analysis is also performed for an RHR pump initiation time of two hours.

The acceptance criteria used in evaluating this fire event include criteria for fuel cladding integrity, and for suppression pool integrity.

The reactor level response provides a good indication whether fuel damage (fuel cladding perforation) is expected. If the core remains covered, no fuel cladding damage would occur. If the top portion of the core is uncovered for a brief period, the combination of low power level for this portion of the fuel and the steam updraft cooling will prevent any significant heat up or fuel cladding damage. To ensure the fuel cladding integrity, the calculated peak cladding temperature (PCT) should be less than the temperature (approximately 1500 degrees F) at which cladding damage can occur.

To judge the acceptability of the suppression pool response three criteria were used:

1. Temperature and pressure in the pool should remain below the design conditions of 281 F and 56 psig.
2. The suppression pool temperature should remain below the Heat Capacity Temperature Limit (HCTL) for the pool while the reactor vessel is pressurized.
3. Adequate NPSH to the low pressure pump should be available in order to prevent possible pump cavitation. A suppression pool temperature of approximately 190 F for the RHR pump and a temperature of approximately 185 F at atmospheric pressure will provide adequate NPSH for the CS pump.

Analysis results identified the following:

The indicated water level remained above the top of the core for approximately 24 minutes at which time the reactor vessel is depressurized (the actual water level remained above the TAF until 27 minutes). When the reactor is depressurized to the operating pressure of the core spray pump, the pump operated to maintain reactor inventory. When reactor inventory was sufficiently recovered, the operator started the RHR System to provide suppression pool cooling. During the depressurization, some core uncovery was expected. This core uncovery resulted in a PCT of approximately 1320 F which is below the temperature at which cladding perforations can occur. Therefore, the postulated fire event will not cause fuel cladding damage.

The suppression pool response to the event was also evaluated. The pool temperature before reactor depressurization (after 24 minutes) was about 106 F and the pool pressure was about 2 psig. The pool temperature was well below the HCTL for the corresponding reactor pressure. Utilizing the RHR system to provide suppression pool cooling after reactor depressurization, the maximum pool temperature and pressure are expected to remain below 180 F and 11 psig, respectively. Further, this combination of pool temperature and pressure is below the design limits, and will provide adequate NPSH to assure the operation of the RHR and Core Spray pumps for coolant injection. Therefore, the requirements identified for the suppression pool are satisfied.

The analysis concluded that the PCT is low enough to ensure fuel cladding integrity; that adequate margin to assure containment and suppression pool integrity for initial pool temperatures up to 100 F and the initiation of the RHR pump at up to two hours; and that available NPSH will maintain an adequate margin above required NPSH for the core spray and RHR pumps.

This analysis is the analysis of record and defines the acceptance criteria for the Appendix R fire event. This analysis is included as Attachment 2 to Enclosure 1. Subsequent plant changes involving an increased ultimate heat sink temperatures were evaluated (Reference 9) to ensure Appendix R acceptance criteria were satisfied.

3.2 Alternative Shutdown Zones that Credit ADS and Low Pressure Injection Systems:

The following fire zones require an exemption from 10 CFR 50, Appendix R Section III.L.2.b.

Fire Area 1.9 Reactor Building Zones
Zone 1.1 Reactor Building, El. -17'6", RHR and Core Spray Pumps Room "A"
Zone 1.6 Reactor Building, El. -17'6", CRD Pump Room
Zone 1.8 Reactor Building, El. 2'9", CRD Pump Room Mezzanine
Zone 1.9* Reactor Building, El. 23'0", CRD Modules Area - east
Zone 1.11* Reactor Building, El. 51'0", Open Area - east half
Zone 1.14 Reactor Building, El. 74'3", Open Area - north half and south half Zone 1.13 all zones above
Zone 1.32 Reactor Building, El. 23'0", Steam Tunnel

Fire Area 1.9 Turbine Building Zones – Stairwell Area 2.16
Zone 2.16* Radwaste and Control Building, Stairway #8, El. -1'0" to 37'0", Stairwell

Fire Area 1.9 Turbine Building Zones - Vital MG Set Area 3.5
Zone 3.5* Radwaste and Control Building, El. 23'0", Vital Motor Generator Set Room

Fire Area 1.10 Reactor Building Zones
Zone 1.2 Reactor Building, El. -17'6", RHR and Core Spray Pumps Room "B"
Zone 1.3 Reactor Building, El. -17'6", HPCI Pump Room
Zone 1.4 Reactor Building, El. -17'6", HPCI Pump Panel and Valve Room
Zone 1.5 Reactor Building, El. -17'6", RCIC Pump Room
Zone 1.7 Reactor Building, El. 2'9", RCIC Pump Room Mezzanine
Zone 1.10* Reactor Building, El. 23'0", CRD Modules Area - west
Zone 1.12* Reactor Building, El. 51'0", Open Area - west half
Zone 1.30A* Reactor Building, El. -17'6", Torus Compartment

The plant fire zones listed above are zones that either directly rely on OMAs (annotated with (*) or are located in Reactor Building locations in close proximity to the zones that rely on OMAs. With respect to the fire zones in the Reactor Building that are adjacent to zones the require OMAs, these zones utilize the same shutdown systems and follow the same safe shutdown procedures (References 10 and 11). However, theses zones are separate from the alternative shutdown room or zone under consideration per Generic Letter 86-10 (Reference 12) Enclosure 2, Question 3.1.5 and do not require the same level of fire protection as that defined in III.G.3.

3.3 Previously Approved Appendix R Exemptions in Applicable Fire Zones

Due to the fact that the above referenced plant fire zones may be redefined as part of this exemption request to be Alternate Shutdown (III.G.3 and III.L) zones, Appendix R Section III.G.3 requirements for providing fire detection and fixed suppression must be satisfied or an exemption needs to be requested to justify the adequacy of fire protection features provided.

Table 1 provides a compliance summary for each fire zone that requires the III.L.2.b exemption. References to the approved / pending fire protection exemptions are identified. It must be noted that some Reactor Building fire zones are located in the same fire area as the fire zones that require OMAs and can not be evaluated to be separated by fire hazards analysis. These zones utilize the same train of safe shutdown systems and rely on the same safe shutdown procedures to accomplish shutdown and will therefore also require exemption from III.L.2.b. However, these fire zones do not contain redundant safe shutdown cables, do not require OMAs, and may only be of consequence if fire starts and spreads to the adjacent zone where OMAs are required. Therefore, consistent with GL 86-10, Enclosure 2, Question 3.1.5, alternate shutdown is provided on the basis of rooms or zones and the provision of fire detection and fixed suppression is only required in the room or zone under consideration (i.e., the zone requiring the OMAs).

The approved Appendix R exemptions applicable to the zones identified in Section 3.2 above, are identified and summarized below. The exemption summaries identify the purpose of the exemption and provide reference to submittal and approval letters. Attached figures 1, 2, 3, 4, and 5 depict the Reactor Building floor elevations and applicable fire zone layouts.

These exemptions and the 1983 safety evaluation were utilized as the basis to implement the existing plant safe shutdown program. As such, the current safe shutdown program (shutdown procedures and fire protection features) are ensured to be consistent with the bases and analysis identified the approved exemptions. On-going reviews are performed to ensure fire protection program features are not adversely affected by the proposed plant changes.

In most instances, the approved exemptions address the adequacy of existing fire protection features (i.e., detection, suppression, and barriers) to satisfy Appendix R requirements. These exemptions do not justify the adequacy of primary safe shutdown systems (e.g., HPCI, RCIC ADS, CS, and RHR) to meet system performance goals applicable to Appendix R Section III.L (i.e, maintain reactor level above the top of the core when ADS and low pressure injection systems are used). Therefore, the previously approved exemptions are not affected by this new III.L.2.b exemption request.

Exemption #1B – Control Room Suppression and Detection

PNPS requested an exemption from providing full area suppression in the Control Room. The area does not meet Appendix R requirements because it is an Alternate Shutdown area and Appendix R Section III.G.3 requires fire detection and fixed fire suppression to be installed in the area, room, or zone under consideration. Fire detection is provided in specific panels.

Submittal/Approval Documents:
PNPS Letter 2.81.059, dated 3/18/81
NRC SER (Letter 1.81.336) dated 11/10/81

Exemption #5 – Torus Area Summary

PNPS requested an exemption from providing an automatic suppression system and a fire detection system in the Torus Area. The area does not meet Appendix R requirements because automatic suppression and detection systems are not provided and redundant trains of torus temperature and level indication are in the area.

Submittal/Approval Documents:
PNPS Letter 2.83.130, dated 5/17/83
PNPS Letter 2.84.049, dated 4/02/84
NRC SER (Letter 1.85.191) dated 6/10/85

Exemption #7 and #8 – Reactor Building 23' and 51' Water Curtains

PNPS requested an exemption from the requirement of providing full area suppression on the 23' and 51' elevations of the Reactor Building and from the requirement of having 20 feet of separation with no intervening combustibles or fire hazards. A water curtain was installed in the open area separating Fire Zones 1.9 from 1.10 and 1.11 from 1.12 to establish an east-west separation zone between redundant safe shutdown systems.

Submittal / Approval Documents:
PNPS Letter 2.83.130, dated 5/17/83
PNPS Letter 2.84.049, dated 4/2/84
PNPS Letter 2.86.084, dated 6/17/86
PNPS Letter 2.86-009, dated 2/3/86
NRC SER (Letter 1.84.379) dated 12/18/84
NRC SER (Letter 1.85.191) dated 6/10/85
NRC letter (1.86.282) dated 8/19/86

Exemption #9 - Lack of Suppression in Zones 1.9, 1.10, 1.11, 1.12, and 3.5

PNPS requested an exemption from the Appendix R Section III.G requirement to have a fixed suppression system in areas which credit or rely on Alternate Shutdown capability. The following fire zones were specifically identified:

Fire Zone 1.9 - East Side Reactor Building, EL 23 ft.
Fire Zone 1.10 - West Side Reactor Building, EL 23 ft.
Fire Zone 1.11 - East Side Reactor Building, EL 51 ft.
Fire Zone 1.12 - West Side Reactor Building, EL 51 ft.
Fire Zone 3.5 - Vital M.G. Set Room, EL 23 ft.

Submittal / Approval Documents:
PNPS Letter 2.83.130, dated 5/17/83
PNPS Letter 2.85.049, dated 3/20/85
NRC SER (Letter 1.85.191) dated 6/10/85

Exemption #11- Torus to NE Quad Fire Barrier

PNPS requested an exemption from the requirement to provide a three-hour rated fire barrier between the Torus Area (FZ 1.30A) and the Northeast Quadrant of the Reactor Building below the 23-ft. floor elevation (FZ 1.6 and 1.8). Fire Zone 1.30A is associated with Appendix R Fire Area 1.10. Fire Zones 1.6 and 1.8 are associated with Appendix R Fire Area 1.9.

Submittal / Approval Documents:
PNPS Letter 2.83.281, dated 11/16/83
PNPS Letter 2.86.110, dated 7/28/86
PNPS Letter 2.86.176, dated 11/14/86
NRC SER (Letter 1.88.254) dated 7/14/88

Exemption #12 - Torus to SE Quad Fire Barrier

PNPS requested an exemption from the requirement to provide a three-hour rated fire barrier between the Torus Area (Fire Zone 1.30A) and the Southeast Quadrant of the Reactor Building below the 23-ft. Floor elevation (Fire Zone 1.1). Fire Zone 1.30A is associated with Appendix R Fire Area 1.10. Fire Zone 1.1 is associated with Appendix R Fire Area 1.9.

Submittal / Approval Documents:
PNPS Letter 2.83.281, dated 11/16/83
PNPS Letter 2.86.110, dated 7/28/86
NRC SER (Letter 1.88.254) dated 7/14/88

#13 - Structural Steel in Torus Area

PNPS requested an exemption from the requirement to provide fire protection to structural steel members supporting the fire barrier that separates the Torus Area (Fire Zone 1.30A) from Reactor Building locations on the 23' floor elevation (Fire Zones 1.9, 1.9A, 1.10, 1.10A, 1.10B, 1.25, and 1.32). Fire Zones 1.30A, 1.10, 1.10A and 1.10B are associated with Appendix R Fire Area 1.10. Fire Zones 1.9, 1.9A, 1.25, and 1.32 are associated with Appendix R Fire Area 1.9.

Submittal / Approval Documents:
PNPS Letter 2.83.281, dated 11/16/83
PNPS Letter 2.86.110, dated 7/28/86
PNPS Letter 2.86.176, dated 11/14/86
PNPS Letter 2.87.062, dated 4/21/87
PNPS Letter 2.87.132, dated 8/4/87
PNPS Letter 2.88.010, dated 1/19/88
NRC SER (Letter 1.88.254) dated 7/14/88

Exemption #14 - Structural Steel in Main Steam Tunnel

PNPS requested an exemption from the requirement to provide fire protection to structural steel members supporting the ceiling fire barrier that separates the Main Steam Tunnel (Fire Zone 1.32) from Reactor Building and Turbine Building locations on

the 51' floor elevation (Fire Zones 1.11, 1.12, 1.23A and 1.23B). Fire Zone 1.32 and 1.11 are associated with Appendix R Fire Area 1.9. Fire Zones 1.12, 1.23A and 1.23B are associated with Appendix R Fire Area 1.10.

Submittal / Approval Documents:
PNPS Letter 2.83.281, dated 11/16/83
PNPS Letter 2.86.110, dated 7/28/86
PNPS Letter 2.88.010, dated 1/19/88
NRC SER (Letter 1.88.254) dated 7/14/88

Exemption #15 - Radwaste/ Control Building Corridor at the (-) 1' Elev

PNPS requested an exemption from the requirement to install full area fire detection and automatic suppression in the Radwaste and Control Building between Corridor #137 on elevation 23 feet and Corridor #49 on elevation (-) 1 foot. These plant areas contain redundant Division A and B safe shutdown power cables. Corridor #137 is located in Fire Zone 3.9A and Fire Zone 3.9A is associated with Fire Area 3.3. Corridor #49 is located in Fire Zone 3.7 and Fire Zone 3.7 is associated with Fire Area 1.10.

Submittal / Approval Documents:
PNPS Letter 2.87.135 dated 8/10/87
NRC SER (Letter 1.88.261) dated 7/20/88

Exemption #18 - Reactor Building Annex

PNPS requested an exemption from the requirement that no intervening combustibles be present between redundant safe shutdown systems located in the Reactor Building Annex area. Train A safe shutdown cables associated with the RBCCW, SSW, and EDG Fuel Oil Systems are routed through the Acid Neutralizing Sump (1.21A) which is located at the 13 foot elevation. Redundant Train B safe shutdown equipment and cables are located in the "B" RBCCW Room (FZ 1.22 and 1.3A) which is on the 3 foot elevation. Although the Acid Neutralizing Sump and the RBCCW Pump Room are separate fire areas, non-rated floor/ceiling barrier penetrations allow both of these areas to communicate with the Water Treatment Area (FZ 1.29), located above on the 23 foot elevation. Fire Zone 1.21A is associated with Fire Area 1.21. Fire Zones 1.3A, 1.22, and 1.29 are associated with Fire Area 1.10. The exemption identifies that adequate fire protection is provided to ensure that fire will not spread to and impact redundant safe shutdown systems or cables.

Submittal / Approval Documents:
PNPS Letter 2.87.135 dated 8/10/87
NRC SER (Letter 1.88.261) dated 7/20/88

Exemption #21 - Hot Shutdown Repairs:

PNPS requested and exemption from the requirements of Appendix R, Section III.G.1.a for performing a series of pre-planned procedurally-controlled operator actions to transfer control, then replace control circuit fuses or install jumper wire if necessary, on specific equipment required to achieve and maintain hot shutdown. The exemption applies to Fire Zones 3.1, 3.2 and 1.9.

Submittal / Approval Documents:
PNPS Letter 2.87.160, dated 10/2/87
NRC SER (Letter 1.88.120) dated 04/14/88

Exemption #22 - Torus Level Instrumentation Separation in Zones 1.23, 3.4, and 3.11

PNPS requested an exemption from the requirement for providing fire detection and automatic suppression for torus water level indication cable located in specific Reactor Building and Radwaste/Control Building locations. The exemption applies to the Radwaste/Control Building areas (FZ 1.23B, 3.4, and 3.11) that are associated with Fire Area 1.10, and credit the availability of the alternate shutdown torus level indication provided on Panel C165 (FZ 1.10) which is in Fire Area 1.10. Control Room indication and ASD Panel indication will not be impacted by common fire.

Submittal / Approval Documents:
PNPS Letter 2.87.135 dated 8/10/87
NRC SER (Letter 1.88.261) dated 7/20/88

4.0 SPECIAL CIRCUMSTANCES:

Achieve and Maintain Hot Shutdown During a Fire Event
The underlying purpose of 10 CFR 50 Appendix R, Section III.G.1 is to provide reasonable assurance that at least one train of systems necessary to achieve and maintain safe shutdown conditions from either the control room or emergency control stations(s) is free from fire damage. Pilgrim station satisfies the underlying purpose of 10 CFR 50 Appendix Section III.G.1 for all plant fire areas.

However, as stated in our initial 1982 response to Appendix R (Reference 1), Pilgrim Station did not meet the separation requirements of Appendix R Section III.G.2 for seventeen (17) of the sixty-nine fire zones evaluated. Consistent with compliance strategies described in the initial Appendix R submittal for these seventeen (17) fire zones, and the NRC SER (Reference 2) which approved the conceptual design for alternate safe shutdown, Pilgrim Station implemented modifications and developed safe shutdown procedures which relied on operator manual actions to ensure safe shutdown capability in 1987.

Fire Zones 1.9, 1.10, 1.11, 1.12, 1.30A, 2.16, and 3.5, were included with the list of seventeen (17) zones that did not meet Appendix R, Section III.G.2 requirements. Modifications were not implemented to resolve compliance concerns (ie, OMAs) in these zones and procedure actions are relied on to ensure safe shutdown capability. The previously approved procedure actions are now considered acceptable for use in Alternative Shutdown (meets III.G.3 compliance) zones. Additionally, these fire zones rely on the use of low pressure systems used in conjunction with ADS to restore reactor inventory.

Reliance on these systems for reactor inventory control inherently results in short duration uncovery of the reactor core which does not satisfy the Appendix R, Section III.L.2.b requirement for maintaining reactor coolant level. As a result an exemption from

the requirements of Appendix R, Section III.L.2.b (to maintain the reactor coolant level above the top of the core) is required.

Reliance on ADS and low pressure injection system for reactor inventory control has been evaluated by the NRC to be an acceptable means to accomplish safe shutdown for both III.G.2 and for III.G.3 compliance. NRC review and approval of this safe shutdown strategy is documented in the PNPS safety evaluation (Reference 2) and in generic industry reviews (Reference 7). As such, reliance on these systems is acceptable and the underlying intent of the 10 CFR 50, Appendix R Section III.G.1 regulation to ensure safe shutdown capability is satisfied.

Special Circumstance

A review of NRC Regulatory Guide (RG) 1.189, Revision 2, dated October 2009 identifies that special circumstances exist when an approved SER is issued and no corresponding exemption has been approved. The RG identifies that pre-1979 licensees need an exemption, even if a staff decision in an SER approves an aspect of the Fire Protection Program (FPP) that does not comply with regulatory requirements. The RG specifically identifies (on page 13 under SERs) that pre-1979 licensees that have SERs, but not a corresponding exemption from the regulatory requirements must request an exemption under 10 CFR 50.12 by (1) highlighting the special circumstances of 10 CFR 50.12(a)(2), (2) citing the SER as the safety basis, and (3) confirming that the safety basis established in the SER remains valid.

In accordance with the instruction provided in RG 1.189, the special circumstance is that the provision of 10 CFR 50.12(a)(2) applies; the previously approved SER provides the safety basis; and the safety basis established in the SER remains valid.

5.0 CONCLUSION:

Based on the technical justification and the special circumstances detailed above, Pilgrim Station requests an exemption from the requirements of 10 CFR Part 50, Appendix R, Section III.L.2.b for Alternative Shutdown fire zones that credit the use of ADS and low pressure systems for reactor inventory make-up. Reliance on these previously approved systems may result in short term core uncovery but will not jeopardize capability to achieve and maintain safe shutdown.

6.0 REFERENCES

1. Pilgrim Letter 2.82.180, "Boston Edison Response to Appendix R", dated June 25, 1982.
2. NRC Letter dated November 2, 1983, "Safety Evaluation for Appendix R to 10 CFR Part 50 Items G3 and III.L", (PNP Letter No. 1.83.267).
3. NRC Regulatory Issue Summary 2006-10, "Regulatory Expectations with Appendix R Paragraph III.G.2 Operator Manual Actions"' June 30, 2006.
4. Entergy Letter, "Request for Exemption from 10 CFR 50 Appendix R Section III.G.2 to allow Hot Shutdown Manual Operator Actions," dated March 6, 2009.

5. Entergy Letter, "Response To NRC RAI For Exemption To Allow Hot Shutdown Manual Actions At Pilgrim Nuclear Power Station (TAC NO. ME831)," dated December 8, 2009
6. NRC Regulatory Guide 1.189, R2, dated October 2009, "Fire Protection For Nuclear Power Plants"
7. NRC Letter dated December 12, 2000, Subject "BWR Owners Group Appendix R Fire Protection Committee Position on SRVs + Low Pressure Systems used as "Redundant" Shutdown Systems Under Appendix R (Topical Report GE-NE-T43-0002-00-03-R01 (TAC NO. MA8545)"
8. General Electric Company Report, EAS 82-0787, July 1987 (PNPS SUDDS/RF 87-889), Safe Shutdown Analysis for the Pilgrim Nuclear Power Plant.
9. General Electric Company Report, GE-NE-T23-00749-01, December 1997 (PNPS SUDDS/RF 97-96), "Pilgrim Nuclear Power Station Containment Heatup Analysis with ANS 5.1 + 2σ Decay Heat."
10. Pilgrim Procedure 2.4.143.1, "Shutdown with fire in the Reactor Building East (Fire Area 1.9)", R15
11. Pilgrim Procedure 2.4.143.2, "Shutdown with fire in the Reactor Building West (Fire Area 1.10)", Rev. 15.
12. NRC Generic Letter 86-10, "Implementation of Fire Protection Requirements", April 24, 1986.
13. Pilgrim Station Power Systems Calculation No. PS-32, "Appendix R Safe Shutdown Analysis Report", Revision 5
14. Pilgrim Station Updated Fire Hazards Analysis, Report 89XM-1-ER-Q, Revision E5.

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Area 1.9								
Zone 1.1	RHR A Quad	No	No	No	Yes	No	#12 – Torus to RHR A Quad Barrier	No OMAs; Exemption requested from III.L.2.b.
Zone 1.6 / 1.8*	CRD Quad	Yes (Zn 1.8 only – proposed mod)	No	No	Yes	No	#11 – Torus To CRD Quad Fire Barrier	No OMAs; Exemption requested from III.L.2.b.
Zone 1.9*	RB East 23'	Yes (proposed mods and OMAs)	Yes	No	Yes	Yes	#7 – RB wtr Curtain; #9 – Full area FP Sup and detect in Alt Shutdown zone; #21 – Hot Shutdown Repairs; #22 Torus Instruments	Existing III.G.3 exemption; Exemption requested from III.L.2.b

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Zone 1.11*	RB East 51'	Yes (proposed mods and OMAs)	Yes	No	Yes	Yes	#8 - RB wtr Curtain; #9 – Full area FP Sup and detect in Alt Shutdown zone; #22 Torus Instruments	Existing III.G.3 exemption; Exemption requested from III.L.2.b
Zone 1.14* ; (and all Rx Bldg zones at or above 74')	RB 74'	Yes (Zone 1.14 only- proposed cold shutdown op action)	No	HPCI	Yes	No	None	No OMAs; Exemption requested from III.L.2.b.
Zone 1.32*	RB Steam Tunnel	Yes (proposed cold shutdown op action)	No	No	Yes	No	#14 – Structural Steel in Fire Barrier	No OMAs; Exemption requested from III.L.2.b.

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Zone 2.2* and 2.3	Swgr Rm "A" and Battery Rm	Yes (proposed OMAs)	No	No	Yes	No	None	Op actions important to safe shutdown; III.G.2 Compliance based on fire barriers
Zone 2.16*	Stairway # 8	Yes (proposed OMAs)	Yes	No	Yes	Yes	Pending – Lack of fixed suppression in ASD area	Exemption pending; Exemption requested from III.L.2.b
Zone 3.5*	Vital MG Set Rm	Yes (proposed OMAs)	Yes	No	Yes	Yes	#9 – Lack of Fixed Supp in ASD Area	Exemption approved; Exemption requested from III.L.2.b.
Fire Area 10								
Zone 1.2	RHR B Quad	No	No					No OMAs; Exemption requested from III.L.2.b.

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Zone 1.3/1.4	HPCI Room and	No	No	No	Yes	No	None	No OMAs; Exemption requested from III.L.2.b.
Zone 1.5/1.7	RCIC Quad	No	No	No	Yes	No		No OMAs; Exemption requested from III.L.2.b.
Zone 1.10*	RB West 23'	Yes (proposed mods and OMAs)	Yes	No	Yes	Yes	#7 – RB wtr Curtain; #9 – Full area FP Sup and detect in Alt Shutdown zone; #22 Torus Instruments	Existing III.G.3 exemption; Exemption requested from III.L.2.b
Zone 1.12*	RB West 51'	Yes (proposed mods and OMAs)	Yes	No	Yes	Yes	#8- RB wtr Curtain; #9 – Full area FP Sup and detect in Alt Shutdown zone	Existing III.G.3 exemption; Exemption requested from III.L.2.b

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Zone 1.22	RBCCW "B" Pp Rm	Yes (proposed mods)	No	No	Yes	No	#18 – Redundant Train Separation	No OMAs; III.G.2 demonstrated with fire barriers.
Zone 1.30A*	Torus Compartment	Yes (proposed mods and OMAs)	Yes	No	Yes	Yes	#5 – Torus Instrument and lack of suppression and detection; #11, #12, and #13 – Fire Barrier and Structural Steel to adj Quad zones.	Existing III.G.3 exemption; Exemption requested from III.L.2.b

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Zone 2.1* and 2.4	Swgr Rm "B" and Battery Rm	Yes (proposed OMAs)	No	No	Yes	No	None	Op actions important to safe shutdown; III.G.2 Compliance based on fire barriers
Zone 2.10* (and other Turbine Bldg zones 2.5 thru 2.13)	Condenser Bay	Yes (Zone 2.10 only – proposed OMAs)	No	No	Yes	No	None	Op actions important to safe shutdown; III.G.2 Compliance based on fire barriers
Zone 1.23	SBGT 51'	No	Yes	Yes	Yes	Yes	#22 – Torus Instruments and Lack of FP Sup and detection in Alt Shutdown Zone	Exemption approved for III.G.3: III.L.2.b exemption not required.

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Zone 3.4	CR HVAC Fan Rm 51'	No	Yes	Yes	Yes	Yes	#22 – Torus Instruments and Lack of FP Sup and detect in Alt Shutdown Zone	Exemption approved for III.G.3: III.L.2.b exemption not required.
Zone 3.11	Control Rm Annex 37'	No	Yes	Yes	Yes	Yes	#22 – Torus Instruments and Lack of FP Sup and detect in Alt Shutdown Zone	Exemption approved from III.G.3: III.L.2.b exemption not required.
Fire Area 1.21								
Zone 1.21*	RBCCW "A" Pp Rm	Yes (proposed mods)	No	No	Yes	No	#18 – Redundant Train Separation	No OMAs; III.G.2 demonstrated with fire barriers.

Table 1
Fire Zones Compliance Summary

Fire Area/ Fire Zone under consideration (See Note 1)	Zone Description	III.G.2 Compliance Problem (Initial Submittal/ SER and proposed resolution)	Alternative Shutdown (ASD) Zone (Current)	High Pressure System Available (Initial Submittal and SER)	ADS / Low Pressure System Available	Hot Shutdown Operator Manual Actions (OMAs)	Approved Appendix R Exemption	III.G.3 and III.L.2.b Compliance
Fire Area 3.1								
Zone 3.1*	Control Rm	Yes (proposed mods and OMAs)	Yes	Yes	Not currently credited	Yes	#1B – Lack of Fixed Suppression; #21 – Hot Shutdown repairs	Existing III.G.3 exemption; HP Systems available, III.L.2.b exemption not required.
Fire Area 3.2								
Zone 3.2*	Cable Spread Rm	Yes (proposed mods and OMAs)	Yes	Yes	Not currently credited	Yes	#21 – Hot Shutdown repairs	In compliance with III.G.3; HP Systems available, III.L.2.b exemption not required.

Note 1- The fire zones annotated with an asterisk (*) were identified in the original Appendix R Submittal as a zone where III.G.2 compliance was not demonstrated.

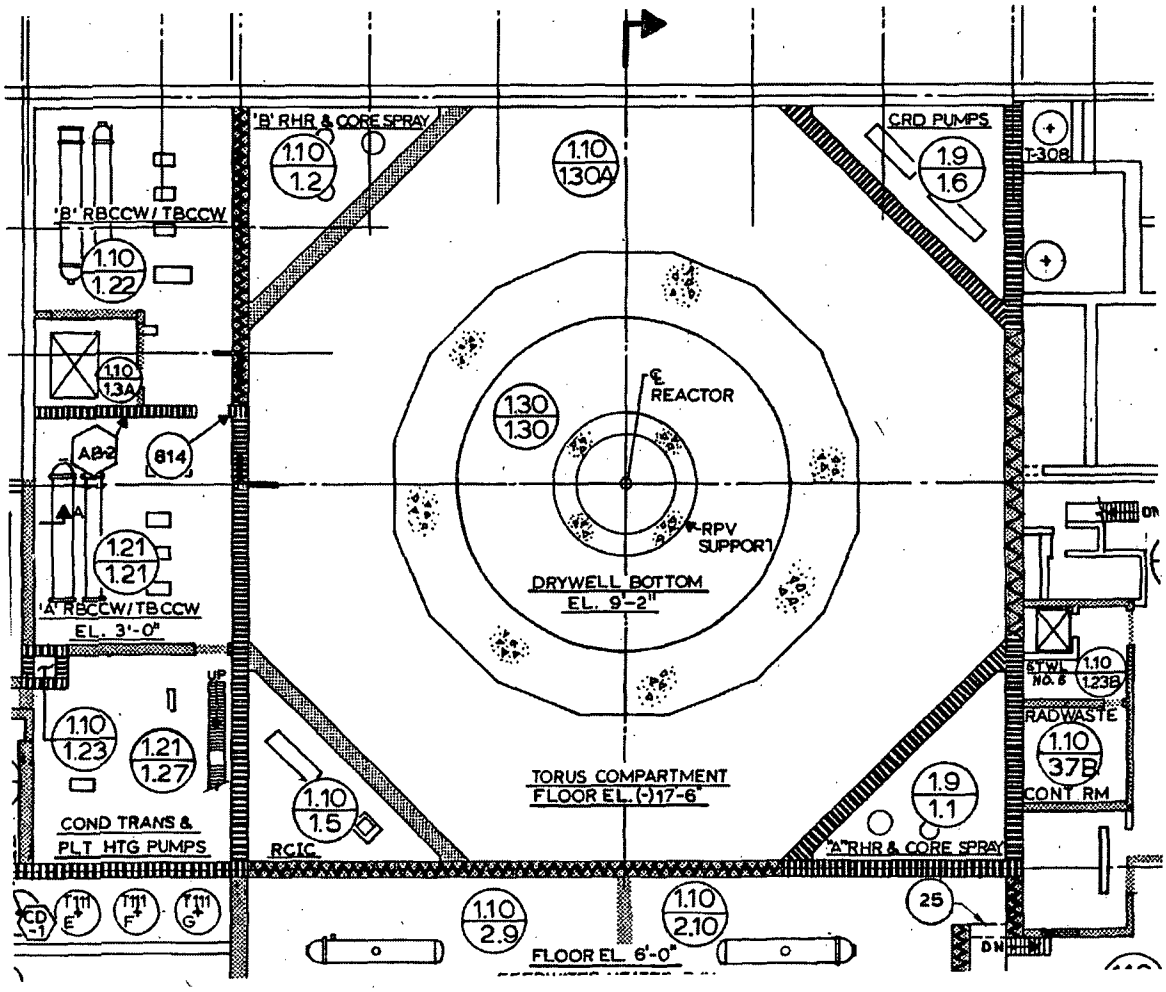
Attachment 1 to Enclosure 1 Entergy Pilgrim Letter 2.10.011

Pilgrim Station Exemption request from 10 CFR 50 Appendix R, Section III.L.2.b

Reactor Building Fire Zones
Figures 1, 2, 3, 4, and 5

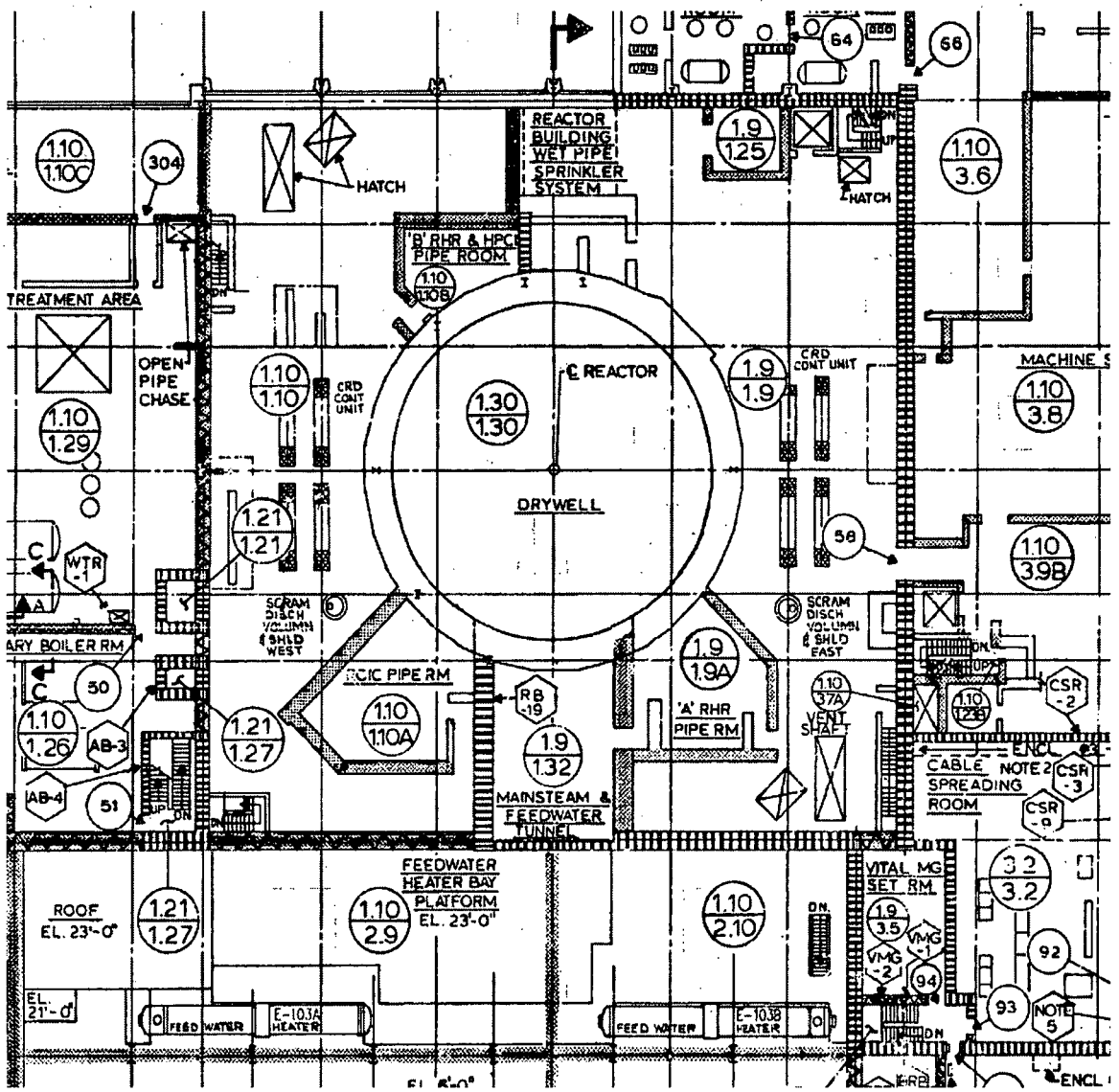
5 Total pages

Attachment 1
Reactor Building Figures



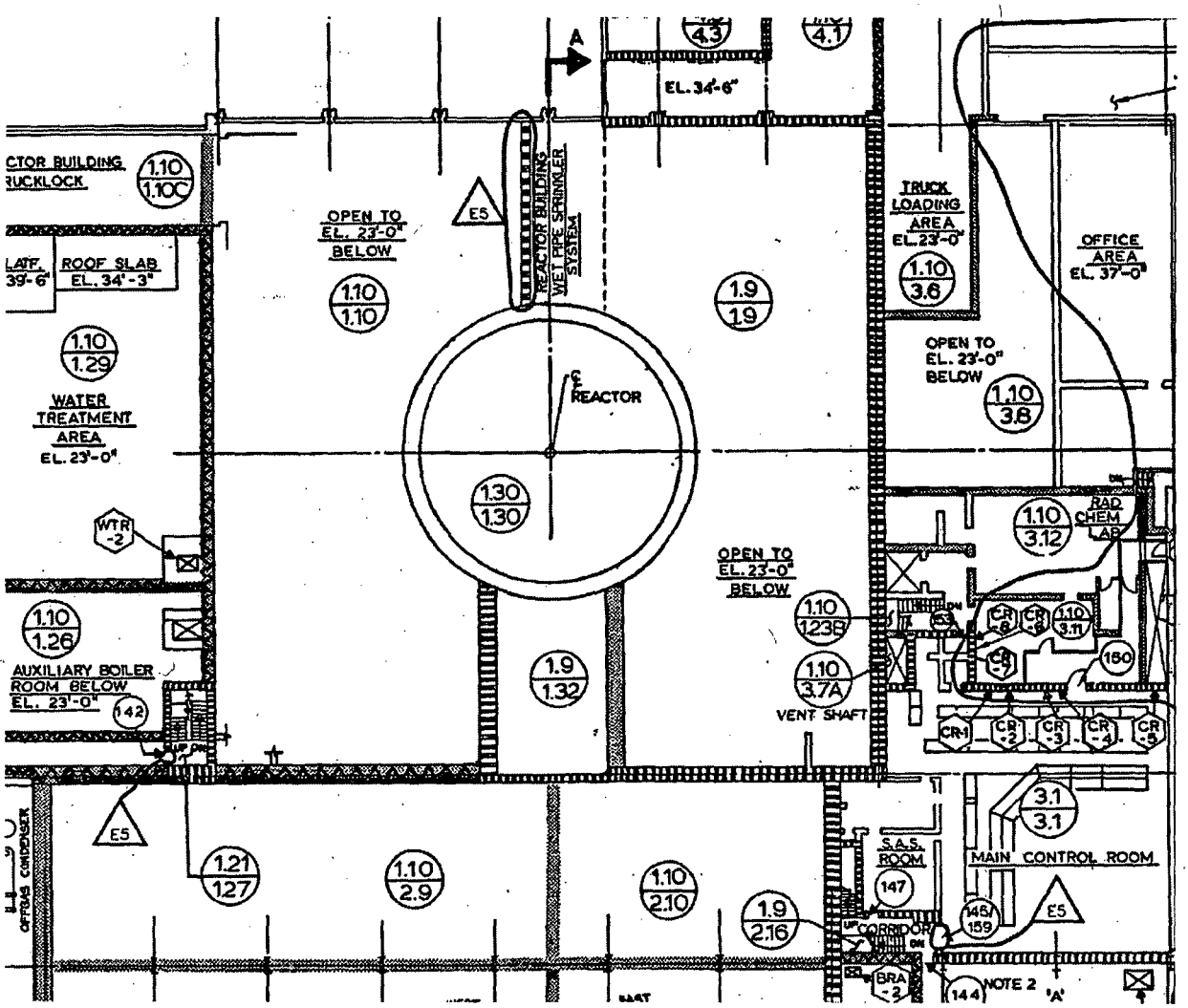
Reactor Building (-) 17' elevation
Figure 1

Attachment 1
Reactor Building Figures



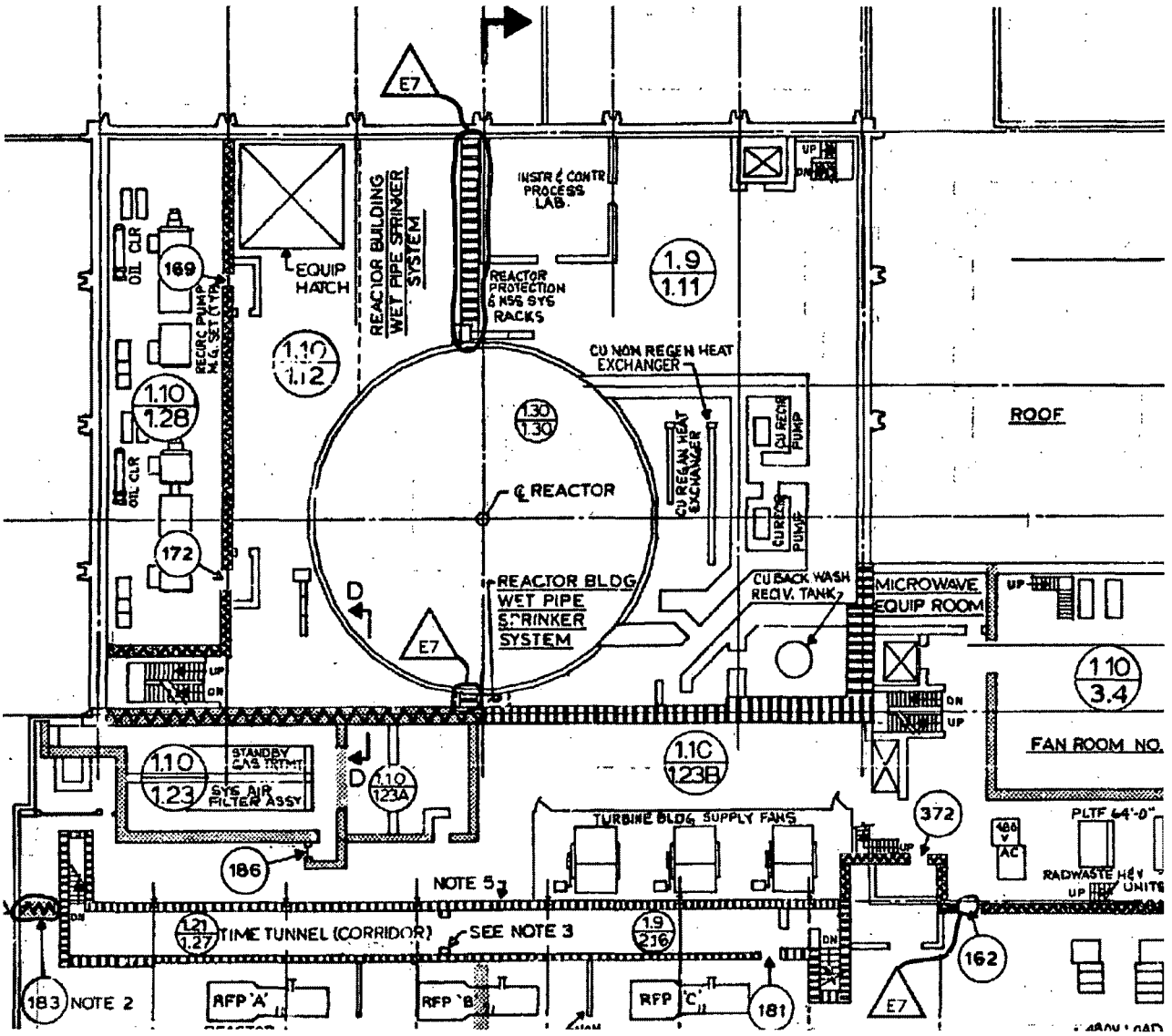
Reactor Building 23' elevation
Figure 2

Attachment 1
Reactor Building Figures



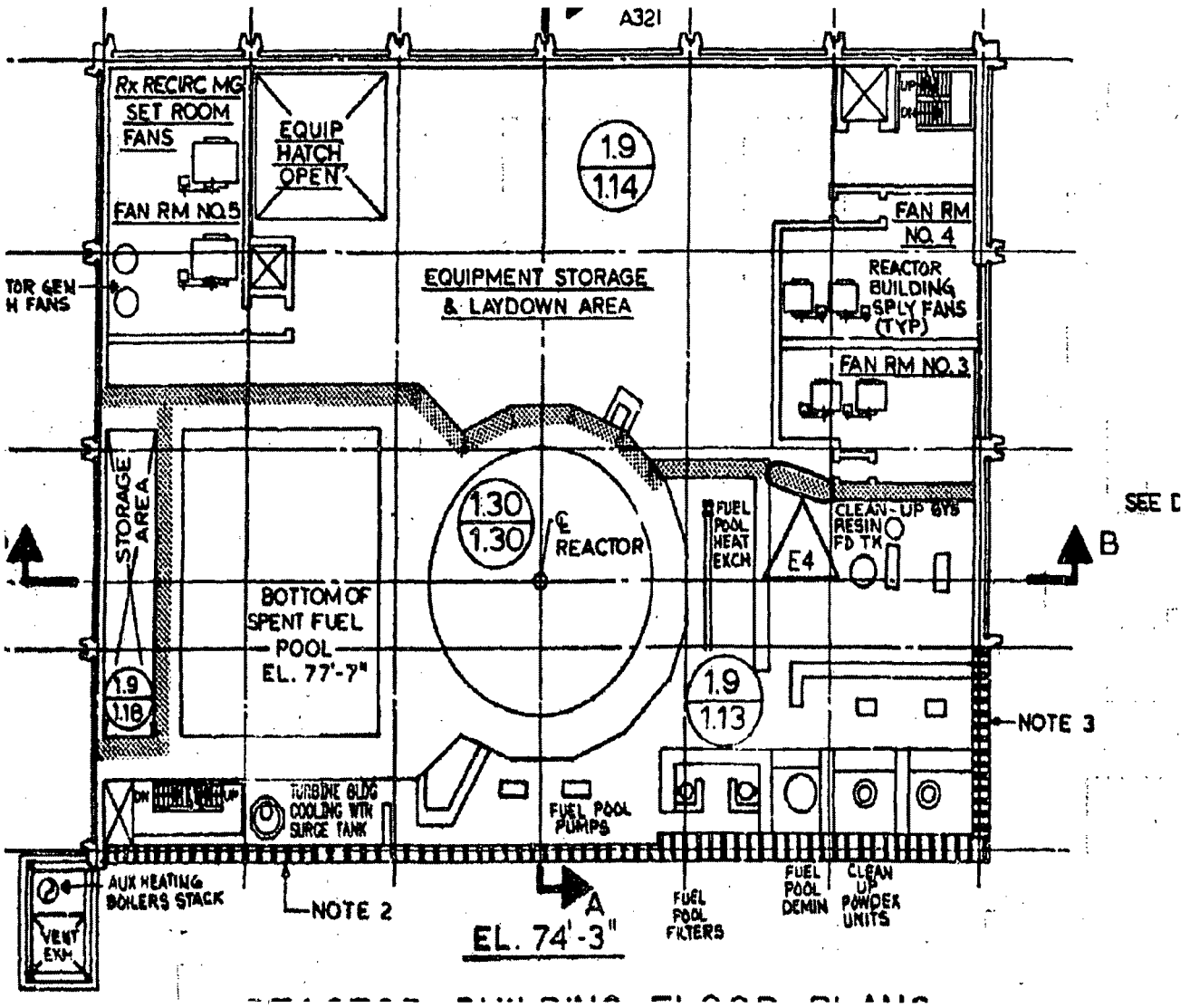
Reactor Building 37' elevation
Figure 3

Attachment 1
Reactor Building Figures



Reactor Building 51' elevation
Figure 4

Attachment 1
Reactor Building Figures



Reactor Building 74' elevation
Figure 5

Attachment 2 to Enclosure 1 to Entergy Pilgrim Letter 2.10.011

Pilgrim Station Exemption request from 10 CFR 50 Appendix R, Section III.L.2.b

General Electric Analysis of Pilgrim Station Appendix R Fire Event

EAS 82-078
DRF A00-03144
Rev. 0
July 1987

17 Total Pages

A-113

EAS 82-0787
DRF A00-03114
Revision 0
July 1987

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SAFE SHUTDOWN APPENDIX R ANALYSES FOR THE PILGRIM NUCLEAR POWER PLANT

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NUCLEAR ENERGY BUSINESS OPERATIONS • GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA 95125

GENERAL ELECTRIC

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

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Please Read Carefully

1. INTRODUCTION 1-1

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1. INTRODUCTION

1.1 BACKGROUND

In accordance with 10CFR50.48 and 10CFR50 Appendix R, adequate protection of plant equipment is required to ensure safe shutdown of a nuclear power plant in the unlikely event of a fire in any plant location. The fire event is assumed to have concurrent loss of off-site power (LOOSP), loss of all automatic function affected by the fire, spurious operation of plant equipment, and, if necessary, control room evacuation. For fire events which may result in control room evacuation, Boston Edison Company (BECo) has elected to implement a remote shutdown system (RSS) for the Pilgrim Nuclear Power Station (PNPS). Part of the RSS includes two panels with manual control for pressure relief. These panels include all four safety relief valves (SRVs); two SRVs at each panel.

A fire in the vicinity of one of these shutdown panels may result in a loss of the two SRVs controlled from the panel. Also, the high pressure make up systems may not be available for safe shutdown since the panel area has cables associated with HPCI and RCIC equipment. A fire event may also render some of the pumps for the Residual Heat Removal (RHR) system and Low Pressure Core Spray (LPCS) system unavailable for core cooling. This implies that in the event of a fire at one of the panels, only two SRVs and one LPCS pump will be available for core cooling, and one RHR pump will be available for decay heat removal for safe shutdown.

In order to demonstrate that safe shutdown can be achieved with the equipment specified above, analyses were performed to determine if there is adequate capability to depressurize the reactor to ensure no fuel damage, and no failure of the primary pressure vessel or containment. Previous

analyses (Reference 1) have been performed using the Low Pressure Coolant Injection (LPCI) mode and normal shutdown cooling mode of the RHR system. However, due to procedural considerations, BECo has decided to operate the RHR pumps in the suppression pool cooling mode for decay heat removal. The RHR pump will be used to remove the decay heat from the suppression pool after the LPCS pump has been placed in service for core cooling. Further, due to potential loss of control circuits, the RHR pump may require a longer time to become available than previously assumed.

1.2 SCOPE AND OBJECTIVE

The specific objective of the analyses is to demonstrate that the plant can achieve safe shut down and that there is no fuel damage, and there is more than adequate margin to assure containment and suppression pool integrity. The system performance requirements considered in these analyses were consistent with those specified in Section III.L of 10CFR50 Appendix R and NRC guidelines (References 1 and 2).

The analyses and their results are described and summarized in the following sections.

2. EVENT DESCRIPTION

At the start of the hypothetical fire event at one of the two shutdown panels, the reactor is assumed to be operating at full power, normal water level, and steady state conditions. The evaluation of the fire event assumes the concurrent LOOSP. During a LOOSP event, the loss of power to the Reactor Protection System (RPS) and the fail-safe design of the isolation system will result in an automatic scram and isolation.

Immediately after scram and isolation, the reactor pressure increase is limited by the SRVs operating in the pressure actuation mode. The function of the SRVs in this mode is not affected by the fire, since the SRVs are located in the inerted containment and they function in a mechanical mode which does not rely on external power. There is no potential for overpressurization because the SRVs are designed and sized to accommodate this type of isolation event. There is no potential for fuel damage because this event is similar to many transient events, involving LOOSP and closure of all Main Steam Isolation Valves (MSIVs), previously analyzed as part of the plant's design bases safety evaluation.

The LOOSP also results in a loss of feedwater flow to the reactor. Normally, the high pressure make up systems (HPCI and RCIC) will operate to maintain reactor water inventory when substantial reactor inventory is lost due to the SRVs actuations. As discussed earlier, for this postulated fire at one of the two shutdown panels, both HPCI and RCIC are assumed to be unavailable. Without the high pressure make up systems, the SRVs actuations result in a gradual loss of reactor water inventory. This "boil off" continues with the reactor maintained at high pressure (around 1100 psig) until the operator manually actuates the two SRVs to depressurize the reactor. The operator would monitor reactor pressure, reactor water level, suppression pool water temperature and level. Based on this information, the operator would take appropriate actions to achieve safe shutdown.

In accordance with the plant emergency procedures, when the indicated reactor water level reaches the top of active fuel, the operator will initiate manual depressurization with the SRVs available and align the low pressure systems for recovery of reactor inventory and removal of the decay heat. When the reactor inventory is recovered and when the reactor pressure is low enough, the operator will begin operating the Residual Heat Removal (RHR) system in Suppression Pool Cooling (SPC) mode.

3. EVENT ANALYSES

For the postulated fire event, the evaluation of the reactor response was performed utilizing the GE blowdown model (SAFE). The SAFE code determines the reactor coolant inventory (water level) response. If the results show core uncovery occurs, the fuel cladding integrity evaluation is performed by determining the resulting peak cladding temperature (PCT) for the duration of the core uncovery. The PCT calculations were performed by incorporating the SAFE output in the core heatup analysis code (CHASTE). The integrity of the suppression pool was evaluated by performing a mass and energy balance on the suppression pool accounting for the mass and energy added by the SRVs.

The basic analysis assumptions are consistent with 10CFR50.48, 10CFR50 Appendix R and the plant emergency procedure guidelines (EPGs).

3.1 ASSUMPTIONS AND INITIAL CONDITIONS

The key model or input assumptions and initial conditions used in the analyses are summarized below:

a. The reactor is assumed to be operating at full power, and at normal water level at the time of event initiation.

b. The event initiation occurs concurrently with LOOSP.

c. The reactor scrams at event initiation either as a result of the concurrent LOOSP or by manual action from the control room.

d. The Main Steam Isolation Valves (MSIVs) begin to close at event initiation either as a result of LOOSP or due to manual closure.

e. Feedwater flow is assumed to ramp to zero in five seconds after event initiation.

f. The 1979 ANS decay heat correlation is used to realistically model the reactor decay heat.

g. The initial temperature of the suppression pool is 80°F and the containment pressure is 14.7 psia.

h. The water level in the suppression pool is at the lowest level allowed by the plant Technical Specifications.

i. The suppression pool airspace pressure is in equilibrium with the drywell pressure.

j. The suppression pool and the drywell are conservatively assumed to be insulated volumes.

k. No HPCI or RCIC systems are available during fire event.

l. LPCI systems are not used for core cooling in this analysis.

m. One core spray system for core cooling is available after reactor depressurization.

n. One RHR pump for suppression pool cooling is assumed available at one hour after event initiation in initial analyses. Suppression pool analyses are also performed for an RHR pump initiation time of two hours.

3.2 ACCEPTANCE CRITERIA

The acceptance criteria used in evaluating this fire event include criteria for fuel cladding integrity and for suppression pool integrity.

The reactor level response provides a good indication whether fuel damage (fuel cladding perforation) is expected. If the core remains covered

throughout the analyzed event, then no fuel cladding damage would occur. If the top portion of the core is uncovered for a brief period, the combination of low power level for this portion of the fuel and the steam updraft cooling will prevent any significant heatup or fuel cladding damage. If the core is uncovered to a significant depth and duration, then the resultant fuel heat up must be evaluated. To ensure the fuel cladding integrity, the calculated PCT should be less than the temperature (approximately 1500° F) at which cladding damage may occur (Reference 4). The use of a peak cladding temperature as a design requirement rather than no core uncovery is consistent with NRC guidelines (Reference 5) which establishes that core uncovery of the upper portion of the core during depressurization prior to reflooding is acceptable for a BWR.

To judge the acceptability of the suppression pool response three criteria are used. These criteria are:

a. The temperature and pressure in the pool should remain below the design conditions of 281° F and 56 psig.

b. The pool temperature should remain below the Heat Capacity Temperature Limit (HCTL) for the pool while the reactor vessel is pressurized. This criterion, established under EPGs, is imposed to ensure that the operator will have sufficient time to transfer controls to the shutdown panel without the need to depressurize the reactor.

c. Adequate NPSH to the low pressure pump should be available in order to prevent possible pump cavitation. The NPSH available to the pump is a function of both the pressure losses in the suction piping and the pressure and temperature in the suppression pool. A pool temperature of approximately 190° F at atmospheric pressure will provide adequate NPSH for the RHR pump and a temperature of approximately 185° F at atmospheric pressure will provide adequate NPSH for the LPCS pump (Reference 6).

The results of the evaluations for the identified fire event are presented in Section 4.

4. RESULTS

For the postulated fire event, the reactor pressure and reactor water level are shown in Figures 4-1 and 4-2. During the early period of the transient the reactor water level is slowly depleted by each SRV actuation. The indicated water level remains above the TAF until about 24 minutes at which the reactor vessel is depressurized. (The actual water level remains above the TAF until about 27 minutes.) Therefore, the operator has sufficient time to take necessary actions to start depressurizing the reactor with the two SRVs available. When the reactor is depressurized to the operating pressure of the core spray pump, this pump will be operated to maintain reactor inventory. When the reactor inventory is sufficiently recovered, the operator will start the RHR system to provide suppression pool cooling. During the depressurization, some core uncovery is expected. This core uncovery results in a PCT of approximately 1320° F (Figure 4-3) which is well below the temperature at which cladding perforations can occur (approximately 1500° F). Therefore, the postulated fire event will not cause fuel cladding damage.

To ensure that the identified limits for the suppression pool are not exceeded for the duration of hot shutdown, the suppression pool temperature response for this event was evaluated. The pool temperature before reactor depressurization was about 106° F (Figure 4-4), and the pool pressure was about 2 psig. The pool temperature is well below the HCTL for the corresponding reactor pressure. Utilizing the RHR system to provide suppression pool cooling after reactor depressurization, the maximum pool temperature and pressure are expected to remain below about 180°F and 11 psig, respectively. Further, this combination of pool temperature and pressure is below the design limits, and will provide adequate NPSH to assure the operation of the RHR and core spray pumps for coolant injection. Therefore, the requirements identified for suppression pool are satisfied.

The above pool temperature response, which is based on an initial pool temperature of 80°F and RHR pump initiation at one hour, shows a large

margin to the identified design limits for the suppression pool. The margins to the limits are large enough to satisfy the limits for the suppression pool and the NPSH requirements even if the initial pool temperature is at 100°F and RHR pump initiation for suppression pool cooling does not begin until two hours after shutdown begins (Figure 4-5).

Therefore the analyses demonstrate that the remote shutdown system at PNPS meets the requirements specified in Section III.L of 10CFR50 Appendix R for this postulated event of fire at one of the two shutdown panels.

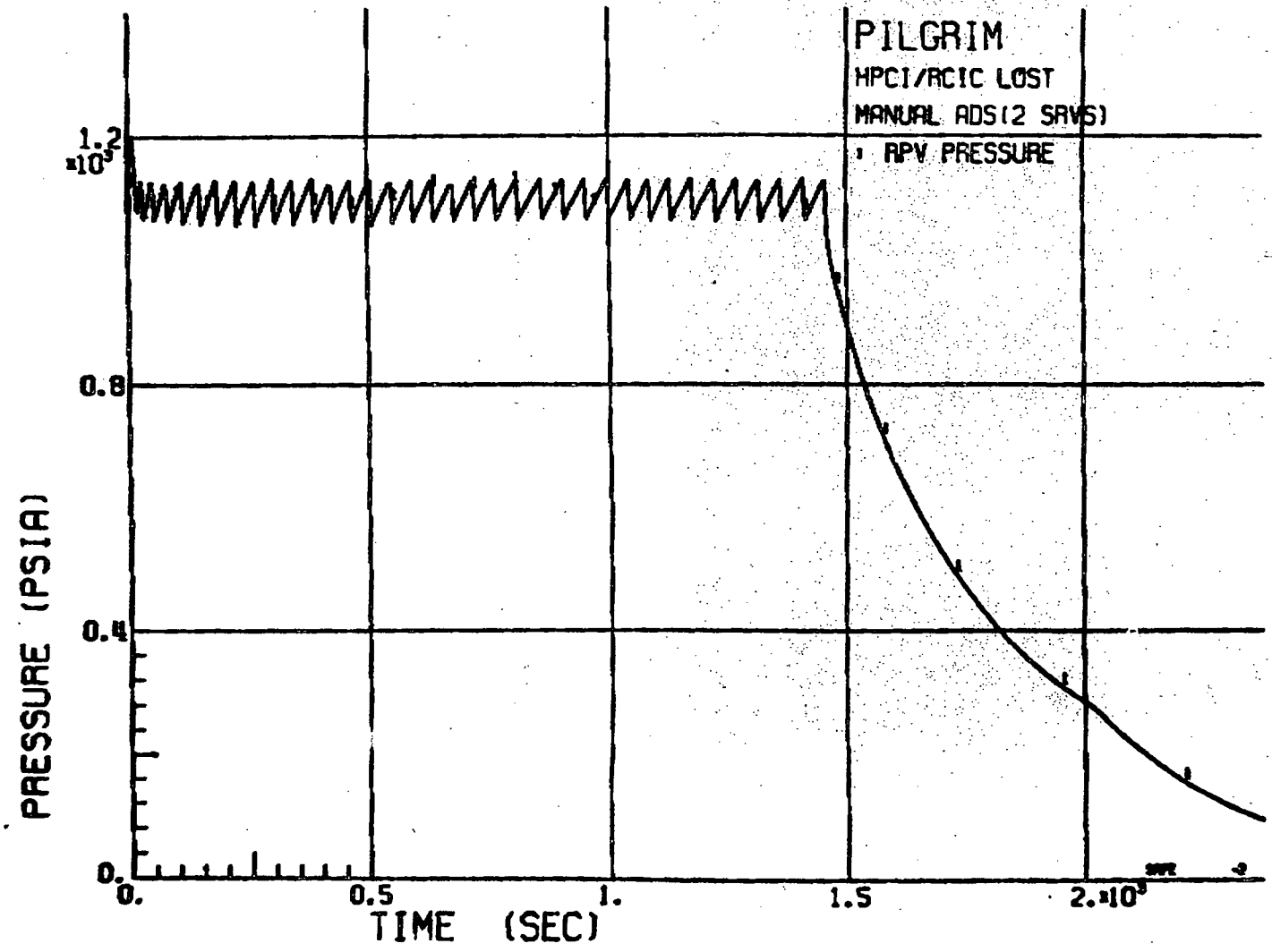

Figure 4-1: Reactor Pressure Response For Fire At One Shutdown Panel

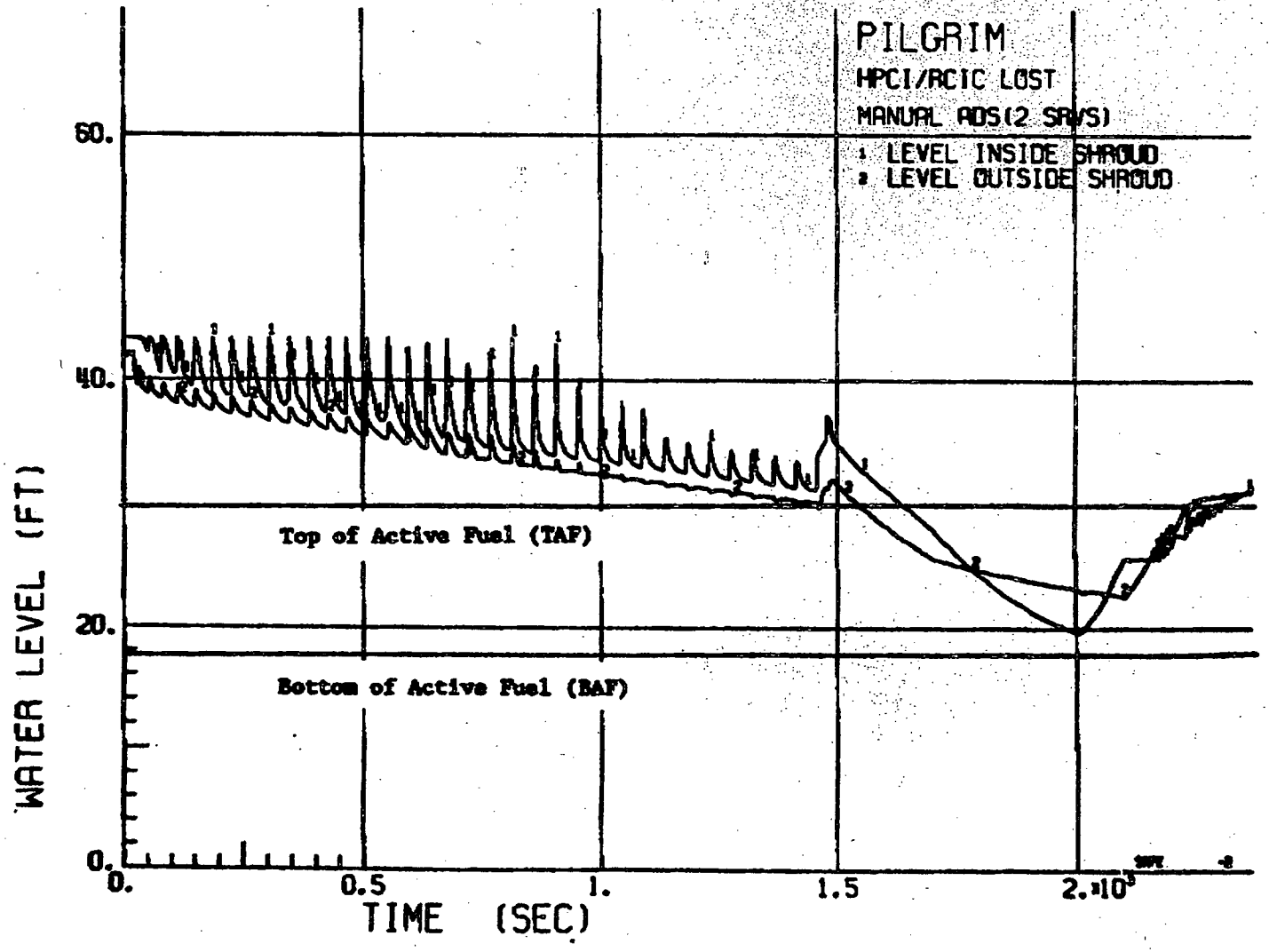

Figure 4-2: Reactor Water Level Response For Fire At One Shutdown Panel

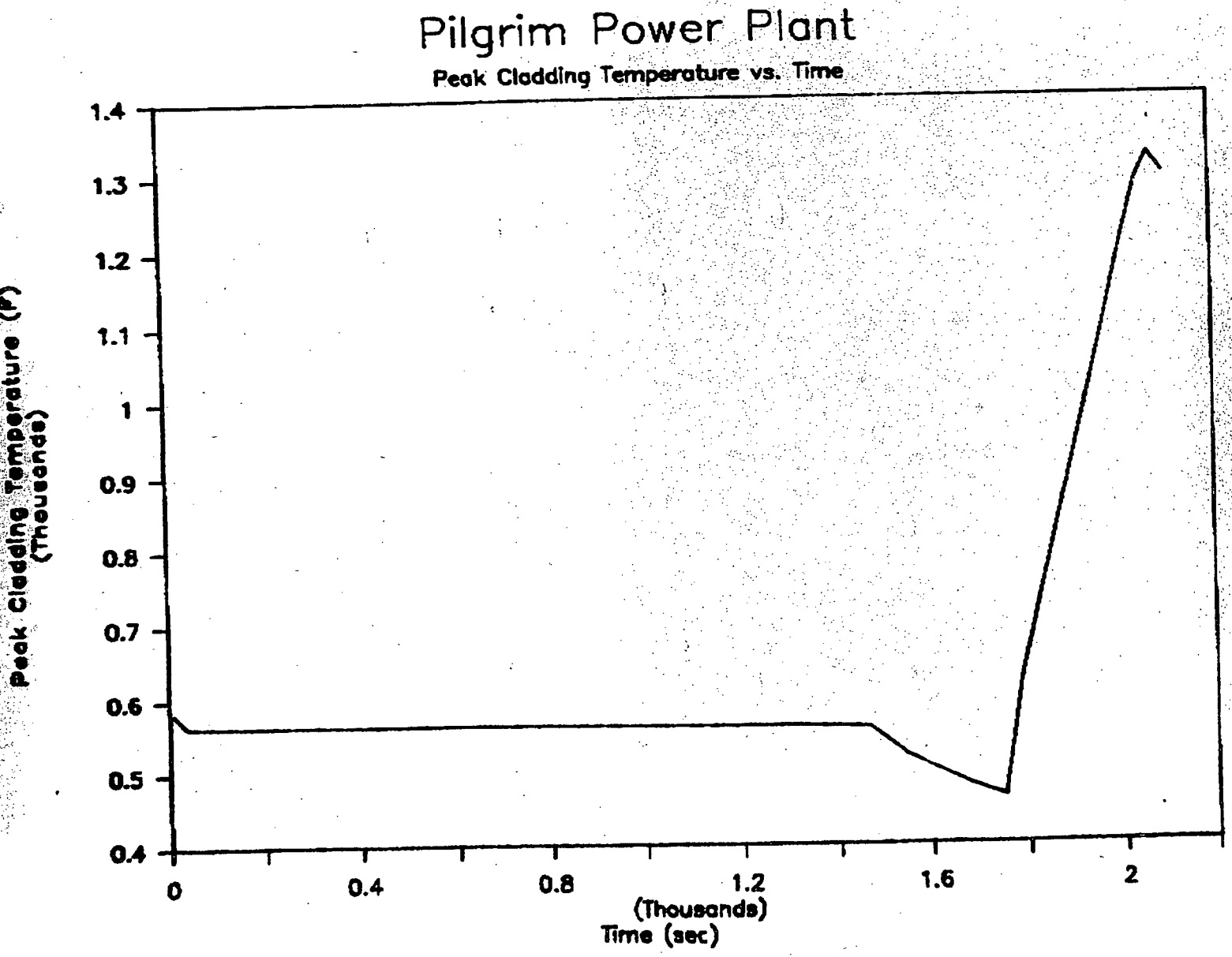

Figure 4-3: Peak Cladding Temperature For Fire At One Shutdown Panel

PILGRIM NUCLEAR POWER STATION

SUPPRESSION POOL TEMPERATURE VS. TIME

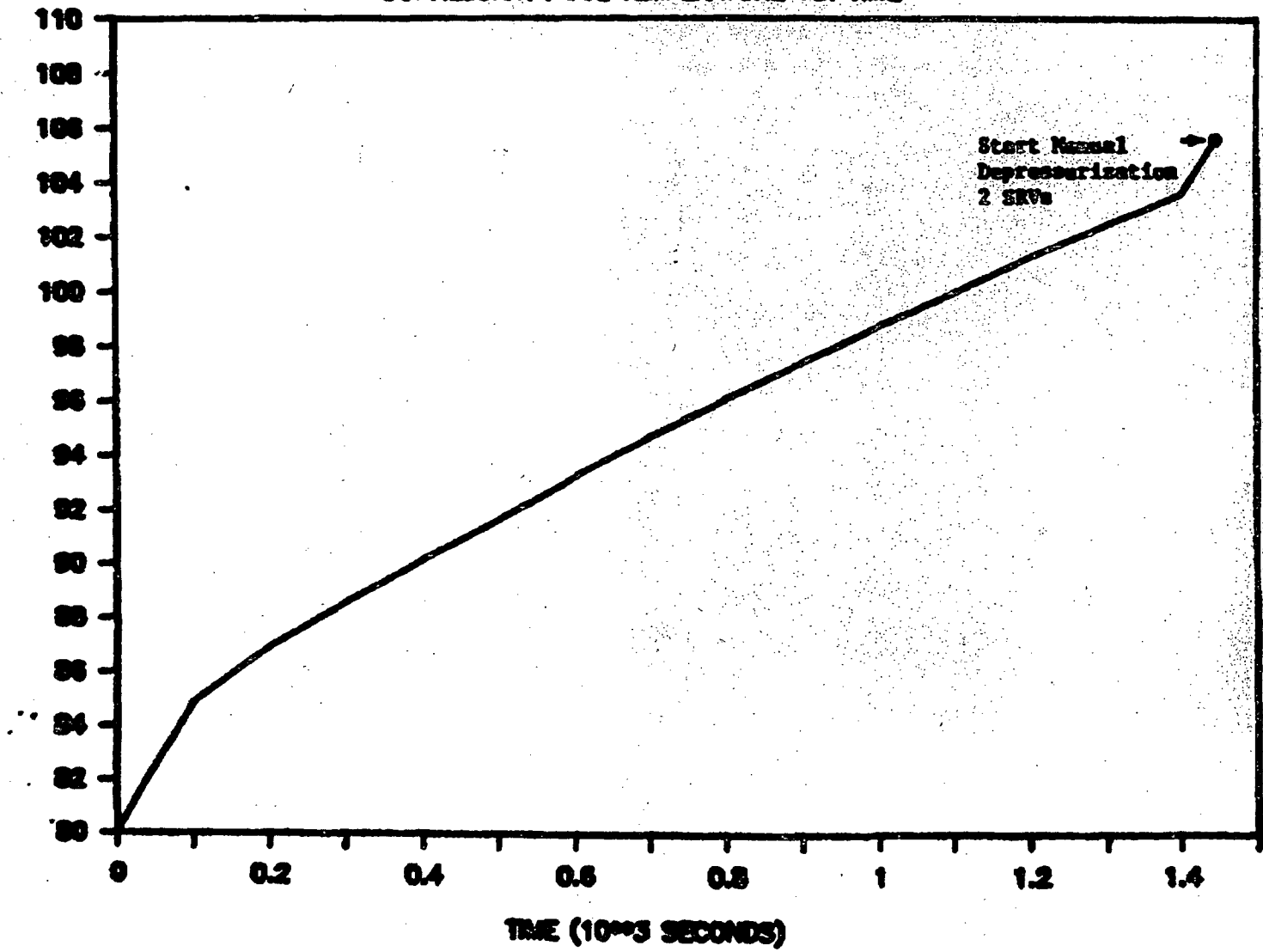

Figure 4-4: Suppression Pool Temperature Response For Fire Event At Shutdown Panel

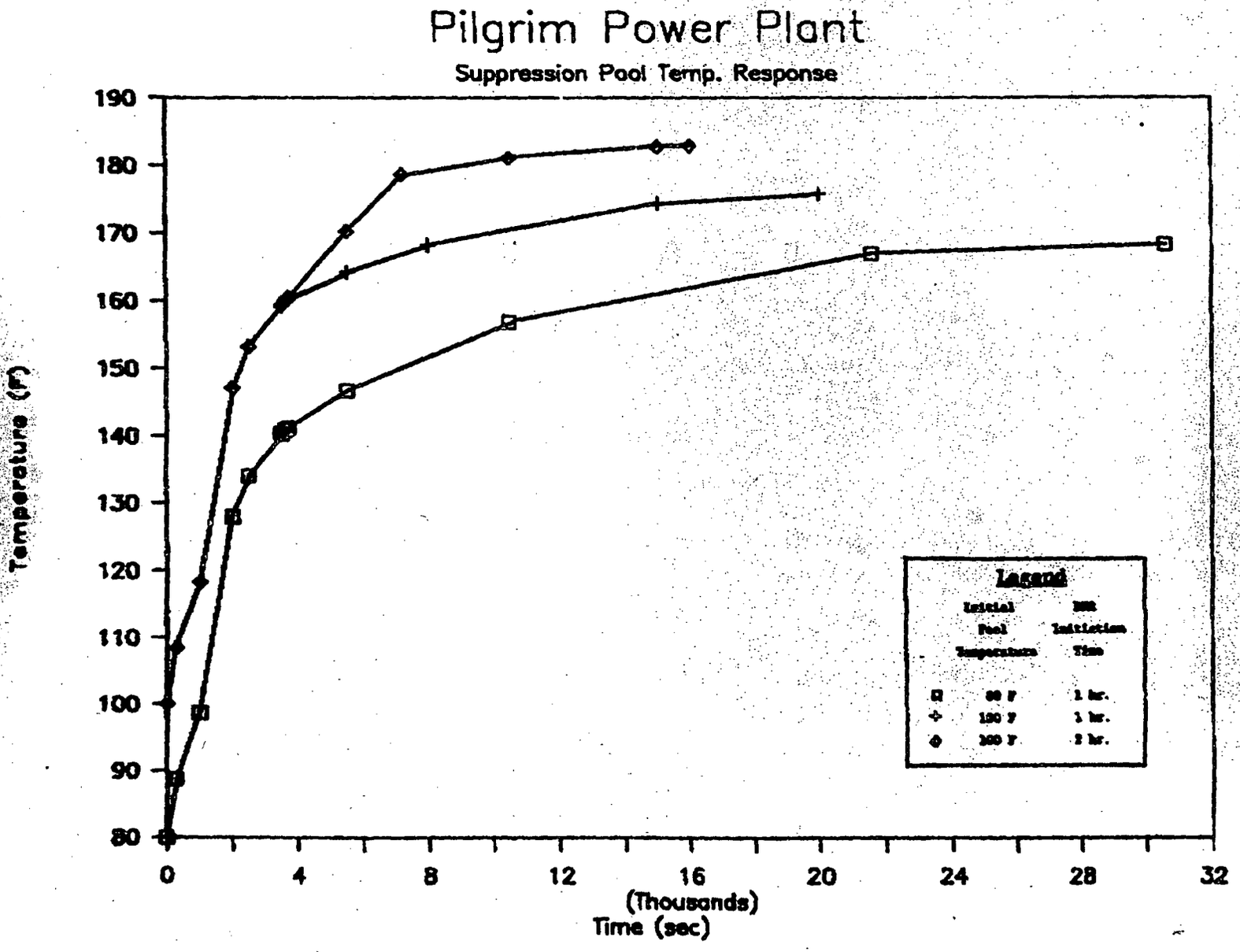

Figure 4-5: Suppression Pool Temperature For 80 F, 100 F Initial Pool Temperature and 1 Hour, 2 Hour RHR Initiation Times

5. CONCLUSION

The analysis results show that safe shutdown can be achieved for a fire event at one of the two remote shutdown panels. The event is postulated to result in the loss of control of two SRVs, the HPCI, RCIC, and LPCI systems; however, two SRVs are available for reactor pressure control, one LPCS pump is assumed available for reactor cooling and one RHR pump is assumed available for suppression pool cooling. The operator will have sufficient time to have the core spray system available to provide core makeup. The peak cladding temperature (PCT) is low enough to ensure fuel cladding integrity. There is also more than adequate margin to assure containment and suppression pool integrity for initial pool temperature of up to 100°F and the initiation of the RHR pump at up to two hours. The analysis also shows that the available NPSH will maintain an adequate margin above the required NPSH for the core spray and RHR pumps.

6. REFERENCES

1. U. C. Saxena, "Safe Shutdown Appendix R Analyses for Fire Event at One Shutdown Panel for Pilgrim Nuclear Power Plant", Revision 1, draft June 1986.

2. Letter, D. G. Eisenhut (NRC) to All Power Reactor Licensees and All Applicants For Power Reactor Licences, " Fire Protection Policy Steering Committee Report (Generic Letter 85-01)", Draft January 9, 1985.

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