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GGNS TS 5.6.2

GNRO2023-00013

April 27, 2023

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

SUBJECT: Grand Gulf Nuclear Station Annual Radioactive Effluent Release Report (ARERR)

Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

In accordance with Grand Gulf Nuclear Station Unit 1 Technical Specification 5.6.2, attached is the Annual Radioactive Effluent Release Report for the time-period of January 1, 2022 through December 31, 2022.

There are no commitments contained in this submittal. If you have any questions or need additional information, please contact me at 802-380-5124.

Sincerely,

JH/ram

Attachment: 1. Annual Radioactive Effluent Release Report

cc: NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

State Health Officer, Mississippi Department of Health

Attachment 1

GNRO2023-00013
Annual Radioactive Effluent Release Report

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Annual Radioactive Effluent Release Report	

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1.0 INTRODUCTION

Grand Gulf Nuclear Station (GGNS) is a nuclear site consisting of one General Electric BWR-6 boiling water reactor with a rated power level of 4408 MWt. The station achieved 253.5 effective full-power days of operation in 2022.

Airborne discharges at GGNS are considered ground-level releases. All liquid and airborne discharges to the environment were analyzed in accordance with Offsite Dose Calculation Manual (ODCM) requirements. All effluent releases were within the concentration and total release limits specified by the ODCM. Projected offsite doses were within the dose limits specified by the ODCM.

This Annual Radioactive Effluent Release Report (ARERR) for the period January 1 through December 31, 2022, is submitted in accordance with Technical Specifications Section 5.6.3 of GGNS License Number NPF-29. The monitoring of radioactive effluents is referenced in ODCM Appendix A, Sections 6.11 and 6.12.

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

The ODCM contains the limits to which GGNS must adhere. Because of the "as low as reasonably achievable" (ALARA) philosophy at GGNS, actions are taken to reduce the amount of radiation released to the environment. Liquid and gaseous release data show that the dose from GGNS is considerably below the ODCM limits. This data reveals that the radioactive effluents have an overall minimal dose contribution to the surrounding environment. The following are the limits required by the ODCM:

1. Fission and Activation Gases

    a. Noble gas dose rate due to radioactive materials released in gaseous effluents to areas at and beyond the site boundary shall be limited to the following:

        - Less than or equal to 500 mrem/year to the total body
        - Less than or equal to 3000 mrem/year to the skin

    b. Noble gas air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary shall be limited to the following:

        1) Quarterly

            - Less than or equal to 5 mrad gamma
            - Less than or equal to 10 mrad beta

        2) Yearly

            - Less than or equal to 10 mrad gamma
            - Less than or equal to 20 mrad beta

2. Iodine, Tritium, and Particulate Radionuclides

   a. The dose rate for Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

      - Less than or equal to 1500 mrem/year to any organ

   b. The dose to a MEMBER OF THE PUBLIC from Iodine-131, Iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

      1) Quarterly

         - Less than or equal to 7.5 mrem to any organ

      2) Yearly

         - Less than or equal to 15 mrem to any organ

3. Liquid Effluents Dose

   a. The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to unrestricted areas shall be limited to the following:

      1) Quarterly

         - Less than or equal to 1.5 mrem to the total body
         - Less than or equal to 5 mrem to any organ

      2) Yearly

         - Less than or equal to 3 mrem to the total body
         - Less than or equal to 10 mrem to any organ

4. Total Dose (40 CFR 190)

   a. The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to the following:

      - Less than or equal to 25 mrem to the total body or any organ except the thyroid
      - Less than or equal to 75 mrem to the thyroid

2.2 Maximum Permissible Concentrations

1. Fission and Activation Gases, Iodine, and Particulates with Half Lives > 8 Days

   For gaseous effluents, maximum permissible concentrations are not directly used in release rate calculations since the applicable limits are expressed in terms of dose rate at the site boundary.

2. Liquid Effluents

   The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to ten times the concentration specified in 10 CFR 20, Appendix B, Table 2, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the total concentration released shall be limited to 2.0E-4 microcuries/ml total activity.

2.3 Average Energy

1. Average Energy determination is not applicable to GGNS. The ODCM limits the instantaneous dose equivalent rates due to the release of noble gases to less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin. The average beta and gamma energies as described in Regulatory Guide 1.21, "Measuring, Evaluation, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," may be used to calculate doses in lieu of more sophisticated software.

   The GGNS radioactive effluent programs employs the methodologies presented in U.S. NRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978. Therefore, average energies are not required for GGNS.

2.4 Measurements and Approximations of Total Radioactivity

1. Gaseous Effluents

   a. Fission and Activation Gas

      Gas samples are collected monthly from gaseous release points and are counted on a high-purity germanium (HPGe) detector for principal gamma emitters. The radionuclides detected are used for release rate calculations. During the period between grab samples, the amount of radioactivity released is based on the effluent radiation monitor readings, which are assigned a scaling factor based on the last isotopic analysis. The scaling factor, along with hourly effluent monitor values and flow rates, are entered into a laboratory computer where the release rates for individual radionuclides are calculated and stored. If no radionuclides are detected in the grab sample, the scaling factor defaults to the monitor response from a historical default mixture of fission gases.

The Technical Specification release points listed below are continuously monitored.

1) Radwaste Building Vent (includes Off Gas)
2) Containment Building Vent
3) Fuel Handling Area Vent
4) Turbine Building Vent
5) Turbine Building Occasional Release Point (when releasing)

b. Radioiodine

Iodine is continuously collected on a TEDA charcoal filter via an isokinetic sampling assembly from each release point. Filters are normally exchanged once per week and then analyzed on a HPGe detector. The flow rates for each release point are averaged over the duration of the sampling period and used in conjunction with the specific radionuclide concentrations measured to calculate the total activity released during the sampling period.

c. Particulate (Half-Life > 8 Days)

Particulates are continuously collected on a glass-fiber filter via an isokinetic sampling assembly from each release point. Filters are normally exchanged once per week and then analyzed on a HPGe detector. The flow rates for each release point are averaged over the duration of the sampling period and used in conjunction with the specific isotopic concentrations measured to calculate the total activity released during the sampling period.

d. Tritium

Tritium is collected monthly by passing a known volume of the sample stream from each release point through a molecular sieve filter. The collected sample is distilled and analyzed by liquid scintillation. The tritium released is calculated for each release point from the measured tritium concentration, the volume of the sample, the tritium collection efficiency, and the stack exhaust flow rate.

e. Gross Alpha

Particulate filters from weekly samples are retained and analyzed monthly for gross alpha radioactivity using a gas proportional detector (primary method) or a scintillation detector (backup method).

f. Hard-to-Detect Radionuclides (Sr-89 and Sr-90)

Particulate filters from weekly samples are retained and shipped quarterly to a qualified contract lab for Strontium-89/90 analysis. This analysis involves chemical separation and subsequent measurement using a gas proportional detector.

g. Carbon-14

Carbon-14 activity of 12.8 Curies released this year in gaseous form was obtained by estimation using EPRI spreadsheet BWR Source Term Calculation (MAL-1)_r1 and the information in NEAD-NS-11-0060-REV1-EC42519 and adjusted by 253.5 full power production days. Carbon-14 activity reported in the tables of this report are based on a constant release rate.

2. Liquid Effluents

a. Each tank of liquid radwaste is sampled and analyzed for principal gamma emitters prior to release. Each sample tank is recirculated for enough time prior to sampling to ensure that a representative sample is obtained. Samples are then analyzed on a HPGe detector and liquid release permits are generated based upon the values obtained from the isotopic analysis and the most recent values for tritium, gross alpha, and hard-to-detect radionuclides (Fe-55, Ni-63, Sr-89, and Sr-90). An aliquot based on release volume is saved and added to composite containers. The concentrations of composited radionuclides and the volumes of the releases associated with these composites establish the proportional relationships that are then utilized for calculating the total activity released for these radionuclides.

b. Tritium analysis is performed monthly on the liquid composite sample, where the sample is distilled and analyzed with a liquid scintillation detector.

c. Gross alpha analysis is performed monthly on the liquid composite sample using a gas proportional detector.

d. Hard-to-Detect radionuclides Fe-55, Ni-63, Sr-89, and Sr-90 analyses are performed quarterly by a qualified contract lab on the liquid composite sample. Following chemical separations, Fe-55 is analyzed with a low-energy photon detector, Ni-63 is analyzed with a liquid scintillation detector, and Sr-80/90 is analyzed using a gas proportional detector.

3. Estimated Total Error Present

Estimates of measurement and analytical error for gaseous and liquid effluents are calculated as follows:

$$E_T = \sqrt{[(E_1)^2 + (E_2)^2 + \cdots (E_n)^2]}$$

Where: E_T = total percent error
$E_1 \ldots E_n$ = percent error due to calibration standards, laboratory analysis, instruments, sample flow, etc.

2.5 Batch Releases

1. Liquid

Time periods in minutes	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
Number of Releases	30	43	50	35	158
Total Release Time	9.33E+03	1.29E+04	1.50E+04	1.07E+04	4.79E+04
Maximum Release Time	4.10E+02	3.96E+02	3.15E+02	3.96E+02	4.10E+02
Average Release Time	3.11E+02	3.01E+02	3.00E+02	3.04E+02	3.03E+02
Minimum Release Time	2.74E+02	1.41E+02	2.70E+02	2.70E+02	1.41E+02
Average Dilution Water Flow (GPM)	8.50E+03	6.76E+03	5.09E+03	4.69E+03	6.12E+03

2. Gaseous

   a. No batch releases occurred during the report period.

2.6 Continuous Releases

1. Liquid

   a. Number of continuous releases: None

2. Gaseous

   a. Continuous sampling is performed on the continuous release points:

      1) Radwaste Building Vent
      2) Containment Building Vent
      3) Fuel Handling Area Vent
      4) Turbine Building Vent
      5) Turbine Building Occasional Release Point (when releasing)

2.7 Abnormal Releases

1. During the first quarter of 2022, the stormwater system was impacted when condensation from a steam leak migrated out of the Turbine Building to a storm drain. Elevated tritium concentrations were observed in Outfall 007 samples during the first quarter of 2022. The average tritium concentration in Outfall 007 for all samples collected during the first quarter of 2022 was 29,796 pCi/L, which is less than the reportable level specified in the GGNS ODCM Table 6.12.1-2. The steam leak was repaired in February 2022, and tritium concentrations at Outfall 007 have remained near baseline levels since March 2022. Plant-related gamma emitting radionuclides remained undetectable in surface water samples during 2022. Samples collected and analysis results of Outfall 007 are included in the GGNS 2022 Annual Radiological Environmental Operating Report (AREOR). This incident is documented in CR-GGN-2022-0608.

2. Liquid
   a. Number of releases: 1
   b. Total activity released: Not determined – the pathway impacted a surface water pathway and not an effluent pathway as defined in the GGNS ODCM.

3. Gaseous
   a. Number of releases: None

2.8 Non-routine, Planned Discharges

1. None

2.9 Radioactive Waste Treatment System Changes

1. None

2.10 Land Use Census Changes

1. The land use census performed in 2022 did not identify any new locations that yielded a calculated dose or dose commitment greater than those currently calculated. No milk-producing animals were identified within a five-mile radius of the plant site.

2.11 Effluent Monitor Instrument Inoperability

1. On 3/30/22 the Circulating Water Low Blowdown Flow Interlock had been bypassed and not restored within 30 days due to an extended Plant Service Water system maintenance period during Refuel Outage 23. This interlock was restored following systems restoration prior to plant startup. This condition is documented in CR-GGN-2022-3691.

2.12 Offsite Dose Calculation Manual Changes

1. None

2.13 Process Control Program (PCP) Changes

1. None

2.14 NON-REMP Groundwater Monitoring Results (NEI 07-07)

1. Ground water samples were taken in support of the Groundwater Protection Initiative. These samples are not part of the Radiological Environmental Monitoring Program. Sample results are included in Attachment 1.

2.15 Sewage Disposal Summary

1. There were no sewage disposals during the report period.

2.16 Errata/Corrections to Previous ARERRs

1. In the second half of 2018 Entergy performed a spent fuel pool clean-up project that included six shipments of control blades for off-site disposal. In October 2022 an error was discovered in the number scheme used in the special nuclear material tracking system, whereby Entergy shipped six control blades that were not scheduled to be shipped. This error resulted in inaccurate control blade data reported on pages 25 and 26 of the 2018 GGNS ARERR, Table 3 – Solid Radioactive Waste and Irradiated Fuel Shipments. The total error in reported control blade curie content was 2.1%. Corrected control blade data for the 2018 GGNS ARERR is provided in Attachment 2. This error is documented in CR-GGN-2022-9835.

3.0 GASEOUS EFFLUENTS

3.1 Gas Effluent Reports

Table 1
Gaseous Effluents – Summation of All Releases

Category	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total % Error
FISSION and ACTIVATION GAS						
Total Release	Ci	5.55E+01	3.65E+01	3.81E+01	1.13E+01	6.90E+01
Average Release Rate for the Period	µCi/sec	7.14E+00	4.64E+00	4.80E+00	1.43E+00	
IODINE						
Total I-131	Ci	3.40E-04	4.98E-05	3.56E-04	9.70E-05	7.10E+01
Average Release Rate for the Period	µCi/sec	4.38E-05	6.33E-06	4.48E-05	1.22E-05	
PARTICULATE						
Particulates with half-life > 8 days	Ci	7.05E-05	9.85E-06	1.66E-05	1.86E-05	6.90E+01
Average Release Rate for the Period	µCi/sec	9.07E-06	1.25E-06	2.08E-06	2.34E-06	
TRITIUM						
Total Release	Ci	3.60E+00	4.45E+00	4.48E+00	3.43E+00	6.60E+01
Average Release Rate for the Period	µCi/sec	4.63E-01	5.66E-01	5.64E-01	4.32E-01	
GROSS ALPHA						
Total Release	Ci	4.20E-07	7.53E-08	3.31E-08	4.17E-07	1.03E+02
Average Release Rate for the Period	µCi/sec	5.40E-08	9.58E-09	4.16E-09	5.25E-08	
CARBON-14						
Total Release	Ci	2.83E+00	2.86E+00	2.77E+00	4.32E+00	
Average Release Rate for the Period	µCi/sec	3.65E-01	3.64E-01	3.48E-01	5.43E-01	

% of limit is on the Radiological Impact to Man, Table 9 – Dose Assessment

Table 2
Gaseous Effluents – Ground Level Release – Continuous Mode

Radionuclide	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
FISSION and ACTIVATION GAS						
Ar-41	Ci	ND	6.03E-01	4.22E+00	1.17E-01	4.94E+00
Kr-85m	Ci	ND	1.99E-01	2.66E+00	9.65E-01	3.83E+00
Kr-88	Ci	1.07E+00	5.69E-01	2.55E+00	3.76E-01	4.56E+00
Xe-133	Ci	2.67E+01	2.05E+01	2.69E+01	4.68E+00	7.88E+01
Xe-135	Ci	2.43E+01	1.28E+01	1.63E+00	4.57E+00	4.32E+01
Xe-135m	Ci	2.82E+00	1.50E+00	1.81E-01	5.15E-01	5.02E+00
Xe-138	Ci	6.41E-01	3.42E-01	4.10E-02	1.17E-01	1.14E+00
Total for Period	**Ci**	**5.55E+01**	**3.65E+01**	**3.81E+01**	**1.13E+01**	**1.41E+02**
IODINE						
I-131	Ci	3.40E-04	4.98E-05	3.56E-04	9.70E-05	8.43E-04
I-133	Ci	3.74E-04	4.61E-05	1.32E-04	1.41E-04	6.93E-04
I-135	Ci	ND	ND	ND	1.07E-04	1.07E-04
Total for Period	**Ci**	**7.15E-04**	**9.59E-05**	**4.88E-04**	**3.45E-04**	**1.64E-03**
PARTICULATE						
Ba-140	Ci	ND	1.07E-06	4.82E-06	5.20E-06	1.11E-05
Co-58	Ci	1.80E-05	ND	6.95E-07	ND	1.87E-05
Co-60	Ci	3.53E-05	3.46E-06	4.30E-06	1.85E-06	4.49E-05
Cr-51	Ci	2.96E-06	ND	3.37E-06	ND	6.33E-06
Mn-54	Ci	1.53E-06	5.71E-07	5.51E-07	ND	2.65E-06
Ru-106	Ci	ND	ND	2.15E-06	1.15E-05	1.37E-05
Se-75	Ci	2.76E-06	4.75E-06	6.92E-07	ND	8.21E-06
Zn-65	Ci	1.00E-05	ND	ND	ND	1.00E-05
Total for Period	**Ci**	**7.05E-05**	**9.85E-06**	**1.66E-05**	**1.86E-05**	**1.15E-04**
TRITIUM						
Total for Period	**Ci**	**3.60E+00**	**4.45E+00**	**4.48E+00**	**3.43E+00**	**1.60E+01**
GROSS ALPHA						
Total for Period	**Ci**	**4.20E-07**	**7.53E-08**	**3.31E-08**	**4.17E-07**	**9.45E-07**
CARBON-14						
Total for Period	**Ci**	**2.83E+00**	**2.86E+00**	**2.77E+00**	**4.32E+00**	**1.28E+01**

% of limit is on the Radiological Impact to Man, Table 9 – Dose Assessment
ND – Not Detected

4.0 LIQUID EFFLUENTS

4.1 Liquid Effluent Reports

Table 3
Liquid Effluents – Summation of All Releases

Category	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total % Error
FISSION and ACTIVATION PRODUCTS						
Total Release	Ci	5.07E-03	8.12E-03	1.63E-02	3.06E-02	7.30E+01
Average Diluted Concentration	µCi/ml	1.67E-08	2.43E-08	5.56E-08	1.58E-07	
TRITIUM						
Total Release	Ci	9.63E+00	1.15E+01	1.05E+01	1.04E+01	7.00E+01
Average Diluted Concentration	µCi/ml	3.18E-05	3.45E-05	3.57E-05	5.39E-05	
DISSOLVED and ENTRAINED GASES						
Total Release	Ci	1.41E-04	1.79E-05	1.74E-05	3.88E-05	6.60E+01
Average Diluted Concentration	µCi/ml	4.65E-10	5.35E-11	5.92E-11	2.00E-10	
GROSS ALPHA						
Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.50E+01
VOLUMES						
Liquid Waste (Prior to Dilution)	Liters	3.27E+06	4.58E+06	5.31E+06	3.77E+06	
Dilution Water	Liters	3.00E+08	3.30E+08	2.89E+08	1.90E+08	

% of limit is on the Radiological Impact to Man, Table 9 – Dose Assessment

Table 4
Liquid Effluents – Batch Mode

Radionuclide	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Year
FISSION and ACTIVATION PRODUCTS						
Ag-110m	Ci	3.57E-05	2.00E-04	5.65E-04	4.17E-04	1.22E-03
As-76	Ci	ND	1.23E-04	ND	1.65E-04	2.88E-04
Ce-141	Ci	ND	ND	ND	5.81E-05	5.81E-05
Ce-143	Ci	ND	7.17E-06	ND	ND	7.17E-06
Co-58	Ci	4.57E-04	3.81E-04	2.85E-03	4.70E-03	8.38E-03
Co-60	Ci	2.09E-03	3.28E-03	6.46E-03	1.14E-02	2.33E-02
Cr-51	Ci	3.41E-04	1.02E-03	4.33E-04	1.34E-03	3.14E-03
Cs-134	Ci	2.90E-04	1.58E-04	1.58E-04	7.54E-05	6.81E-04
Cs-137	Ci	4.82E-04	3.59E-04	3.16E-04	2.73E-04	1.43E-03
Cs-138	Ci	2.25E-05	ND	ND	3.32E-05	5.56E-05
Fe-59	Ci	3.16E-05	8.72E-05	1.76E-05	1.58E-04	2.94E-04
I-131	Ci	ND	ND	ND	1.11E-05	1.11E-05
La-140	Ci	ND	2.24E-05	1.32E-04	5.73E-04	7.28E-04
Mn-54	Ci	6.90E-04	1.15E-03	3.21E-03	4.24E-03	9.30E-03
Na-24	Ci	5.06E-06	ND	3.30E-05	5.29E-04	5.67E-04
Np-239	Ci	ND	ND	1.18E-05	ND	1.18E-05
Pt-195M	Ci	ND	7.92E-05	4.43E-05	2.07E-05	1.44E-04
Ru-106	Ci	2.95E-05	7.99E-05	4.51E-04	2.77E-03	3.33E-03
Sb-124	Ci	2.28E-04	2.79E-04	2.27E-06	ND	5.09E-04
Sb-125	Ci	4.29E-05	2.45E-04	1.97E-05	ND	3.07E-04
Sr-92	Ci	ND	3.17E-05	3.04E-05	2.20E-05	8.41E-05
Tc-99m	Ci	ND	ND	ND	5.95E-06	5.95E-06
Y-88	Ci	7.54E-06	ND	1.92E-05	4.70E-05	7.37E-05
Zn-65	Ci	3.24E-04	6.20E-04	1.57E-03	3.72E-03	6.24E-03
Zn-69m	Ci	ND	ND	ND	1.10E-05	1.10E-05
Total for Period	**Ci**	**5.07E-03**	**8.12E-03**	**1.63E-02**	**3.06E-02**	**6.01E-02**
TRITIUM						
Total for Period	**Ci**	**9.63E+00**	**1.15E+01**	**1.05E+01**	**1.04E+01**	**4.21E+01**
DISSOLVED and ENTRAINED GASES						
Xe-133	Ci	1.36E-04	7.89E-06	1.26E-05	2.87E-05	1.85E-04
Xe-135	Ci	4.79E-06	9.98E-06	4.78E-06	1.01E-05	2.96E-05
Total for Period	**Ci**	**1.41E-04**	**1.79E-05**	**1.74E-05**	**3.88E-05**	**2.15E-04**
GROSS ALPHA						
Total for Period	**Ci**	**ND**	**ND**	**ND**	**ND**	**0.00E+00**

% of limit is on the Radiological Impact to Man, Table 9 – Dose Assessment ND – Not Detected

5.0 SOLID WASTE SUMMARY

5.1 Solid Waste Shipped Offsite for Burial or Disposal (Not Irradiated Fuel)

1. Types of Waste

Table 5
Types of Solid Waste Summary

Type of Waste	Total Quantity (m^3)	Total Activity (Ci)	Estimated Total % Error
Spent Resins, Filter Sludges, Evaporator Bottoms, etc.	2.62E+02	3.65E+02	2.50E+01
Dry Compressible Waste, Contaminated Equipment, etc.	1.31E+03	4.70E+00	2.50E+01
Irradiated Components, Control Rods, etc.	1.16E-01	5.55E+03	2.50E+01
Other: Oil Drum Sealand, Mixed Waste	1.42E+01	1.86E-03	2.50E+01

2. Estimate of Major Radionuclide Composition (by Waste Type)

Table 6
Major Radionuclides (> 0.1%)

Radionuclide	% of Total	Curies
Spent Resins, Filter Sludges, Evaporator Bottoms, etc.		
H-3	0.13	4.76E-01
Cr-51	3.72	1.36E+01
Mn-54	8.20	2.99E+01
Fe-55	23.70	8.65E+01
Fe-59	0.84	3.06E+00
Co-58	4.74	1.73E+01
Co-60	50.36	1.84E+02
Ni-63	0.71	2.60E+00
Zn-65	5.36	1.96E+01
Sr-89	0.35	1.28E+00
Ag-110m	0.30	1.11E+00
Cs-134	0.48	1.76E+00
Cs-137	0.90	3.28E+00
Ce-144	0.12	4.51E-01

Table 6 Major Radionuclides (> 0.1%)		
Radionuclide	**% of Total**	**Curies**
Dry Compressible Waste, Contaminated Equipment, etc.		
H-3	0.55	2.58E-02
C-14	0.13	6.20E-03
Cr-51	2.82	1.32E-01
Mn-54	12.05	5.64E-01
Fe-55	13.25	6.20E-01
Fe-59	0.24	1.14E-02
Co-58	2.84	1.33E-01
Co-60	62.6	2.93E+00
Ni-63	0.27	1.26E-02
Zn-65	2.66	1.25E-01
Sr-89	0.38	1.80E-02
Cs-134	0.68	3.17E-02
Cs-137	1.49	6.96E-02
Irradiated Components, Control Rods, etc.		
Mn-54	0.40	2.22E+01
Fe-55	33.90	1.88E+03
Co-60	57.04	3.17E+03
Ni-63	8.57	4.76E+02
Other: Oil Drum Sealand, Mixed Waste for Volume Reduction		
Cr-51	3.54	6.54E-05
Mn-54	11.37	2.10E-04
Fe-55	6.69	1.24E-04
Co-58	1.67	3.08E-05
Co-60	74.12	1.37E-03
Cs-134	0.88	1.63E-05
Cs-137	1.74	3.22E-05

3. Solid Waste Disposition

Table 7
Solid Waste Disposition

Number of Shipments	Mode of Transportation	Destination
2	Hittman	EnergySolutions Clive Disposal Site (Containerized Waste Facility) – Clive, UT
11	Hittman	EnergySolutions Clive Disposal Site (Bulk Waste Facility) – Clive, UT
54	Hittman	EnergySolutions Bear Creek Road – Oak Ridge, TN
3	Hittman	Erwin Resin Solutions – Erwin, TN
1	Hittman	Toxco Inc. – Oak Ridge, TN
1	Hittman	Waste Control Specialists – Andrews, TX

Table 8
Irradiated Fuel Shipments Disposition

Number of Shipments	Mode of Transportation	Destination
None	N/A	N/A

6.0 RADIOLOGICAL IMPACT TO MAN

6.1 10 CFR Part 50, Appendix I Evaluation

Table 9
Dose Assessment

Category	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Liquid Effluent Dose Limit – Total Body	1.5 mrem	1.5 mrem	1.5 mrem	1.5 mrem	3 mrem
TOTAL BODY DOSE	8.91E-02	7.75E-02	1.11E-01	1.26E-01	3.99E-01
% of Limit	**5.94E+00**	**5.17E+00**	**7.39E+00**	**8.38E+00**	**1.33E+01**
Liquid Effluent Dose Limit – Any Organ	5 mrem	5 mrem	5 mrem	5 mrem	10 mrem
MAXIMUM ORGAN DOSE	1.25E-01	1.14E-01	1.75E-01	2.27E-01	6.20E-01
% of Limit	**2.50E+00**	**2.28E+00**	**3.49E+00**	**4.53E+00**	**6.20E+00**
Gaseous Effluent Dose Limit – Gamma Air	5 mrad	5 mrad	5 mrad	5 mrad	10 mrad
GAMMA AIR DOSE	1.81E-02	1.12E-02	1.95E-02	4.37E-03	5.32E-02
% of Limit	**3.61E-01**	**2.24E-01**	**3.91E-01**	**8.75E-02**	**5.32E-01**
Gaseous Effluent Dose Limit – Beta Air	10 mrad	10 mrad	10 mrad	10 mrad	20 mrad
BETA AIR DOSE	1.98E-02	1.23E-02	1.22E-02	4.22E-03	4.85E-02
% of Limit	**1.98E-01**	**1.23E-01**	**1.22E-01**	**4.22E-02**	**2.42E-01**
Gaseous Effluent Organ Dose Limit Iodine, Tritium, Particulates with > 8-day Half-Life	7.5 mrem	7.5 mrem	7.5 mrem	7.5 mrem	15 mrem
GASEOUS EFFLUENT ORGAN DOSE Iodine, Tritium, Particulates with > 8-day Half-Life – Including C-14	7.78E-01	7.85E-01	7.59E-01	1.18E+00	3.51E+00
% of Limit	**1.04E+01**	**1.05E+01**	**1.01E+01**	**1.58E+01**	**2.34E+01**
DIRECT RADIATION (mrem)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

7.0 METEOROLOGICAL DATA

1. Data recovery for reporting period: 99%
2. Predominant wind direction: From Northeast 12.0% of the reporting period
3. Predominant stability class: D (39.9%)
4. Average wind speed: 4.3 miles per hour at the 33-foot level
5. The annual meteorological data (Hourly Average Data or Joint Frequency Distribution) is maintained on site in a file that will be provided to the NRC upon request.

Attachment 1

Nuclear Energy Institute (NEI) Groundwater Protection Initiative Sample Results

GPI Ground Water samples were collected from onsite Dewatering Wells (DW), Monitoring Wells (MW), and Sentinel Wells (SW). Samples were analyzed for Tritium and gamma and selected samples were analyzed for hard-to-detect (HTD) radionuclides (Americium-241, Curium-242, Curium-243/244, Iron-55, Nickel-63, Plutonium-238, Strontium-89 and Strontium-90). Analyses are to the Lower Level of Detection (LLD) values for the GGNS Radiological Environmental Monitoring Program.

No dose to the public is attributed to ground water since wells with results above Minimum Detectable Activity (MDA) are bounded by wells which are less than MDA. Tritium and gamma results are shown in the table below. HTD analyses performed on DW-07 and MW-115B indicated < MDA for all HTD radionuclides.

All results were less than Reporting Levels of GGNS ODCM Table 6.12.1-2. MW-115B indicated tritium of 20,300 pCi/L in the second quarter of 2022. The MW-115B second quarter average tritium was 18,050 pCi/L, which is below the Reporting Level. Subsequent samples for remaining quarters of 2022 indicated normal historic tritium values. This event is documented in CR-GGN-2022-5542.

Location	Number of Samples	Maximum TRITIUM (pCi/L)	Maximum GAMMA (pCi/L)
DW-01	4	8,140	< MDA
DW-02	4	1,120	< MDA
DW-03	4	1,170	< MDA
DW-04	4	1,070	< MDA
DW-05	4	< 559	< MDA
DW-07	4	1,720	< MDA
MW-01	3	1,100	< MDA
MW-04	4	< 583	< MDA
MW-06	4	2,350	< MDA
MW-100B	1	< 538	< MDA
MW-101B	4	< 595	< MDA
MW-102B	1	< 561	< MDA
MW-103B	1	< 579	< MDA
MW-104B	1	< 546	< MDA
MW-105B	4	699	< MDA
MW-106B	4	< 590	< MDA
MW-107B	4	1,080	< MDA
MW-108B	4	1,300	< MDA
MW-109B	4	1,400	< MDA

Attachment 1

Nuclear Energy Institute (NEI) Groundwater Protection Initiative Sample Results

Location	Number of Samples	Maximum TRITIUM (pCi/L)	Maximum GAMMA (pCi/L)
MW-110B	3	< 593	< MDA
MW-111B	5	15,500	< MDA
MW-112B	5	< 555	< MDA
MW-113B	4	< 645	< MDA
MW-114B	5	2,060	< MDA
MW-115B	5	20,300	< MDA
MW-116B	5	< 586	< MDA
MW-118B	5	1,040	< MDA
MW-119B	1	< 571	< MDA
MW-120B	1	< 594	< MDA
MW-121B	1	< 576	< MDA
MW-122B	4	< 574	< MDA
MW-123B	4	692	< MDA
MW-1007C	1	< 542	< MDA
MW-1009C	1	< 514	< MDA
MW-1012C	1	< 557	< MDA
MW-1020C	1	< 550	< MDA
MW-1024C	1	< 527	< MDA
MW-1027C	1	< 557	< MDA
MW-1042C	1	< 535	< MDA
MW-1134C	1	< 382	< MDA
P-05	1	< 563	< MDA
SW-103A	4	< 561	< MDA

< MDA – Less than Minimum Detectable Activity

Attachment 2 **Page 1 of 2**

Errata/Corrections to Previous ARERRs

Corrected 2018 GGNS ARERR, Table 3 – Solid Radioactive Waste and Irradiated Fuel Shipments

TABLE 3
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (NOT IRRADIATED FUEL)

1. Type of Waste	Unit	Class A	Class B	Class C	Estimated Total Error
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3 Ci	2.50E+02 1.14E+02	0.00E+00 0.00E+00	0.00E+00 0.00E+00	± 25%
b. Dry compressible waste, contaminated equipment, etc.	m^3 Ci	1.46E+03 1.07E+00	0.00E+00 0.00E+00	0.00E+00 0.00E+00	± 25%
c. Irradiated components, control rods, etc.	m^3 Ci	0.00E+00 0.00E+00	0.00E+00 0.00E+00	8.43E-01 6.85E+04	± 25%
d. Other: Oily waste drums	m^3 Ci	5.74E+02 2.44E-01	0.00E+00 0.00E+00	0.00E+00 0.00E+00	± 25%

2. Estimate of Major Nuclide Composition (by type of waste)

a. Spent resins, filter sludges, evaporator bottoms, etc.

Isotope (> 0.1%)	Percent	Curies
H-3	0.97	1.11E+00
C-14	2.20	2.52E+00
Cr-51	0.48	5.45E-01
Mn-54	7.08	8.09E+00
Fe-55	50.35	5.76E+01
Co-58	1.43	1.63E+00
Co-60	32.18	3.68E+01
Ni-63	0.94	1.08E+00
Zn-65	3.28	3.75E+00
Ag-110m	0.16	1.78E-01
Sb-125	0.10	1.17E-01
Cs-134	0.19	2.15E-01
Cs-137	0.45	5.12E-01
Ce-144	0.12	1.37E-01

Attachment 2

Errata/Corrections to Previous ARERRs

TABLE 3 - Continued
ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION UNIT 1

SOLID RADIOACTIVE WASTE AND IRRADIATED FUEL SHIPMENTS

b. Dry compressible waste, contaminated equipment, etc.

Isotope (> 0.1%)	Percent	Curies
H-3	0.83	8.84E-03
Mn-54	8.57	9.12E-02
Fe-55	36.2	3.85E-01
Co-58	0.67	7.14E-03
Co-60	35.7	3.80E-01
Ni-63	0.19	2.07E-03
Zn-65	1.42	1.51E-02
Sr-90	0.12	1.30E-03
Zr-95	4.63	4.93E-02
Nb-95	9.22	9.82E-02
Sn-113	0.31	3.31E-03
Sb-125	1.35	1.44E-02
Cs-137	0.38	4.03E-03
Ce-144	0.38	4.08E-03

c. Irradiated components, control rods, etc.

Isotope (> 0.1%)	Percent	Curies
Mn-54	0.39	2.66E+02
Fe-55	42.33	2.90E+04
Co-60	49.07	3.36E+04
Ni-63	7.58	5.19E+03
Sb-125	0.51	3.51E+02