Annual Radiological Environmental Monitoring Program (REMP) Report for the Three Mile Island, Unit 2 (TMI-2) Independent Spent Fuel Storage Installation (ISFSI)

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ABSTRACT

This report presents the results of the 2020 Radiological Environmental Monitoring Program (REMP) conducted in accordance with 10 CFR 72.44 for the Three Mile Island, Unit 2 (TMI-2), Independent Spent Fuel Storage Installation (ISFSI). A description of the facility and the monitoring program is provided. The results of monitoring the two predominant radiation exposure pathways, potential airborne radioactivity releases and direct radiation exposure, indicate the facility operation has not contributed to any increase in the estimated maximum potential dose commitment to the general public.

SUMMARY

The purpose of this report is to present the results of the REMP conducted during 2020 for the TMI-2 ISFSI. TMI-2 core debris was transferred to the ISFSI between March 1999 and April 2001 and remains in interim storage at the ISFSI.

The REMP was implemented from January through December 2020. Results of the loose surface radioactive contamination surveys indicated no increase in radioactivity attributed to the facility operation. The results of the airborne radioactivity sampling did not indicate releases of airborne particulate radioactivity from the loaded Horizontal Storage Modules (HSMs) that would contribute to an increase in the estimated maximum potential dose commitment to the general public. The results of the environmental dosimetry network did not indicate an increase in radiation levels above pre-operational background attributed to the TMI-2 facility operation.

The monitoring program results support the conclusion reached in the Final Environmental Impact Statement that operation of the facility will not result in a significant dose commitment to the Maximum Exposed Individual.

1.0 Introduction

The TMI-2 ISFSI is a spent fuel dry storage facility designed for interim storage of the TMI-2 core debris. The TMI-2 ISFSI, located within the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory (INL), is operated by Spectra Tech, Inc. for the Department of Energy (DOE). The TMI-2 ISFSI was licensed on March 19, 1999 by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 72 for authorization to receive, possess, store, and transfer spent fuel and fuel debris, resulting from the 1979 TMI-2 accident, for a twenty-year term.[1, 2] The license was renewed on September 16, 2019 extending the license expiration date to March 19, 2039.[3]

The TMI-2 ISFSI is a modified NUHOMS spent fuel storage system, designated NUHOMS-12T. Each of the thirty NUHOMS-12T modules within the facility provide for the horizontal dry storage of up to twelve TMI-2 stainless steel canisters inside a dry shielded canister (DSC) which is placed inside a concrete horizontal storage module (HSM). The NUHOMS-12T modification includes venting of the DSC through high efficiency particulate air (HEPA) grade filters during storage. The vent system allows for release of hydrogen gas, generated due to radiolysis, and monitoring and/or purging of the system during operation.

The TMI-2 core debris which had been stored in stainless steel canisters in a fuel pool at the Test Area North site within the INL was transferred to the TMI-2 ISFSI for interim storage. A Settlement Agreement entered into by the State of Idaho, the Department of Energy, and the Department of the Navy in October 1995 established a schedule for commencing core debris transfers by March 31, 1999, and completing such transfers by June 1, 2001.[4] The first core debris transfer was completed on March 31, 1999. Nine additional transfers were completed during 2000. The remaining nineteen transfers were completed during 2001, with the last one completed on April 20, 2001.

A REMP was developed for the TMI-2 ISFSI and implemented in accordance with 10 CFR 72.44. This report presents the REMP results during the TMI-2 ISFSI operation in 2020.

2.0 Program Description

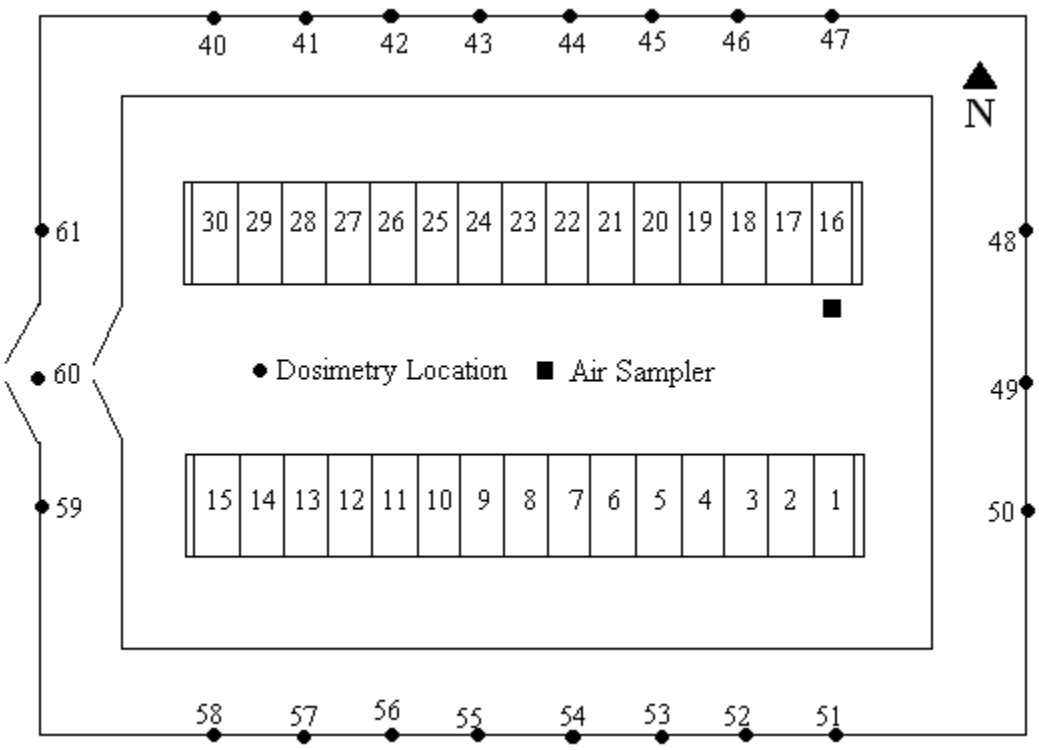
The REMP is designed to monitor the two predominant radiation exposure pathways inherent with the facility design: potential airborne radioactivity releases and direct radiation. The airborne radioactivity release pathway is monitored using a combination of loose surface radioactive contamination surveys and periodic airborne radioactivity sampling. The direct radiation exposure pathway is monitored using environmental dosimetry located along the outer perimeter fence of the TMI-2 ISFSI.

Loose surface radioactive contamination surveys are performed at the vent and purge ports of each DSC as well as the drain port of each loaded HSM. The survey frequency was performed monthly during the first year, quarterly during the second through fifth years, and is now performed annually. The frequency coincides with the radiation monitoring

surveillance schedule required by the TMI-2 ISFSI Technical Specifications.[5] Sample media is analyzed for beta radioactivity. Depending on the amount of beta radioactivity detected, gamma isotopic analysis is either performed for each sample or for an annual sample composite. The presence of Cs-137 is qualitatively determined (or quantitatively as necessary) during the gamma isotopic analysis.

Twenty-two dosimetry stations are located and maintained along the outer perimeter fence of the TMI-2 ISFSI. The dosimetry station locations are noted in Figure 1. Dosimetry is changed out on a quarterly frequency. The minimum detectable dose is no greater than 10 mrem. Since the TMI-2 ISFSI is located among other non-licensed DOE nuclear facilities, there is no specific control dosimetry station for the TMI-2 ISFSI. The INL Radiological Environmental Monitoring Program maintains 17 control dosimetry stations located outside the INTEC boundary.

Figure 1. TMI-2 ISFSI Dosimetry Station Locations.



A low-volume air sampler is used to collect air through a particulate filter during a seven-day period each month. The air sampler is located between the two rows of HSMs inside the TMI-2 ISFSI. Each air particulate sample is analyzed for beta radioactivity with a Lower Limit of Detection (LLD) no greater than 0.01 pCi/m^3. Depending on the amount of beta radioactivity detected, gamma isotopic analysis is either performed for each air particulate sample or for an annual sample composite. The presence of Cs-137 is qualitatively determined (or quantitatively as necessary) during the gamma isotopic analysis. Independent airborne radioactivity monitoring stations are maintained off-site of the INL by the INL Environmental Surveillance Program (one station in Howe, ID), the Idaho Department of Environmental Quality INL Oversight Program (three stations in Craters of the Moon National Monument, Fort Hall, ID, and Idaho Falls, ID), and the Environmental Protection Agency, Region 10 (one station in Boise, ID). These stations are relied upon as control air sampling stations; the sampling results of which are used for comparison purposes when necessary.

3.0 Results

The loose surface contamination survey results for the purge, vent, and drain ports were less than the Minimum Detectable Activity (MDA), 80 dpm/100 cm^2 beta/gamma and 17 dpm/100 cm^2 alpha, calculated in accordance with NUREG/CR-1507.[6] The gamma isotopic results for the purge, vent, and drain port contamination survey composite samples from the HSMs indicated no fission product radioactivity. Cs-137 radioactivity was less than MDA which averaged 2.7E-02 nCi/sample; well below the required LLD of 5 nCi/sample.

Monthly air sampling beta radioactivity results for the TMI-2 ISFSI are presented in Table 1. Beta radioactivity was not detected above the established threshold of 4E-14 μCi/cc (0.04 pCi/m^3) on each monthly sample collected during January through November. In December, beta radioactivity was detected above the established threshold at 4.8E-14 μCi/cc (0.048 pCi/m^3). Quantitative gamma spectroscopy was performed on the December air sample, and the analysis did not indicate the presence of fission or activation product activity. In addition, quantitative gamma spectroscopy was performed on the composited air samples collected throughout 2020. Results from the composite analysis did not indicate the presence of fission or activation product activity.

Dosimetry results are presented in Table 2 in units of mrem/d. Mean dosimetry responses for each location ranged from 3.2 to 24.0 mrem/d. The mean responses for all quarters during the year were higher than the preoperational mean. Quarterly standard deviations were between 6.1 mrem/d and 6.4 mrem/d. Analysis of variance results for all quarters of 2020 were not equal to the pre-operational baseline variance measured in March 1999.

Table 1. TMI-2 ISFSI Air Sample Results (pCi/m^3).

Sample Date	Beta	Sample Date	Beta
January	0.019	July	0.022
February	0.023	August	0.022
March	0.015	September	0.035
April	0.017	October	0.015
May	0.012	November	0.017
June	0.018	December	0.048

Table 2. TMI-2 ISFSI Dosimetry Results (mrem/d).

LOCATION	Q1	Q2	Q3	Q4	MEAN
40	4.94	5.07	4.97	4.87	4.96
41	4.41	4.92	4.38	4.41	4.53
42	4.33	4.90	3.92	3.62	4.19
43	3.70	4.42	4.83	3.94	4.22
44	4.09	3.56	3.47	3.97	3.77
45	3.27	3.75	3.72	3.80	3.63
46	3.22	3.27	4.03	3.53	3.51
47	2.80	3.44	3.23	3.34	3.20
48	3.20	3.29	3.60	3.25	3.33
49	3.90	4.43	3.96	4.55	4.21
50	4.41	5.11	5.23	4.83	4.89
51	9.85	10.00	9.92	10.34	10.03
52	9.16	9.07	9.93	9.81	9.49
53	11.53	11.09	10.48	12.43	11.38
54	12.80	14.36	14.14	12.60	13.48
55	14.03	16.60	15.73	14.72	15.27
56	16.95	17.84	18.75	18.48	18.01
57	22.59	22.12	20.61	18.47	20.95
58	21.94	23.79	24.35	25.94	24.00
59	12.83	15.40	13.88	14.85	14.24
60	9.99	11.43	12.27	11.40	11.27
61	7.97	9.02	9.47	8.54	8.75
Mean	8.72	9.40	9.31	9.17	9.15
Sigma	6.07	6.41	6.32	6.34	6.25

4.0 Discussion

The TMI-2 ISFSI REMP was conducted in accordance with established procedures.

Calibration and quality control of instrumentation used for beta analysis of surface contamination and airborne radioactivity sample media is maintained in accordance with procedures used by the ICP Radiological Control Program.[7] Radioactive sources used for instrumentation calibration and quality control are traceable to the National Institute of Standards and Technology (NIST).

The loose surface radioactive contamination survey results indicate there has been no measurable release of radioactive material from the DSCs stored in the HSMs at the ISFSI above and beyond that projected in the Final Environmental Impact Statement (EIS).[8] Radioanalytical results are not significantly different from pre-operational results as well as those projected in the EIS.

The airborne radioactivity sampling results indicate there has been no measurable release of radioactive material from the DSCs stored in the HSMs at the ISFSI above and beyond that projected in the EIS. As previously stated, beta radioactivity was not detected above the established threshold of 4E-14 μCi/cc (0.04 pCi/m^3) on each monthly sample except in December when beta radioactivity was detected at 4.8E-14 μCi/cc (0.048 pCi/m^3). Follow-up quantitative gamma spectroscopy was performed on the December air sample, and the analysis did not indicate the presence of fission or activation product activity. The elevated beta radioactivity initially detected for the December monthly air sample was likely attributable to factors associated with the rate of decay of the radon/thoron progeny such as its presence in naturally occurring soils and rocks and naturally occurring environmental conditions such as temperature inversions typical in December.

The radiation dosimetry results indicate there has been no measurable increase in ambient background radiation levels outside the TMI-2 ISFSI perimeter fence attributed to storage of the TMI-2 core debris. Increased background resulting in elevated dosimetry readings initially addressed in the 2018 TMI-2 REMP report,[9] continued for 2020. The following discussion summarizes the reasons for the increased readings.

In 2017, TMI-2 facility management personnel were notified that a new temporary waste storage facility was planned for installation approximately 51 feet south of the TMI-2 facility. This facility, identified as Interim Storage Area (ISA)-4, is used for storage of DOE-regulated materials (unaffiliated with the TMI-2 facility) associated with the DOE cleanup mission at the INTEC facility. Thus, the source term from the ISA-4 is not NRC-regulated but impacts the TMI-2 facility dosimetry stationed on the ISFSI outer fence.

Loading of ISA-4 facility concluded on July 15, 2019. Final surveys were performed in and around both the ISA-4 facility and the TMI-2 facility to determine final condition radiation readings. Review of the survey maps and consultations with ICP radiological

engineering concluded that a significant amount of "Skyshine" is affecting the does rates at the TMI-2 perimeter fence.

As required by the REMP, dosimetry stations located on the ISFSI outer perimeter fence are changed out on a quarterly basis within one week of the first day of the calendar quarter. Dosimetry readings are typically read and provided to the facility manager approximately one month after change-out. Dosimetry readings in 2020 are generally static and increasing trends were not found after loading of the neighboring ISA-4 facility completed in July 2019. Given this assessment and the fact that no other REMP monitoring activities performed in 2020 identified changes in conditions at TMI-2, the elevated dose rate to the TMI-2 dosimetry continues to be fully attributed to the neighboring ISA-4 waste storage facility.

In accordance with the TMI-2 Radiation Protection Program,[10] routine radiation and contamination surveys are performed each quarter during normal fuel storage operations at TMI-2 to ensure internal and external occupational radiation exposure monitoring thresholds specified in 10 CFR 20 are not exceeded. Radiation surveys (beta-gamma and neutron) are conducted on contact and at 30 centimeters at the front and rear door of each of the horizontal storage modules (HSMs) as well as at the end shield walls. Surface contamination surveys are also performed at the rear door vent and drain lines. Survey reports for 2020 indicate no readings above background levels, and all contamination results were less than minimum detectable activity.

Based on the above summary information no measurable increase in ambient background radiation levels outside the TMI-2 ISFSI perimeter fence is attributed to storage of the TMI-2 core debris. The absence of any increase in radiation levels at the TMI-2 ISFSI perimeter fence attributed to the TMI-2 ISFSI also supports conclusions reached in the EIS.

5.0 Conclusion

Airborne radioactivity releases and direct radiation exposure from the TMI-2 facility during 2020 did not contribute to any increase in the estimate of maximum potential dose commitment to the general public; characterized as 2.7E-3 mrem/y to the Maximum Exposed Individual reported in the EIS. There were no radioactive liquid effluents released from the facility, hence no radionuclides to report. Elevated dosimetry results detected at the TMI-2 ISFSI perimeter fence during 2020 are attributed to the neighboring ISA-4 waste storage facility affiliated with the ICP.

6.0 References

1. Materials License SNM-2508 for the Three Mile Island, Unit 2, Independent Spent Fuel Storage Installation (TAC No's L22283 and L22800), March 19, 1999, Docket No. 72-20.

2. 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," *Code of Federal Regulations*, Office of the Federal Register, October 2004.

3. Renewed Materials License No. SNM-2508 for the Three Mile Island Unit 2 Independent Spent Fuel Storage Installation (CAC/EPID Nos. 001028/L-2017-RNW-0019 and 000993/L-2017-LNE-0007), September 16, 2019, Docket No. 72-20.

4. Settlement Agreement between the State of Idaho, Department of the Navy, and the Department of Energy, October 16, 1995.

5. Technical Specifications and Bases for the INL TMI-2 Independent Spent Fuel Storage Installation.

6. NUREG/CR-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions," December 1997.

7. ICP, Radiological Control Manuals 15B and 15C.

8. NUREG-1626, "Final Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation to Store the Three Mile Island Unit 2 Spent Fuel at the Idaho National Engineering and Environmental Laboratory," Docket No. 72-20, March 1998.

9. CLN1900709, "Submittal of the Annual Radiological Environmental Monitoring Program Report per 10 CFR 72.44(d)(3), for the Three Mile Island Unit 2 Independent Spent Fuel Storage Installation, License SNM 2508, Docket 72-20," February 20, 2019.

10. STI-NLF-RAD-001, TMI-2 Radiation Protection Program, Revision 2, January 24, 2020.