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November 26, 1986

TMI-2 Cleanup Project Directorate
Attn: Dr. W. D. Travers
Director
US Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, PA 17057

Dear Dr. Travers:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Ex-Vessel Defueling Safety Analysis

Attached for your review and approval is the Safety Analysis (SA) for the Pressurizer Spray Line Defueling System. This system is designed to flush fuel fines and/or core debris from the Pressurizer Spray Line to the Pressurizer Vessel and the Reactor Coolant System Cold Leg Loop 2A. This evolution is currently scheduled to commence on December 22, 1986. The analysis demonstrates that the proposed activity can be accomplished without presenting an undue risk to the health and safety of the public.

Per the requirements of 10 CFR 170, an application fee of $150.00 is enclosed.

Sincerely,

F. R. Standerfer
Vice President/Director, TMI-2

FRS/CJD/eml

Attachments

Enclosed: GPU Nuclear Corp. Check No. 00027169

Dooq w/check
$150
00027169
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SAFETY ANALYSIS

SA # 4710-3255-86-006

Rev. # 1

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TITLE

SAFETY ANALYSIS REPORT

FOR THE

PRESSURIZER SPRAY LINE DEFUELING SYSTEM

Originator Rich M. Conrad Date 11/19/86

CONCURRENCE

Lead Engineer/RTR [signature] Date 11/19/86 SRG J J Barkyoumb Date 11-20-86

Cognizant Eng. R J Wolfgang Date 11/19/86 Rad Con [signature] Date 11-20-86

APPROVAL

Mgr. Eng. Section [signature] Date 11/20/86 Site Ops Director [signature] Date 11/20/86

FORM 4000-ENG-7310.09-1 (9/86)

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SAFETY ANALYSIS REPORT

FOR THE

PRESSURIZER SPRAY LINE DEFUELING SYSTEM (PSLDS)

1.0 INTRODUCTION

1.1 General

The Pressurizer Spray Line Defueling System (PSLDS) is designed to remove fuel fines and/or core debris from the Pressurizer Spray Line. The source of flush water will be from the Defueling Water Cleanup System. A flexible hose will run from the newly installed Defueling Water Clean-up System (DWCS) tie-in downstream of the filter canisters and end at a new tie-in attached to the Pressurizer Spray Line. Defueling will consist of flushing the Pressurizer Spray Line in a series of steps to adequately remove fuel fines and debris in each different flow path from the spray line tie-in. ⚠

The DWCS Filter Train B will be used for the PSLDS. Filter Train A is independent of Pressurizer Spray Line defueling activities. No physical changes are made or restrictions placed on Filter Train A. The ability to filter Reactor Vessel inventory (via Train A) during spray line defueling ensures that ex-vessel defueling will not interfere with in-vessel defueling efforts.

1.2 Scope

The scope of this document includes the operation of the PSLDS, the components of the PSLDS, and its tie-ins to the DWCS and Pressurizer Spray Line. This safety analysis report is applicable only during the recovery mode as the PSLDS is a temporary system required to support the ex-vessel defueling efforts and will be removed prior to restart of the plant.

1.3 Background

Due to the effects of the TMI-2 accident on March 28, 1979; fuel and/or core debris have been located throughout the Nuclear Steam Supply System (NSSS). A potential location for some of the fuel/core debris is the Pressurizer Spray Line. The Pressurizer Spray Line is a logical starting point for the defueling of ex-vessel components. Due to the small size of the spray line (2 1/2 inch), flushing is considered to be the most efficient and cost effective method of defueling.

2.0 SYSTEM DESCRIPTION

2.1 General

The Pressurizer Spray Line Defueling System is designed to carry filtered flush water from the DWCS Filter Train B to the Pressurizer Spray Line. The system's only function is to relocate

fuel fines and/or core debris (in the spray line and by-pass line) to the Pressurizer Vessel and Cold Leg Loop 2A for future fuel removal.

2.2 Operation

The Pressurizer Spray Line is flushed via a connection to the DWCS. The source water from the DWCS will be supplied at a flow rate of 200 gpm. The velocity developed by the 200 gpm flow rate would be approximately 18 fps for a 2 1/2" sch 160 pipe (spray line). With this velocity, a flush time of 30 minutes per flowpath will be used. Considering the flow rate, velocity and duration of this operation, the Pressurizer Spray Line volume will be displaced (defueled) over 580 times during a single flush period. This should be sufficient to assure that most of the loose core/fuel debris or any particulate will be relocated for future defueling. ⚠

2.3 Quality Classification

The quality classification of the PSLDS is Important To Safety (ITS). ITS as used in this document is defined in the TMI-2 Recovery Quality Classification List.

3.0 TECHNICAL EVALUATION

3.1 General

The PSLDS is totally contained within areas that have controlled ventilation and area isolation capability. This limits the environmental impact of the system during normal system operations, shutdown or postulated accident conditions. The effects of the potential PSLDS failures will be supplied below on a case-by-case basis.

The system failures analyzed are reactor vessel inventory loss via line/hose break, boron dilution, and criticality. The failure modes not covered by this safety analysis, but described in the DWCS TER (see Reference 1, Section 3.2) are loss of power and loss of instrumentation/instrument air. No unacceptable consequences were found to result from the operation of the PSLDS provided that proper administrative control is maintained. ⚠

3.2 Pressurizer Spray Line Defueling System Failures

3.2.1 Line or Hose Break

The principle consequence of any line/hose break is loss of reactor vessel inventory. This system is designed to mitigate the consequences of such an accident to the extent possible.

In case of a hose or line rupture on the PSLDS, the DWCS will trip the reactor vessel pumps on IIF low level and alarm at control panels located in the control room and the Fuel Handling Building. This type of accident could deliver approximately 500 to 1000 gallons of filtered reactor vessel water to the area of the rupture. The affected area would be within the Reactor Building, which has a sump to contain the spill.

The recovery from this event would be accomplished by isolating the ruptured section and replacing the ruptured hose or pipe.

3.2.2 Boron Dilution

The only credible means of attaining criticality of the fuel contained in the vessel is by deboration of the reactor coolant water. Deboration could develop from the misconnection of the defueling flexible hose to a nonborated source. To lessen the possibility of a misconnection, all valves, quick disconnect fittings and hoses (both ends) will be properly tagged and/or color coded. All valves used to operate/regulate and isolate the PSLDS shall be monitored by the Control Room in accordance with Procedure 4000-ADM-3020.04. In addition to valve monitoring, all hose connections as well as

valve alignment will be visually inspected prior to system start-up to ensure that the flush water flow path is as intended by design.

3.2.3 Criticality

Fuel accumulation in the PSLDS is precluded by the use of the DWCS, which will deliver filtered flush water for defueling.

During the course of the TMI-2 Recovery Operations, the Reactor Vessel inventory has been bled and fed a number of times. This cycling of the vessel water level would have caused the pressurizer water to combine with the Reactor Vessel water and create a more uniform boron concentration between the two vessels. Additionally, the Pressurizer Spray Line Defueling System, by virtue of its operation, will promote circulation of the vessel inventory; thus resulting in more uniform boron concentration. Hence, boron dilution/concentration is not a notable concern.

The PSLDS will transport fuel fines into the Pressurizer Vessel and Cold Leg Loop 2A. Under optimum conditions, a minimum of 70 kg of fuel is required for criticality (Ref. 6). The Pressurizer Spray Line is expected to contain a maximum of 0.1 kg of fuel, while the

Pressurizer Vessel and Reactor Coolant Cold Leg Loop 2A are expected to contain a maximum of 25 kg and 0.1 kg, respectively (Reference 5, Table 2.3-1) . Therefore, the small amount of fuel in the spray line could accumulate in either location, and the total amount of fuel would be less than the 70 kg limiting value. Therefore, a possible critical configuration of fuel debris is unlikely. In the event that 70 kg was introduced to the system, the boron concentration present would preclude a criticality. ⚠

4.0 RADIOLOGICAL AND ENVIRONMENTAL ASSESSMENT

4.1 On-Site Dose Assessment

The potential exists that defueling the Pressurizer Spray Line may increase the specific activity in the reactor vessel water. This could occur during operation of the PSLDS through disturbance of the core debris by the introduction of flush water into the Cold Leg Loop 2A. Fuel material greater than 0.5 microns and other soluble fission products should be removed by the operation of the DWCS Filter Train A. ⚠

4.2 Occupational Exposures

Operation of the DWCS Train A may reduce the occupational exposure during the defueling of the Pressurizer Spray Line by maintaining low specific activities in the reactor vessel (see Reference 1, Section 4.3).

The following table provides an estimate of the man-hours and man-rem associated with the installation, operation and removal of the Pressurizer Spray Line Defueling System. These estimates are based upon current man-hour projections:

LOCATION	ACTIVITY	MAN-HOURS	(mR/Hr) γ	MAN-REM
R.B. Floor at Elev. 348'-3"	Installation	4	100 mRem	.4
	Operation	0		--
	Removal	3		.3
"A" D-Ring at Elev. 367'-4"	Installation	1	80 mRem	.08
	Operation	0		--
	Removal	.75		.06
Pressurizer Missile Shield at Elev. 370'-4"	Installation	.5	50 mRem	.025
	Operation	3		.15
	Removal	.5		.025
Pressurizer Platform at Elev. 355'-3"	Installation	5	600 mRem	3.0
	Operation	1.5	*	.9
	Removal	3.5		2.1
			TOTAL	7.040

* There is a 12 Rem source present in the proximity of the grating platform at elevation 349'-9" south of the Pressurizer Vessel. This source must be adequately shielded prior to commencing the defueling activities.

The total man-rem attributable to the installation, operation, and removal of the PSLDS, as a whole, is expected to be between 6 and 11 man-rem. The estimate is based upon a total of 7.0 man-rem increased by 20% for RadCon coverage and allowing ± 30% due to uncertainties.

Personnel protection for airborne and other potential contamination generated by the installation, use and/or removal of the PSLDS will be addressed in the appropriate plant procedures.

5.0 SAFETY EVALUATION

5.1 Technical Specifications/Recovery Operations Plan

No additional Technical Specifications/Recovery Operations Plan changes are required to install and operate the PSLDS.

5.2 Safety Questions (10CFR50.59)

10CFR50, Paragraph 50.59, permits the holder of an operating license to make changes to the facility or perform a test or experiment, provided the change, test, or experiment is determined not to be an unreviewed safety question and does not involve a modification of the plant technical specifications. ⚠

A proposed change involves an unreviewed safety question if:

a) The possibility of the consequence of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report may be increased; or

b) The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report may be created; or

c) The margin of safety, as defined in the basis for any technical specification, is reduced.

The Pressurizer Spray Line Defueling System (PSLDS) does not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in a safety analysis report. The system failures evaluated are presented in Section 3.2 of this report. The PSLDS was found to have no failures that would increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety (ITS).

The possibility of an accident or malfunction of a different type than previously evaluated in this safety analysis report is not created by the existence of the PSLDS. The PSLDS is essentially a flushing system to transport fuel fines and/or core debris from the Pressurizer Spray Line to the Pressurizer Vessel and Cold Leg Loop 2A.

Operation of the Pressurizer Spray Line Defueling System does not result in a reduction in the margin of safety as defined in the bases for the Technical Specifications (Reference 4). Liquid effluents will not be released to the environment directly from the PSLDS operations. The effluents from the operation of the PSLDS will be returned to the sources in order to maintain proper specific activity and water levels. The results of the radioactive release analysis presented in the DWC Technical Evaluation Report (Reference 1) therefore bound the releases from the PSLDS. Since no change in the maximum permissible concentrations specified in Appendix B of the Technical Specifications (Reference 4) was required for the DWCS operation and since the PSLDS operation is bounded by the DWCS operation, no changes are required for the PSLDS operation.

Based on the above, the installation and operation of the PSLDS does not present an unreviewed safety question as defined in 10CFR50.59.

6.0 CONCLUSIONS

Based on this Safety Analysis Report, the Pressurizer Spray Line may be defueled without any adverse safety effects.

The effects of the potential failures of the PSLDS identified in Section 3.2 were found acceptable, provided that proper administrative control is maintained. All possible modes of failure have been incorporated into the design of the PSLDS and/or are bounded by the operation of the DWCS. Therefore, the installation, operation and removal of the PSLDS should provide minimal effects to personnel and no effects to the public.

7.0 REFERENCES

1. TER 15737-2-G03-106 Rev. 9, "TMI-2 Division Technical Evaluation Report for the Defueling Water Cleanup System."

2. DC 3255-86-0003 Rev. 0, "TMI-2 Design Criteria for Pressurizer Spray Line Defueling System."

3. Code of Federal Regulations 10 (Energy) Part 50 Paragraph 50.59, Revised as of January 1, 1985.

4. Three Mile Island Nuclear Station Unit 2 Operating License Number DPR-73 with the Recovery Technical Specification.

5. TPO/TMI-186 Rev. 0, "A strategy for the recovery program completion and post-recovery configuration;" Volume 2 - Technical Basis.

6. Technical Plan for Ex-RCS Criticality Safety, TPO/TMI-132, TMI-2 Technical Planning Department, Nov. 1985. ⚠1