Attachment 2

Vermont Yankee Nuclear Power Station

Proposed Technical Specification Change No. 263 -- Supplement No. 23

Extended Power Uprate

Response to Request for Additional Information

Exhibits

BVY 05-017
Docket No. 50-271

Exhibit 1

Vermont Yankee Nuclear Power Station

Proposed Technical Specification Change No. 263 – Supplement No. 23

Extended Power Uprate

Response to Request for Additional Information

Suppression Pool Cooling Study

Total number of pages in Exhibit 1
(excluding this cover sheet) is 17

Engineering Report No. VY-RPT-05-00003 Rev. 0

Entergy

ENTERGY NUCLEAR NORTHEAST

Engineering Report Cover Sheet

Engineering Report Title:

VYNPS Suppression Pool Cooling Study Performed With 2 RHR Pumps

Engineering Report Type:

New ☒ Revision ☐ Cancelled ☐ Superceded ☐

Applicable Site(s)

IP1 ☐ IP2 ☐ IP3 ☐ JAF ☐ PNPS ☐ VY ☒

Quality-Related: ☒ Yes ☐ No

Prepared by: Alan L. Robertshaw — Date: 10 February 2005
Responsible Engineer (Print Name/Sign)

Verified/ Reviewed by: Pedro B. Pérez — Date: 10 February 2005
Design Verifier/Reviewer (Print Name/Sign)

*Reviewed by: N/A — Date:
Authorized Nuclear In-service Inspector (ANII)

Approved by: James G. Rogers for — Date: 2/17/05
Supervisor (Print Name/Sign)

Multiple Site Review			
Site	Design Verifier/Reviewer (Print Name/Sign)	Supervisor (Print Name/Sign)	Date

*: For ASME Section XI Code Program plans per ENN-DC-120, if required.

RECORD OF REVISIONS

Engineering Report No: VY-RPT-05-00003 VYNPS Suppression Pool Cooling Study Performed With 2 RHR Pumps

Revision No.	Description of Change	Reason For Change
0	Original report	NA

TABLE OF CONTENTS

LIST OF ATTACHMENTS

EXECUTIVE SUMMARY

The suppression pool cooling study summarized in this report supports the responses to a Nuclear Regulatory Commission Request for Additional Information. The study was originally performed when a question was asked by the State of Vermont regarding the worst single failure assumption in the DBA LOCA suppression pool temperature calculation with respect to containment overpressure. The State of Vermont was interested in the results if the single failure compromised containment overpressure. Design basis analyses are performed with a single failure assumption. The single failure assumption that compromises containment overpressure is independent of Residual Heat Removal (RHR) system performance. Only one single failure needs to be assumed and in the case of containment overpressure unavailability, the coincident unavailability of an RHR heat exchanger does not have to be assumed. The suppression pool cooling study was performed to demonstrate the use of two RHR pump trains in suppression pool cooling mode results in a suppression pool temperature that would not require containment overpressure to meet net positive suction head requirements.

Nomenclature

DBA	Design Basis Accident
DBD	Design Basis Document
ENO	Entergy Nuclear Operations, Inc.
EOP	Emergency Operating Procedure
GENE	General Electric – Nuclear Energy
LOCA	Loss of Coolant Accident
NPSH	Net Positive Suction Head
NRC	United States Nuclear Regulatory Commission
RAI	Request for Additional Information
RHR	Residual Heat Removal
RHRSW	Residual Heat Removal Service Water
TS	Technical Specifications
VYNPS	Vermont Yankee Nuclear Power Station
WW	Wet well (same as Suppression Pool)

SECTION 1

INTRODUCTION

1.1. Purpose

The scope of this study is limited to supporting the NRC RAI related to suppression pool cooling with two trains of RHR in suppression pool cooling mode. Specifically, RAI SPSB-C-40 requests the following [Reference 1]:

> "The response to SPSB-C-10, dated July 2, 2004, contains a calculation which shows that with two heat exchangers operating but all other conservative assumptions of the licensing basis calculation unchanged, the suppression pool temperature is reduced from 194 F to 169 F. Is the flow through each heat exchanger due to just one residual heat removal (RHR) pump and one service water pump? Under what conditions would the operator actually use both trains of RHR to cool the suppression pool as opposed to using one train to cool the suppression pool and one train to inject water into the reactor vessel? The RAI response states that the calculation was not performed to QA program requirements. The staff requests that this calculation be verified according to the VYNPS Appendix B program."

1.2. Background

The VYNPS DBA LOCA suppression pool temperature analysis assumes conditions that maximize the energy addition to the suppression pool [Reference 2]. The analysis assumes that all ECCS pumps are available and introduce pump heat to the fluid systems that is ultimately added to the suppression pool. This assumption is different from the 10CFR50.46 evaluation that assumes a loss of an electrical division. The worst single failure in the DBA LOCA suppression pool temperature analysis is the unavailability of a RHR heat exchanger. The RHR pump would continue to deliver flow to the suppression pool without the RHRSW system removing energy. This single failure assumption, along with other conservatisms in the analysis results in a suppression pool temperature that requires containment overpressure to meet ECCS pump NPSH requirements.

The State of Vermont in April 2004 informally questioned the worst single failure assumption in the DBA LOCA suppression pool temperature calculation with respect to containment overpressure. The State of Vermont was interested in the results if the single failure compromised containment overpressure. The single failure assumption that compromises containment overpressure is independent of the RHR system performance. Only one single failure needs to be assumed and in the case of containment overpressure unavailability, the coincident unavailability of an RHR heat exchanger does not have to be assumed.

The VYNPS GOTHIC model for the DBA LOCA containment response was modified to perform the suppression pool cooling study for EPU. The study results demonstrate the use of two trains of RHR in suppression pool cooling mode results in a suppression pool temperature that would not require containment overpressure to meet ECCS net positive suction head requirements.

The study was not formally documented at that time, but the suppression pool temperature results were used in an earlier RAI discussion.

SECTION 2

EVALUATION

2.1. Method of Analysis

2.1.1. General

The Vermont Yankee GOTHIC DBA LOCA containment model [Reference 3] was used in this study. The model was updated for EPU conditions in order to reproduce the SHEX DBA LOCA EPU results [Reference 4]. The GOTHIC model was then modified to add a second RHR train in suppression pool cooling mode with the same characteristics as the DBA model. The DBA LOCA model with 1 RHR train and the modified model for this study with 2 RHR trains are shown ion Figures 2-1 and 2-2, respectively. The GOTHIC code is designated Level A software and is documented in Reference 7.

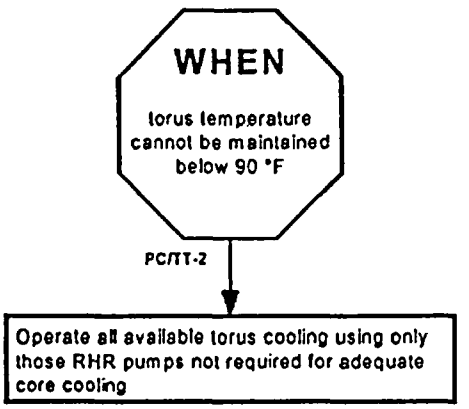
2.2. Assumptions

2.2.1. EPU Conditions

The DBA LOCA initial conditions and assumptions that were used in the SHEX analysis were also applied in this study. The only difference is the RHR trains available.

2.2.2. RHR Availability for Suppression Pool Cooling

The RHR system is described in the RHR DBD [Reference 6]. The study assumes there are two RHR trains available for maximizing suppression pool cooling as called in EOP-3 [Reference 5] to improve the cooling function (see below).



The study assumes that the core spray system is also available to maintain adequate core cooling.

Figure 2-1

GOTHIC DBA LOCA Model

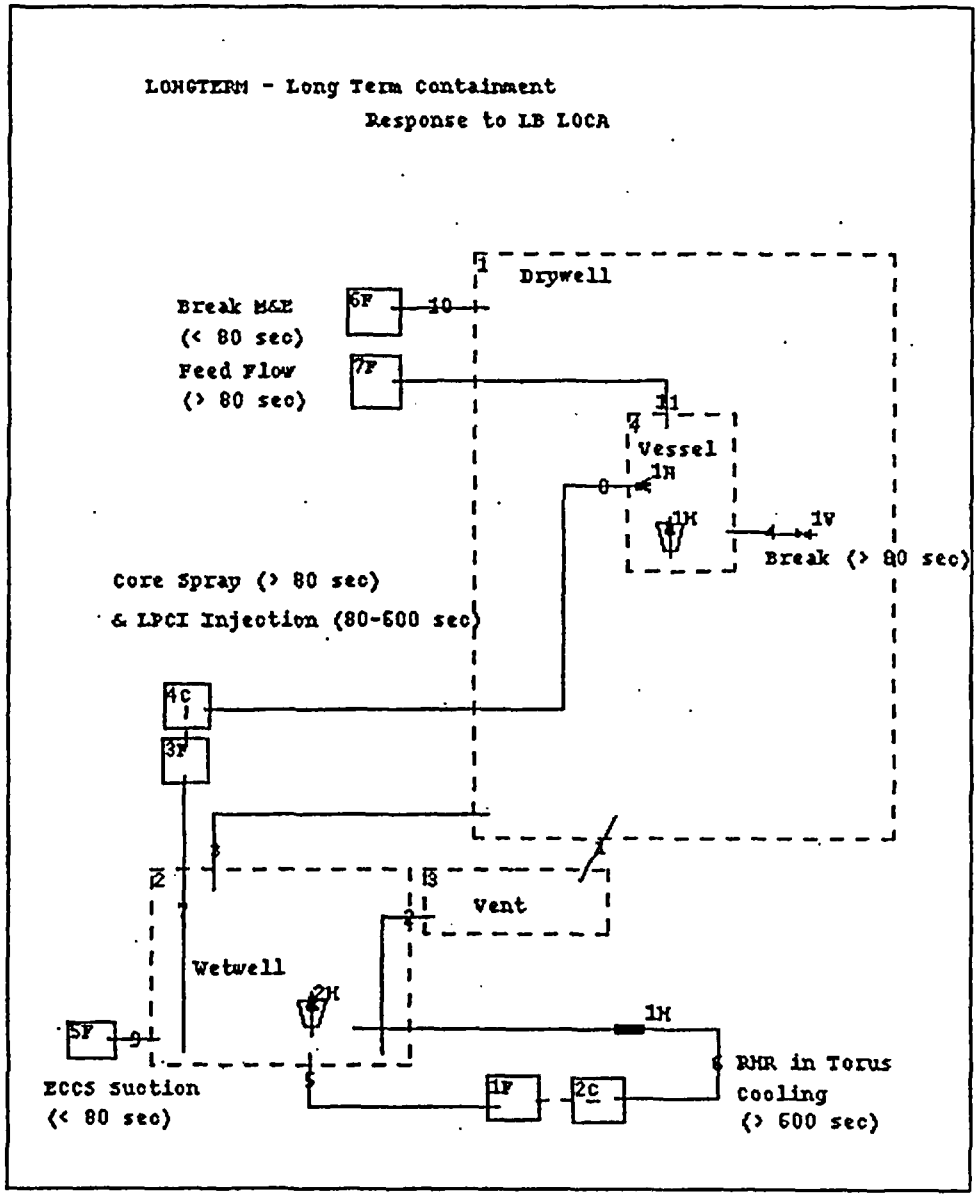
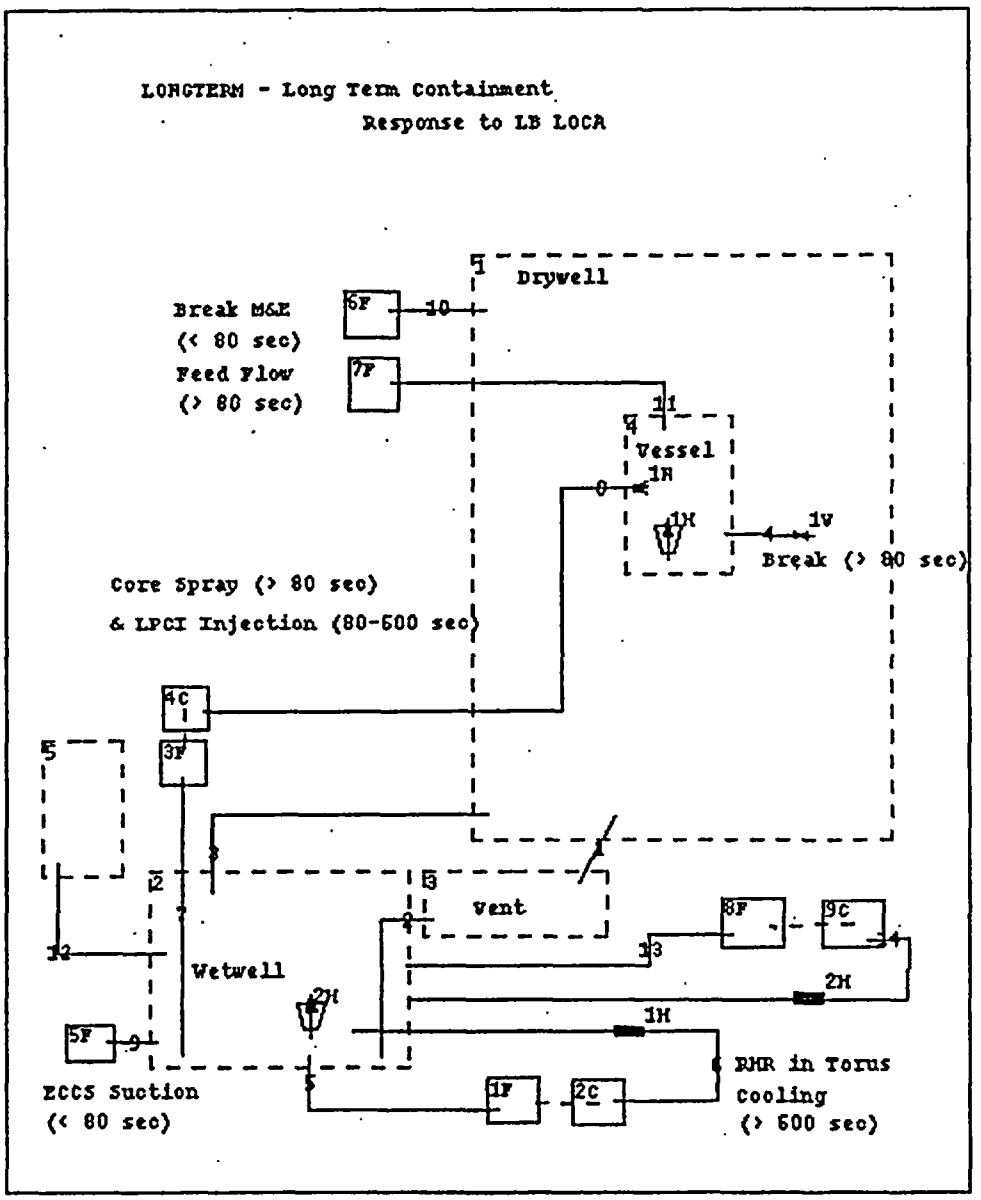


Figure 2-2

GOTHIC Study Model



SECTION 3

SUMMARY OF RESULTS

3.1. GOTHIC and SHEX Comparison

The GOTHIC and SHEX models for the comparison case used the same inputs to the extent of the computer code requirements. The GOTHIC and SHEX suppression pool temperature profiles are provided in Figure 3-1. The times corresponding to peak suppression pool temperature are approximately equal. The peak temperature comparison is presented in Table 3-1. The difference of 2.1°F is most likely due to the differences between SHEX and GOTHIC codes. For example, SHEX applies a constant heat exchanger "K" value whereas GOTHIC calculates the time variant heat exchanger performance based on the calculated conditions. The difference in peak temperature is not considered significant and the GOTHIC model is used in this sensitivity.

Table 3-1 GOTHIC and SHEX Comparison

Suppression Pool Peak Temperature	
GOTHIC	SHEX
192.6°F	194.7°F

3.2. GOTHIC RHR Study Results

The GOTHIC RHR sensitivity results are summarized in Figure 3-2 and Table 3-2. The suppression pool temperature with 2 RHR pump trains is 169.6°F and is below the containment overpressure threshold temperature of approximately 183°F.

Table 3-2 GOTHIC RHR Study Results

Suppression Pool Peak Temperature	
1 RHR	2 RHR
192.6°F	169.6°F

Figure 3-1

Suppression Pool Temperature Comparison

GOTHIC and SHEX Results

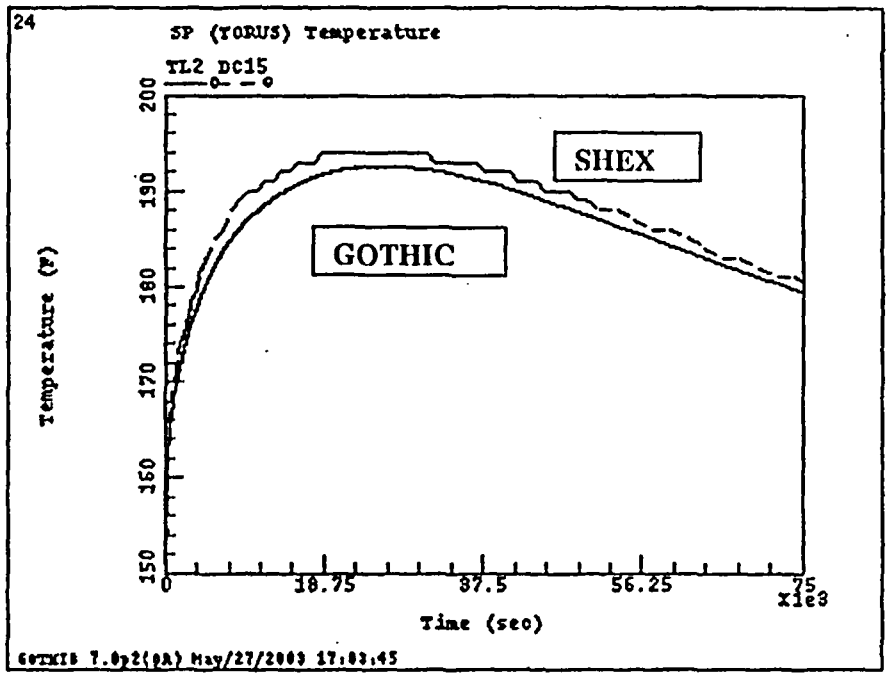
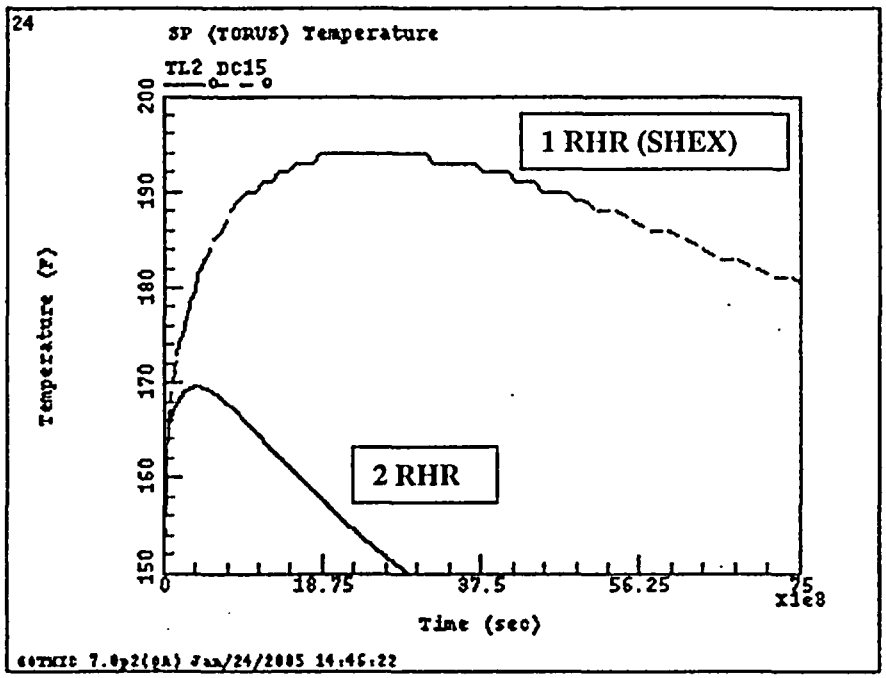


Figure 3-2

Suppression Pool Temperature Comparison

DBA 1 RHR and Study 2 RHR



SECTION 4

CONCLUSIONS

4.1. Suppression Pool Temperature

The suppression pool temperature following a DBA LOCA, assuming two trains of RHR in suppression pool cooling mode, is approximately 170°F. This temperature is well below the threshold for requiring containment over pressure to meet NPSH requirements.

SECTION 5

REFERENCES

(1) Letter, R. Ennis, USNRC to M. Kansler, ENO, Inc., "Request for Additional Information – Extended Power Uprate, Vermont Yankee Nuclear Power Station (TAC No. MC0761)," dated 31 December 2004.

(2) GE-NE-0000-0029-7076-R1, "VYNPS LOCA-DBA Long Term NPSH Information Transmittal – 15% per Day Leakage and 100% Containment Spray Thermal Mixing Efficiency," dated July 2004.

(3) ENVY Calculation VYC-1628, Revision 0, CCN-03, "Torus Temperature and Pressure. Response to Large Break LOCA and MSLB Accident Scenarios."

(4) ENVY Technical Evaluation TE-2003-038,"GOTHIC Benchmark of GE LOCA Model for Power Uprate," dated July 2003.

(5) ENVY Emergency Operating Procedure, EOP-3, Revision 3, "Primary Containment Control."

(6) VYNPS Design Basis Document for Residual Heat Removal (RHR) System, Revision 2.

(7) VYC-2208, Revision 0, GOTHIC 7.0 Code Installation, Validation and Verification at Vermont Yankee.

ATTACHMENT A- RAI Responses

Is the flow through each heat exchanger due to just one residual heat removal (RHR) pump and one service water pump?

Yes, the flow through each of the two heat exchangers is from one RHR pump and one RHR service water pump.

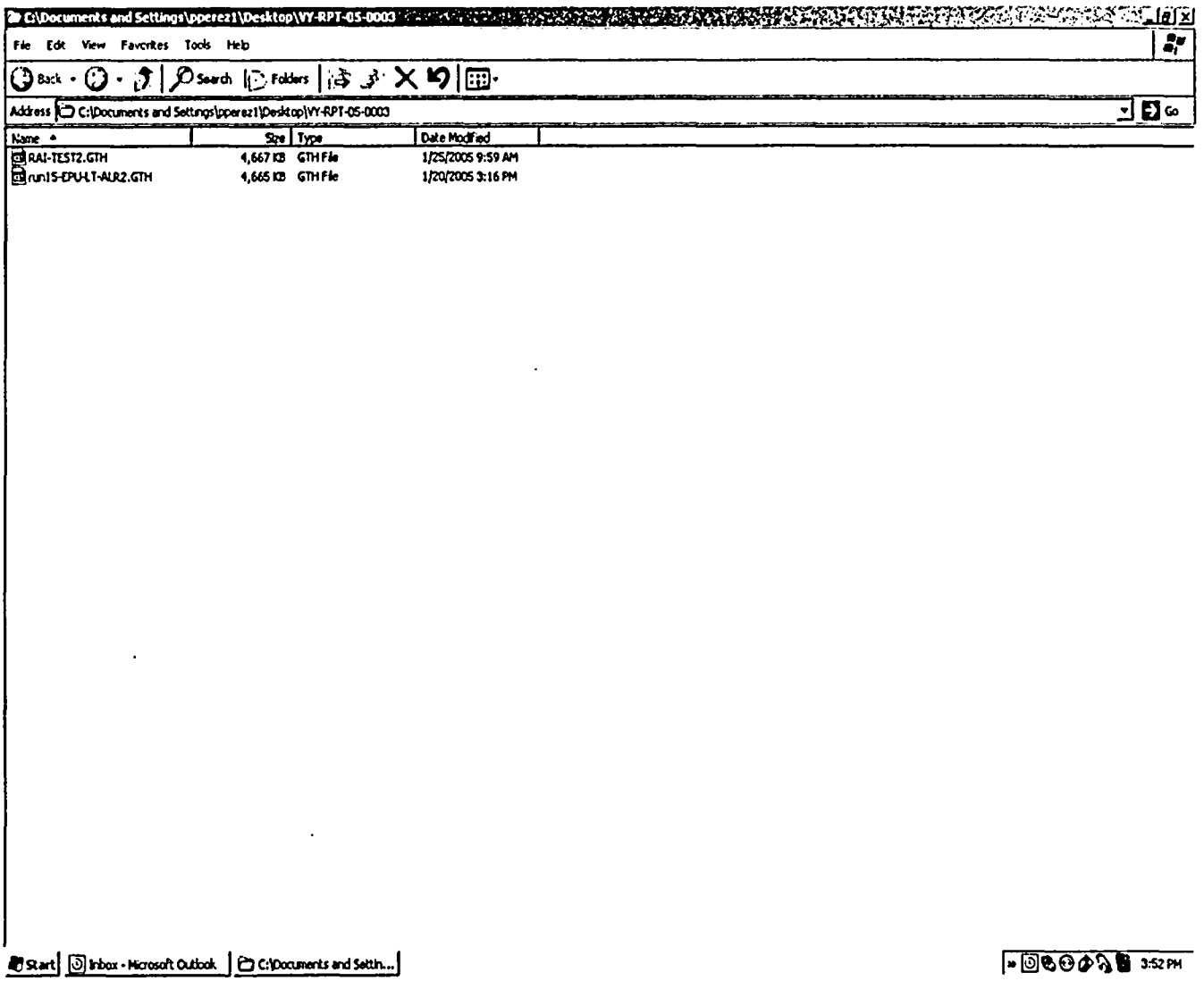
Under what conditions would the operator actually use both trains of RHR to cool the suppression pool as opposed to using one train to cool the suppression pool and one train to inject water into the reactor vessel?

The conditions would be best estimate where the ECCS is fully available and core spray adequately maintains the core cooling.

The RAI response states that the calculation was not performed to QA program requirements. The staff requests that this calculation be verified according to the VYNPS Appendix B program.

The initial calculation was performed to address a question from the State of Vermont. The calculation has been subsequently performed to QA requirements and documented in Engineering Report VY-RPT-05-00003.

Attachment B – CD VY-RPT-05-00003 Contents



Attachment C – Technical Review Comments And Resolution Form

Entergy

ENN Site Applicability: ☐ IP1 ☐ IP2 ☐ IP3 ☐ JAF ☐ PNPS ☒ VY

Engineering Report
Technical Review Comments and Resolutions Form

Engineering Report Number:	VY-RPT-05-0003	Rev. 0	Title	VYNPS Suppression Pool Cooling Study Performed With 2 RHR Pumps
Quality Related: ☒ Yes ☐ No		**Special Notes or Instructions: None**		

Comment Number	Section/ Page No.	Review Comment	Response/Resolution	Responsible Engineer's Accept Initials
1	**Various**	**Minor editorial changes.**	**Completed**	GBS
2	**References**	**Please add RHR DBD as a reference.**	**Completed**	GBS
3	**Section 3.2**	**Indicate/label data curves for graphs.**	**Completed**	GBS
Reviewed/ Verified By:		Pedro B. Pérez	Date: 2-10-05	
Site/Department:		VYNPS/Design Engineering, Fluid Systems	Phone: 802-451-3118	