10 CFR PART 72 SCREEN

Screen No. 11-010

Facility Name: TMI-2 ISFSI Change No.: EDF-9897

Activity Description: EDF-9897 is devleoped to document the 2010 HSM and base mat concrete field inspection and evaluation performed August and September 2010. This EDF documents with photographs and description the concrete condition in 2010. The annual field inspection is a recommendation in EDF-8903 and EDF-9516 to assure noted cracking has not developed to a point that it might affect the structural capacity, radiation shielding capacity, or thermal capacity HSM safety functions. These photographs are used to compare any change that may have occurred since the 2008 concrete evaluation documented in EDF-8903 and the WJE inspection documented in EDF-9516. During this inspection notable active cracking and efflorescence growth was observed in new and exiting locations indicating cracking is active. The polyurethane foam recommended in EDF-9516 has been installed. Since the structural capacity has not been reduced and no concrete thickness has been lost, neither the structural capacity, radiation shielding capacity or thermal capacity of the HSM affecting the safety functions of the HSM has been changed.

Use of this form must be in accordance with MCP-2925. Sufficient activity description, justifications, and documents reviewed must be provided to permit an independent reviewer to reach the same conclusions. The discussions in Appendix A should be used to develop any justifications documented below.

1. License Condition or Technical Specification: (Complete this section for all Part 72 screens.)

1a.	Does the activity require any change, even editorial, to the license or technical specifications?	☐ Yes	☒ No
1b.	Does the activity require an exemption to any NRC regulations?	☐ Yes	☒ No
1c.	Is the activity a change to or require a change to FSV SAR Section 7.7, 9.3, or Chapter 11; or TMI-2 SAR Section 7.6, 9.3, or Chapter 11; or ISFF SAR Section 7.6.1.4, 9.3, or Chapter 11?	☐ Yes	☒ No

Justification: This activity resulted in no action that would require any change to the license or technical specifications. This activity resulted in no action that would require an exemption to any NRC regulations. This activity resulted in no action that would require a change to TMI-2 ISFSI SAR Section 7.6, 9.3, or Chapter 11.

Documents Reviewed: TMI-2 ISFSI Technical Specifications, TMI-2 ISFSI SAR Section 7.6 R5, Section 9.3 R7, Chapter 11 R5, EDF-8903, and EDF-9516.

If the answer to 1a or 1b is "Yes" the activity may not be implemented until NRC approval is obtained. If the answer to 1c is "Yes" a ***72.44 Evaluation*** in accordance with MCP-2925 is required before the activity may be completed.

2. Facility Change: If the activity is a physical change (addition, modification, or removal) within a facility or to any equipment or structure, or to any design document (drawing, calculation, analysis, specification, design input or assumption, etc.), then complete this section. Also complete this section for changes to the SAR. Otherwise indicate **N/A** at the end of this section.

2a.	Does the activity adversely affect a design function of equipment or structures described in the SAR or TS Bases?	☐ Yes	☒ No
2b.	Does the activity adversely affect a method of performing or controlling a design function of equipment or structures described in the SAR or TS Bases?	☐ Yes	☒ No
2c.	Does the activity adversely affect an evaluation which demonstrates the design functions of equipment or structures described in the SAR or TS Bases?	☐ Yes	☒ No
2d.	Does the activity result in a change to the Technical Specification Bases?	☐ Yes	☒ No

Justification (include effects that are not adverse): The activity does not identify a condition that currently adversely affects a design function of equipment or structures described in the SAR or TS Bases. The activity does not identify a condition that currently adversely affects a method of performing or controlling a design function of equipment or structures described in the SAR or TS Bases. The activity does not adversely affect an evaluation which demonstrates the design functions of equipment or structures described in the SAR or TS Bases. The activity does not result in a change to the Technical Specification Bases.

Documents Reviewed: TMI-2 ISFSI SAR, Technical Specification Bases, EDF-8903, and EDF-9516.

10 CFR PART 72 SCREEN

If any answer in Section 2 is "Yes" then a ***72.48 Evaluation*** in accordance with MCP-2925 is required before the activity may be completed.

3. Procedure Change: If the activity is a change to facility operation, maintenance, transport, test, or experiment procedures, then complete this section. Also complete this section for changes to the SAR. Otherwise indicate **N/A** at the end of this section.

   Is the activity a modification to, addition to, or removal from any procedure that adversely affects the operation and control of equipment or structures as described in the SAR or TS Bases? ☐ Yes ☒ No

   Justification (include effects that are not adverse): N/A

   Documents Reviewed: N/A

   If this answer is "Yes" then a ***72.48 Evaluation*** in accordance with MCP-2925 is required before the activity can be completed.

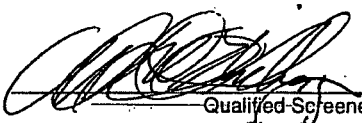
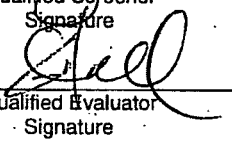
Conclusion:

If all the questions on this form are answered "No", then the signatures on this form will complete the 10 CFR Part 72 regulatory screen and the activity may proceed.

Assumptions & Limitations:

This activity is a follow on activity addressed in EDF-8903, the visual inspection performed in 2008. The purpose of this activity is to identify actions necessary to mitigate and preclude any condition that might reduce the ability of the HSM to maintain the safety functions of structural capacity, radiation protection capacity, and thermal capacity caused by the identified concrete cracking.

APPROVALS (Signature signifies that screener/reviewer has confirmed with requester that change package was complete and accurate before performing/reviewing the screen.)

M. D. Wilberg Completed By Qualified Screener Print/Type Name	 Qualified Screener Signature	4/19/11 Date
G. G. Hall Independent Review By Qualified Evaluator Print/Type Name	 Qualified Evaluator Signature	4/19/11 Date

ENGINEERING DESIGN FILE

EDF No.: 9897 EDF Rev. No.: 0 Project No.: NA FCF and/or FDC No.: NA

1. Title: TMI-2 ISFSI 2010 HSM and Base Mat Concrete Evaluation

2. Index Codes: Building/Type CPP-1774 SSC ID HSM 01 - 30 Site Area INTEC

3. Formal Calculation? ☒ Yes (MCP-2374) ☐ No (MCP-2059) Quality Level: 1 QLD Number: 2880

Formal analyses and calculations require engineering management approval.

*4. NPH PC or SDC:	or ☒ N/A	SSC Safety Category:	or ☒ N/A
*5. (a) Affects Safety Basis:	☒ Yes ☐ No	(b) Affects SNF/HLW:	☒ Yes ☐ No

6. Summary:

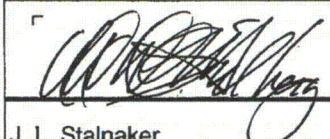
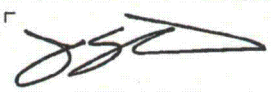
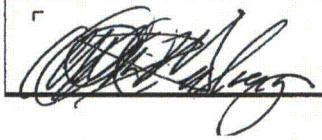
This Engineering Desing File (EDF) documents the 2010 concrete field inspection and evaluation for the Three Mile Island Unit 2 (TMI-2) Independent Spent Fuel Storage Installation (ISFSI) at the Idaho Nuclear Technology and Engineering Complex (INTEC) Facility CPP-1774.

The 30 concrete Horizontal Storage Module (HSM)s and base mat were inspected from August 24 through September 1, 2010 as recommended in EDF-8903, TMI-2 HSM 2008 Evaluation Report - ACI 349.3R7, Revision 0. During the inspection notable active cracking and efflorescence growth was observed in new and exiting locations in 23 of the 30 HSMs and the base mat since the 2008 inspection and evaluation.

In 2009 polyurethane foam was placed in the roof bolt hole voids as a measure to stop active cracking. No measurements were takenof the existing cracks in 2009 to identify any increased cracking or efflorescence growth caused during the 2008 winter. Therefore, validation of the effectiveness of the installation of the polyurethane foam cannot be made until after the 2011 annual HSM and base mat concrete inspection and evaluation and crack gage readings has been completed. Installation of the nut and plate flashing should not occur until after verification of the effectiveness of the polyurethane foam has been completed.

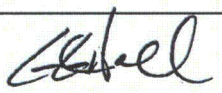
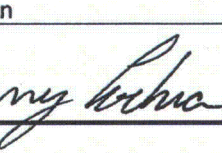
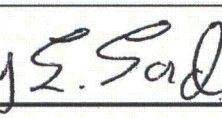
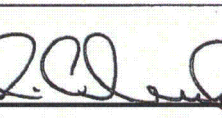
The annual HSM and base mat concrete inspection and evaluation need to be completed in 2011 and continue to be completed annually thereafter to verify measures to stop cracking and efflorescence growth are affective. Cracking and deterioration of the HSMs and base mat concrete will continue until the existing cracks are sealed.

7. Signatures: (See instructions for significance of signatures. Add or delete signatories as needed.)

Name (typed or printed) / Signature and Date	Signatory Role	Organization / Discipline
M. D. Wilberg  04/04/2011	Author	ISFSI Management / 5290 / Design Agent
J. L. Stalnaker  04/04/2011	Technical Checker	ISFSI Management/ 5290 / Technical Checker
	Reviewer	na / * Independent Peer Reviewer (see instructions, Item 7, Note 2)
M. D. Wilberg  04/04/2011	Reviewer	ISFSI Management / 5290 / Requestor (if applicable)

ENGINEERING DESIGN FILE

EDF No.: 9897 EDF Rev. No.: 0 Project No.: NA FCF and/or FDC No.: NA

G. G. Hall 	Reviewer	ISFSI Management / 5290 Regulatory Compliance
D. D. Cochran 	Reviewer	QA Systems & Ops Support/ 2510 * Quality Assurance (only if 5(b) is "Yes")
H. L. Lord 	Reviewer	ISFSI Management/ 5290 * Nuclear Safety (only if 5(a) is "Yes")
R. K. Elwood 	Document Owner	ISFSI Management / 5290 Document Owner

8. Does document contain sensitive unclassified information? ☐ Yes ☒ No
   If Yes, what category:

9. Will document be externally distributed? ☒ Yes ☐ No

10. Registered Professional Engineer's Stamp (if required) ☒ N/A

Registered Professional Engineer Stamp

This Engineering Design File was prepared under the direction of the Registered Professional Engineer as indicated by the stamp and signature provided on this page. The Professional Engineer is registered in the State of Idaho to practice _____ Engineering.

* Not required for commercial level calculations.

Purpose

The purpose of this Engineering Design File (EDF) is to provide documentation of the continued inspection and evaluation of the Three Mile Island Unit 2 (TMI-2) Independent Spent Fuel Storage Installation (ISFSI) Horizontal Storage Module (HSM) and base mat concrete. This inspection was completed September 1, 2010. The evaluation is completed with the approval of this EDF.

This inspection and evaluation of the TMI-2 HSM and base mat concrete is a continuing activity based upon recommendation No. 3 of EDF-8903, *TMI-2 HSM 2008 Evaluation Report – ACI 349.3R7* [1]. Recommendation No. 1 of EDF-8903 was to contract a firm with professional, trained, and experienced personnel in testing and analyzing concrete structures to perform a site investigation and laboratory studies of HSM and base mat concrete. Wiss, Janney, Elstner (WJE), Northbrook, Illinois, was contracted to perform this recommended inspection and evaluation and this work was completed July 31, 2009. The work of WJE is documented in EDF-9516, *TMI-2 ISFSI Concrete Evaluation of Horizontal Storage Module (HSM) and Base Mat* [2] and RFP No. 00713089, *TMI 2 HSM and Pad CPP-1774 Inspection* [3].

One of the recommendations made by WJE was to seal and eliminate the bolt hole voids in the roof slab of the HSM. This work was partially completed in October 2009 and is documented in EDF-9565, *TMI-2 ISFSI Horizontal Storage Module (HSM) Roof Slab Bolt Holes Filled with Polyurethane Foam* [4].

Assumptions

EDF-8903 establishes the "cracked" base line physical condition of the HSM concrete for each HSM 01 through 30 and the concrete base mat. As stated in EDF-8903 "In 2008 the facility management of TMI-2 ISFSI determined it was necessary to perform a comprehensive visual inspection to establish a baseline of the current condition of the HSMs. Management and engineering of TMI-2 did not consider the 2000 and 2007 surveys comprehensive enough to establish a sound baseline." This base line represents the cracked and efflorescence condition of the HSMs and base mat in 2008 and is documented in EDF-8903, Section 3.0, Present Condition of Structures, and Appendix A.

EDF-9516 establishes maintenance activities necessary to assure the HSM and base mat concrete are maintained in a condition equal to or better than the base line described in EDF-8903.

Crack severity (crack width) is based upon *Concrete Repair Manual*, Third Edition, Volume 1, published jointly by; American Concrete Institute (ACI) and International Concrete Repair Institute (ICRI), Diagnosis of Deterioration in Concrete Structures, Table 1: Examples of Classification of Defects, Cracks in reinforced concrete due to overloading [5]. Two deviations are made to Table 1. First, the damage rating 1 (very slight) value per Table 1, less than 0.004 inch (0.1 mm), is adjusted to 0.005 inch (0.12 mm) for the crack severity width for convenience of crack measurement during inspection because 0.005 inch is the smallest width reading on the crack comparator used for this inspection. Secondly, damage rating 4 (severe) width upper value is 0.118 inch (3 mm) and the lower value width of damage rating 5 (very severe) is greater than 0.197 inch (5 mm) skipping the widths between 0.118 inch and 0.197 inch. The lower crack severity rating 5 (severe) will be adjusted to greater than 0.118 inch rather than 0.197 inch thereby including the crack widths between 0.118 inch and 0.197 inch. Additionally, two categories of crack dispersion through out the roof slab will be added to the Crack Severity Rating table; Crack dispersion across roof top surface and crack spread through out roof vertical side faces. These two categories are added to the crack width providing more comprehensive significance to the crack severity rating. With this severity rating a roof corner with smaller crack widths may be raised in severity rating because of the extent of the crack dispersion. Spalling is not required for a severity rating but is an additional indicator of concrete deterioration. American Concrete Association (ACI) *Code Requirements for Nuclear Safety Related Concrete Structures*, ACI 349 is the design code for the HSMs and is used in EDF-8903 to evaluated concrete degradation. ACI 349 has three criteria designators to evaluate concrete degradation: first-tier evaluation, second-tier evaluation, and exceed second-tier criteria. This ACI criterion is included in the Crack Severity Rating. A crack severity rating includes all categories of the table below the severity rating.

The inspection is a field exercise to visually observe the existing physical condition of the HSM and base mat concrete, measure existing cracking and efflorescence, and document proof of condition with photographs.

The work completed by WJE in 2009 is considered to be the 2009 annual inspection of the TMI-2 HSMs and base mat concrete. This inspection did not document the cracking condition of each HSM. The inspections performed in the 2008 and 2010 did document the cracking condition of each HSM. Therefore the comparison for the evaluation will be between the inspection information collected in 2008 and 2010.

The 2010 inspection is documented in the photos contained in Appendix A, Part I, II, and III (electronic file) and Appendix B, of this EDF. These photos are used to evaluate the activity of cracking, efflorescence growth, and effectiveness of the installed polyurethane foam.

The evaluation is the comparison of crack and efflorescence changes between the 2008 and 2010 inspection photos contained in Appendix A of each EDF and assignment of the crack severity designation.

The placement of polyurethane foam in the bolt hole voids penetrating the roof slab recommended by WJE was completed in October 2009. The placement of this foam is to prevent water from being contained and freezing in the cold weather and causing the concrete to crack. It is assumed that the placement of this polyurethane has prevented water from being contained and freezing in the bolt hole

voids therefore precluding new cracks from developing and existing cracks from growing. Since there was not a detailed inspection performed in 2009 the increased cracking noted in 2010 is presumed to have occurred in the cold weather between 2008 fall and 2009 winter/ spring. This presumption will not be verified until the inspection and evaluation of 2011 is complete. Inactive degradation can be determined by the quantitative comparison of the current observed condition with that of prior inspections. Therefore, the evaluation in 2011 will compare the cracking measured in 2011 to that measured in 2010 to determine whether the polyurethane foam has stopped the concrete degradation caused by freezing water in the bolt hole voids. Sealing of these bolt hole voids will not be complete until the recommended nut and plate flashing has been installed.

Calculation Inputs

There are no calculations for this engineering analysis.

The following data will be used for the engineering analysis.

Document Review

- EDF-8903, *TMI-2 HSM 2008 Evaluation Report – ACI 349.3R7*, [R0], 27 August, 2008
- EDF-9516, *TMI-2 ISFSI Concrete Evaluation of Horizontal Storage Module (HSM) and Base Mat*, [R0], 06 April, 2010
- EDF-9565, *TMI-2 ISFSI Horizontal Storage Module (HSM) Roof Slab Bolt Holes Filled with Polyurethane Foam*, [R0], 12 May, 2010
- Wiss, Janney, Elstner Associates, Inc., *Three Mile Island Facility CPP-1774 Structural Inspection of Horizontal Storage Modules and Pad*, WJE Northbrook, Illinois, 2009 [EDMS Document No., WJE NO.2008.1917], 31 July 2009

Field Investigation

The HSM and base mat concrete inspection, crack measurement, and photography were performed August 24 through September 1, 2010 and it was performed by the same personnel that completed the 2008 inspection.

Visual Inspection

The visual inspection of photographs, crack comparison, and crack severity designation between the 2008 and 2010 inspection documentation was made by the same personnel that performed the field investigations.

Crack Severity Designation

The crack severity rating is based upon the four severity category (Crack width, Crack dispersion across roof top surface, Crack spread through out roof vertical side faces, and ACI 349 Evaluation Criteria) criteria listed below each severity rating in Table 1.

Table 1

Crack Severity Rating					
Severity	1 (very slight)	2 (slight)	3 (moderate)	4 (severe)	5 (very severe)
Crack width	< 0.005 inch (0.12 mm) (adjusted)	0.005 inch (0.12 mm) - 0.012 inch (0.3 mm)	0.012 inch (0.3 mm) - 0.039 inch (1 mm)	0.039 inch (1 mm) - 0.118 inch (3 mm)	> 0.118 inch (3 mm) (adjusted)
Crack dispersion across roof top surface	Mainly around bolt hole	Extending beyond bolt hole	Wide spread over roof top surface to side face edges	Through out roof corner top surface to both side faces	Through out roof corner top surface to both side faces
Crack spread through out roof vertical side faces	Not on corner side faces	Not on corner side faces	Some extending across roof surface continuing through corner side faces	Through out corner side faces from top roof surface to bottom with spalling	Through out corner side faces from top roof surface to bottom with spalling
ACI 349 Evaluation Criteria	First-Tier: passive cracks, <0.015 in (0.4 mm) maximum, spalling <3/8 inch deep and 4 inch any dimension		Second-Tier: passive cracks, <0.04 in (1mm) maximum, spalling	Exceeds second-tier criteria: active cracking, cracking damage can continue or intensify	

This crack severity rating does not relate or correspond to the safety function of structures, systems, or components or items related to safety. This crack severity rating defines the extent of cracking damage which influences the rate of deterioration of the concrete and the magnitude and type of repair needed to restore the concrete to a non damaged condition.

Computer Hardware and Software

No computer hardware or software was used for the analysis.

Summary and Conclusions

Summary

The annual HSM and base mat concrete inspection was performed August 24 through September 1, 2010. There are a number of notable changes in HSM conditions from 2008 to 2010. There are not as notable changes in the Base Mat from 2008 to 2010. A description of the notable changes in the condition of each HSM and base mat follows.

HSM 01

- North East Corner; bottom of the roof slab has notable increase in efflorescence growth in exiting cracks, indicating water is migrating through the cracking in the roof slab. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part I, Photos HSM 01 through 10, page 17)

- North West Corner; cracking in existing cracks in the top of the roof slab has increased in width 0.060 inch in 2008 to 0.075 inch in 2010. This indicates active cracking continues. Cracking in existing cracks in the bottom of the roof slab has also increased in width 0.050 inch in 2008 to 0.055 inch in 2010 and 0.030 inch 2008 to 0.035 inch in 2010. This indicates active cracking continues through the slab thickness. A crack gage has been attached to the roof top and roof face at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 22 & 36)

HSM 02

- South West Corner; top corner of the base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the crack. Crack severity in this corner is rated 2 – slight. (Appendix A, Part I, Photos HSM 01 through 10, page 46)

- North West Corner; cracking in existing cracks in the top of the roof slab has increased in width 0.060 inch in 2008 to 0.075 inch in 2010. This indicates active cracking continues. Cracking in existing cracks through the face of the roof slab from top of slab to bottom have visually increased in width and separation since 2008. Cracking in existing cracks in the bottom of the roof slab have increased in width 0.013 inch in 2008 to 0.035 inch in 2010. A crack gage has been attached to the roof top at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 56, 58 & 62)

HSM 03

- South East Corner; bottom corner of the roof slab has notable bug hole openings indicating the concrete surface continues to deteriorate. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part I, Photos HSM 01 through 10, page 75)

- North East Corner; cracking in existing cracks through the face of the roof slab from top of slab to bottom have visually increased in width and separation with some spalling since 2008. This indicates active cracking continues. Roof slab has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the crack. A crack gage has been attached to the roof top and roof face at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 85, 90 & 93)

HSM 04

- South East Corner; top corner of the base has notable spalling since 2008 indicating the concrete continues to deteriorate. A crack gage has been attached to the roof face at this corner. The crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 114)

- North East Corner; cracking in existing cracks in the top of the roof slab has increased notably since 2008. This indicates active cracking continues. Roof slab has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the crack. A crack gage has been attached to the roof top at this corner. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part I, Photos HSM 01 through 10, page 123 & 127)

HSM 05

- North East Corner; cracking in existing cracks in the top of the roof and the face of the roof slab has increased notably since 2008 including some spalling. This indicates active cracking continues. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 154 & 161)

- North West Corner; cracking in existing cracks through the face of the roof slab from top of slab to bottom have visually increased in width and separation since 2008. Cracking has increased in width 0.060 inch in 2008 to 0.25 inch in 2010. This indicates active cracking continues. A crack gage has been attached to the roof top and roof face at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 168 & 175)

HSM 06

- North East Corner; cracking in existing cracks in the top of the roof and the face of the roof slab has increased notably since 2008. Cracking has increased in width 0.050 inch in 2008 to 0.075 inch in 2010. This indicates active cracking continues. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 194)

- North West Corner; a crack gage has been attached to the roof face at this corner. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part I, Photos HSM 01 through 10, page 206)

HSM 07

- South West Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the crack. Notable hole growth indicates the concrete surface continues to deteriorate. Crack severity in this corner is rated 2 – slight. (Appendix A, Part I, Photos HSM 01 through 10, page 213)

- North East Corner; crack growth in top of the roof and face of the roof slab has increased notably. This indicates active cracking continues. The crack severity in this corner is rated 4 – severe. (Appendix A, Part I, Photos HSM 01 through 10, page 219 & 221)

HSM 08

No notable change in 2010.

HSM 09

- South East Corner; bottom of roof slab has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof slab. Top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 3 – moderate, for the roof, and 2 – slight, for the base. (Appendix A, Part I, Photos HSM 01 through 10, page 265 & 266)

- North East Corner; cracking in existing cracks in the top of the roof and the face of the roof slab has increased notably since 2008. Cracking has increased in width 0.025 inch in 2008 to 0.035 inch in 2010 and 0.125 inch in 2008 to 0.375 inch in 2010. This indicates active cracking continues. A crack gage has been attached to the roof face at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part I, Photos HSM 01 through 10, page 276 & 277)

HSM 10

No notable change in 2010.

HSM 11

- North West Face; existing spalling at the bottom of the roof slab has increased indicating deterioration of concrete is continuing. Crack severity in this area is rated 2 – slight. (Appendix A, Part II, Photos HSM 11 through 20, page 26)

HSM 12

North East Corner; existing cracking has notable loss of concrete (spalling) on roof face since 2008. This indicates active cracking continues. Roof face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof cracks. A crack gage has been attached to the base face in this corner. Crack severity in this corner is rated 4 – severe, for the roof, and 2 – slight, for the base face. (Appendix A, Part II, Photos HSM 11 through 20, page 45, 46, 49 & 53)

HSM 13

No notable change in 2010.

HSM 14

North East Corner; cracking in existing cracks in bottom corner of the roof slab has increased in width 0.010 inch in 2008 to 0.035 inch in 2010. This indicates active cracking continues. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part II, Photos HSM 11 through 20, page 102)

HSM 15

North East Corner; roof face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof cracks. Crack severity in this corner is rated 2 – slight. (Appendix A, Part II, Photos HSM 11 through 20, page 134)

HSM 16

No notable change in 2010.

HSM 17

South West Corner; crack gage is attached to the top of the roof slab in this corner. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part II, Photos HSM 11 through 20, page 179)

North West Corner; crack gage is attached to the top of the roof slab in this corner. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part II, Photos HSM 11 through 20, page 186)

HSM 18

South West Corner; tiger foam looks very good, good color, and good flexibility – no visible water - appears to have stopped cracking. Crack severity in this corner is rated 1 – very slight. (Appendix A, Part II, Photos HSM 11 through 20, page 196)

North East Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 2 – slight. (Appendix A, Part II, Photos HSM 11 through 20, page 214)

HSM 19

North East Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Cracking in existing cracks in top corner of the base has increased in width 0.016 inch in 2008 to 0.025 inch in 2010. This indicates active cracking continues. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part II, Photos HSM 11 through 20, page 234 & 235)

North West Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Cracking in existing cracks in top corner of the base has increased in width 0.004 inch in 2008 to 0.020 inch in 2010 and 0.010 inch in 2008 to 0.060 in 2010. This indicates active cracking continues. A crack gage has been attached to the base face at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part II, Photos HSM 11 through 20, page 244, 245, & 246)

HSM 20

North West Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 1 – very slight. (Appendix A, Part II, Photos HSM 11 through 20, page 286 & 288)

HSM 21

North East Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 1 – very slight. (Appendix A, Part III, Photos HSM 21 through 30, page 30)

HSM 22

North East Corner; top of base has crack gage attached to the base face. Crack severity in this corner is rated 4 – severe. (Appendix A, Part III, Photos HSM 21 through 30, page 56)

North West Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 4 – severe. (Appendix A, Part III, Photos HSM 21 through 30, page 58)

HSM 23

South East Corner; roof face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof cracks. Crack severity in this corner is rated 2 – slight. (Appendix A, Part III, Photos HSM 21 through 30, page 72)

North East Corner; top of base has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 2 – slight. (Appendix A, Part III, Photos HSM 21 through 30, page 88)

North West Corner; top of roof has crack gage attached. Crack severity in this corner is rated 2 – slight. (Appendix A, Part III, Photos HSM 21 through 30, page 91)

HSM 24

North East Corner; a crack gage has been attached to the base face. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part III, Photos HSM 21 through 30, page 115)

North West Corner; top of roof has crack gage attached. Crack severity in this corner is rated 2 – slight. (Appendix A, Part III, Photos HSM 21 through 30, page 128 &129)

HSM 25

North West Corner; roof face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof slab. Top of roof has crack gage attached. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part III, Photos HSM 21 through 30, page 157 & 159)

HSM 26

South East Corner; roof face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof cracks. Cracking in existing cracks in roof slab face has increased in width 0.025 inch in 2008 to 0.035 inch in 2010 and 0.016 inch in 2008 to 0.025 in 2010. This indicates active cracking continues. Base face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. A crack gage has been attached to the roof face at this corner. Crack severity in this corner is rated 4 – severe, for the roof, and 1 – very slight, for the base face. (Appendix A, Part III, Photos HSM 21 through 30, page 173, 174, 175 & 177)

North West Corner; base face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. Crack severity in this corner is rated 2 – slight. (Appendix A, Part III, Photos HSM 21 through 30, page 196)

HSM 27

North West Corner; notable spalling on roof slab face indicating surface deterioration is continuing. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part III, Photos HSM 21 through 30, page 234)

HSM 28

North East Corner; roof face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the roof cracks. Base face has notable increase in efflorescence growth in existing cracks, indicating water is migrating through the base cracks. A crack gage has been attached to the roof top at this corner. Crack severity in this corner is rated 3 – moderate, for the roof, and 2 – slight, for the base face. (Appendix A, Part III, Photos HSM 21 through 30, page 257, 259 & 260)

HSM 29

North East Corner; top of base has notable increase in crack width and spalling. This indicates active cracking continues. Crack gage has been attached to the base face at this corner. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part III, Photos HSM 21 through 30, page 292)

North West Corner; a crack gage has been attached to the roof face at this corner. Crack severity in this corner is rated 3 – moderate. (Appendix A, Part III, Photos HSM 21 through 30, page 300)

HSM 30

North East Corner; cracking in existing cracks in top of base has increased in width 0.060 inch in 2008 to 0.075 inch in 2010. Spalling is also notable. This indicates active cracking continues. Crack severity in this corner is rated 5 – very severe. (Appendix A, Part III, Photos HSM 21 through 30, page 323 & 325)

Base Mat

Crack growth continues through out the base mat. This is an indication that cracking is active, water is being frozen in the existing cracks continuing to force crack growth. Crack severity ranges from 1 very slight to 3 moderate. (Appendix B)

Since 2008 there has been notable active cracking continuing in 19 areas of the HSMs and efflorescence growth in 20 areas of the HSMs, and the base mat has active cracking continuing. Notable active cracking and efflorescence growth affects 23 of the 30 HSMs. A summary of notable changes is shown in Appendix C. The cracking severity is summarized in the Crack Severity Table in Appendix D.

Only one of the WJE recommendations to mitigate the cracking and deterioration of the HSMs and base mat has been started. The recommendation started is the installation of the polyurethane foam in the roof bolt hole voids. The nut and plate flashing covers have been fabricated but have not been installed.

Beginning October 26, 2010 and ending November 2, 2010 twenty four (24) crack gages have been attached at discrete locations on HSM 01, 02, 03, 04, 05, 06, 09, 12, 17, 19, 22, 23, 24, 25, 26, 28, and 29. Data from these gages will be collected in 2011 with the annual HSM and base mat concrete inspection.

Conclusions

It is evident from the 2010 inspection and evaluation that active cracking and efflorescence growth has continued in 23 of the 30 HSMs and the base mat concrete since the 2008 inspection.

There is no way to determine if the cracking and efflorescence growth noted in 2010 occurred during the winter of 2008 before the polyurethane foam had been installed or after the installation of the polyurethane foam in 2009. To complete the validation of the

effectiveness of the installation of the polyurethane foam the 2011 annual HSM and base mat concrete inspection and evaluation has to be completed and compared to the 2010 inspection and evaluation. The crack gages installed in 2010 will also help in this evaluation.

Installation of the nut and plate flashing should not occur until after verification of the effectiveness of the polyurethane foam has been completed.

The winter environment will continue to crack the HSM concrete until the existing cracks have been sealed to prevent moisture from accumulating in the cracks and freezing.

References

1. EDF-8903, *TMI-2 HSM 2008 Evaluation Report – ACI 349.3R7*, [R0], 27 August, 2008

2. EDF-9516, *TMI-2 ISFSI Concrete Evaluation of Horizontal Storage Module (HSM) and Base Mat*, [R0], 6 April, 2010

3. Wiss, Janney, Elstner Associates, Inc., *Three Mile Island Facility CPP-1774 Structural Inspection of Horizontal Storage Modules and Pad*, WJE Northbrook, Illinois, 2009 [EDMS Document No., WJE NO.2008.1917], 31 July 2009

4. EDF-9565, *TMI-2 ISFSI Horizontal Storage Module (HSM) Roof Slab Bolt Holes Filled with Polyurethane Foam*, [R0], 12 May, 2010

5. *Concrete Repair Manual*, Third Edition, Volume 1, published jointly by: American Concrete Institute (ACI) and International Concrete Repair Institute (ICRI)

Appendixes

Appendix A – Inspection Photos 2010 HSM 01 through 30 (electronic files)

- Appendix A, Part I, Photos HSM 01 through 10
- Appendix A, Part II, Photos HSM 11 through 20
- Appendix A, Part III, Photos HSM 21 through 30

Note: Appendix A, Parts I, II, and III comprise approximately 1000 pages and can be view electronically but will not be attached to this EDF. For access to the photo files contact the TMI-2 Facility Manager.

Appendix B – Base Mat Photos

Appendix C – Summary – Notable Changes Since 2008

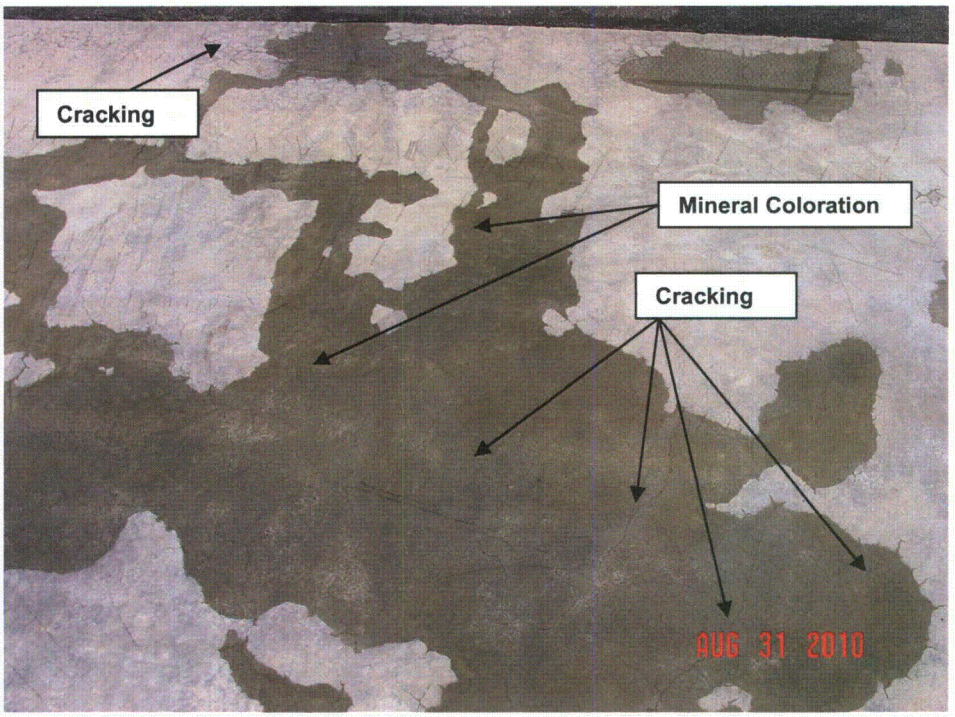
Appendix D – Crack Severity Matrix

Appendix A – Inspection Photos 2010 HSM 01 through 30

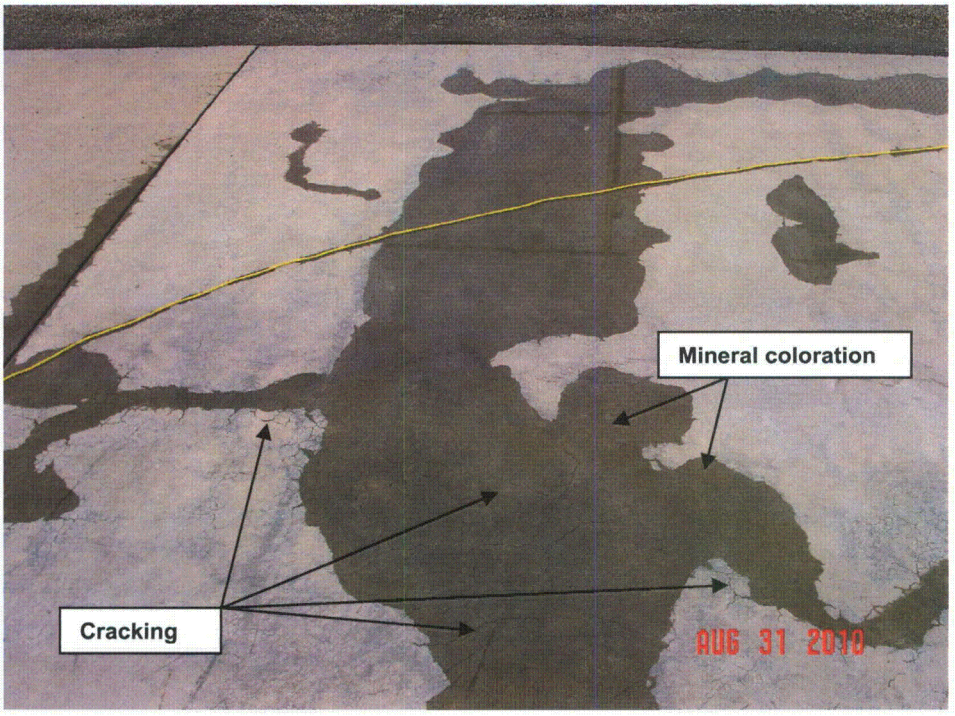
- Appendix A, Part I, Photos HSM 01 through 10 (electronic file)
- Appendix A, Part II, Photos HSM 11 through 20 (electronic file)
- Appendix A, Part III, Photos HSM 21 through 30 (electronic file)

Note: Appendix A, Parts I, II, and III comprise approximately 1000 pages and can be view electronically but will not be attached to this EDF. For access to the photo files contact the TMI-2 Facility Manager.

Appendix B – Base Mat Photos

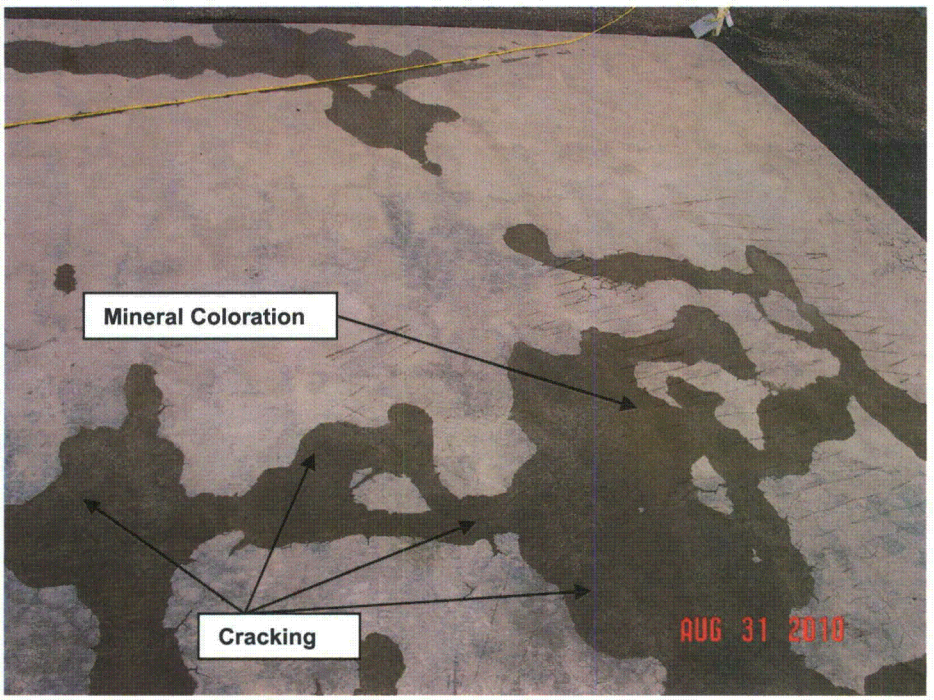


North West Corner Base Mat – Photo 1 of 3



North West Corner Base Mat – Photo 2 of 3

Appendix B – Base Mat Photos (continued)



North West Corner Base Mat – Photo 3 of 3

Appendix C – Summary – Notable Changes Since 2008

Summary – Notable Changes Since 2008				
	South East Corner	**South West Corner**	**North East Corner**	**North West Corner**
HSM 01			Roof – increased efflorescence	Roof – increased cracking
HSM 02		Base top – increased efflorescence		Roof – increased cracking
HSM 03	Roof – increased surface spalling		Roof – increased cracking	
HSM 04	Base – increased surface spalling		Roof – increased cracking & efflorescence	
HSM 05			Roof – increased cracking	Roof – increased cracking
HSM 06			Roof – increased cracking	
HSM 07		Base top – increased efflorescence & spalling	Roof – increased cracking	
HSM 08				
HSM 09	Roof & Base – increased efflorescence		Roof – increased cracking	
HSM 10				
HSM 11				Roof – increased surface spalling
HSM 12			Roof – increased cracking & efflorescence	
HSM 13				
HSM 14			Roof – increased cracking	
HSM 15			Roof – increased efflorescence	
HSM 16				
HSM 17				
HSM 18		Base top – increased efflorescence		
HSM 19			Base top – increased cracking & efflorescence	Base top – increased cracking & efflorescence
HSM 20				Base top – increased efflorescence
HSM 21			Base top – increased efflorescence	
HSM 22				Base Top – increased efflorescence
HSM 23	Roof – increased efflorescence		Base Top – increased efflorescence	
HSM 24				
HSM 25				Roof – increased efflorescence
HSM 26	Roof – increased cracking. Roof & Base Top – increased efflorescence			Base Top - increased efflorescence
HSM 27			Roof – increased spalling	
HSM 28			Roof and Base Top – increased efflorescence	
HSM 29			Roof – increased cracking and spalling	
HSM 30				
Base Mat	Increased cracking	Increased cracking	Increased cracking	Increased cracking

Appendix D – Crack Severity Table

2010 Concrete Inspection - Crack Rating and Location on HSM												
HSM	NW Roof Corner	NE Roof Corner	SE Roof Corner	SW Roof Corner	NW Base Corner	NE Base Corner	SE Base Corner	SW Base Corner	NW Base Face	NE Base Face	SE Base Face	SW Base Face
01	5	3	1	1				1	1			
02	5	2	2	2		2		2		2		
03	3	5	3	1					2	2	1	
04	2	3	2	1			5	1	2	2	1	1
05	5	5	2	1				2	1	1		
06	3	5	1	1					1	1		
07	4	4	1	1						2		2
08	1	1	1	1					1		1	1
09	4	5	3	1							2	
10	5	4	2	1					2	2	1	1
11	2	2	2	1					1	2	2	
12	2	4	2	1		1			2	2		
13	1	4	2	1			2	1	2	2		1
14	3	3	1	1					1	2		
15	2	2	1	1				1	2	2	1	
16	2	2	1	1	1	5		1				
17	3	2	2	3	2				1			
18	1	1	1	1					1	2	1	
19	2	1	1	1	5				1	3		1
20	2	3	2	2	1	1						2
21	2	2	2	1		1	1	1				
22	1	1	1	1	4	4						
23	2	2	2	1	1	2	1				1	
24	2	2	2	2	4	5				5		
25	3	3	1	1	3	2						
26	2	1	4	1	2	1	1				1	1
27	3	3	2	1	1	2	2	2			1	2
28	2	3	2	1		2					1	
29	3	2	2	2	3	5	2				2	2
30	1	1	2	1	5	5		2	1		2	

Crack Severity Rating					
Severity	1 (very slight)	2 (slight)	3 (moderate)	4 (severe)	5 (very severe)
Crack width	< 0.005 inch (0.12 mm) (adjusted)	0.005 inch (0.12 mm) - 0.012 inch (0.3 mm)	0.012 inch (0.3 mm) - 0.039 inch (1 mm)	0.039 inch (1 mm) - 0.118 inch (3 mm)	> 0.118 inch (3 mm) (adjusted)
Crack dispersion across roof top surface	Mainly around bolt hole	Extending beyond bolt hole	Wide spread over roof top surface to side face edges	Through out roof corner top surface to both side faces	Through out roof corner top surface to both side faces
Crack spread through out roof vertical side faces	Not on corner side faces	Not on corner side faces	Some extending across roof surface continuing through corner side faces	Through out corner side faces from top roof surface to bottom with spalling	Through out corner side faces from top roof surface to bottom with spalling
ACI 349 Evaluation Criteria	First-Tier: passive cracks, <0.015 in (0.4 mm) maximum, spalling <3/8 inch deep and 4 inch any dimension		Second-Tier: passive cracks, <0.04 in (1mm) maximum, spalling	Exceeds second-tier criteria: active cracking, cracking damage can continue or intensify	