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U. S. Nuclear Regulatory Commission  
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Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC  
McGuire Nuclear Station, Units 1 and 2  
Docket Nos. 50-369 and 50-370  
Annual Radioactive Effluent Release Report

Pursuant to the requirements of Technical Specification 5.6.3 and Section 16.11.17 of the Selected Licensee Commitments (SLC) Manual, attached is the Annual Radioactive Effluent Release Report for the period of January 1, 2015 through December 31, 2015.

The enclosure titled "Annual Radioactive Effluent Release Report" with the following attachments form the contents of the report:

- Attachment 1 Summary of Gaseous and Liquid Effluents
- Attachment 2 Supplemental Information
- Attachment 3 Solid Radioactive Waste Disposal
- Attachment 4 Meteorological Data
- Attachment 5 Unplanned Offsite Releases
- Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public
- Attachment 7 Information to Support the Nuclear Energy Institute (NEI) Groundwater Protection Initiative
- Attachment 8 Inoperable Equipment
- Attachment 9 Summary of Changes to the Offsite Dose Calculation Manual
- Attachment 10 Summary of Changes to the Process Control Program
- Attachment 11 Summary of Major Modifications to the Radioactive Waste Treatment Systems
- Attachment 12 Errata to Previous Year's ARERR

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Also included in this report is a compact disc (CD-Rom) containing the Offsite Dose Calculation Manual (Revisions 55 and 56) pursuant to the requirements of Technical Specification 5.5.1.

Questions concerning this report should be directed to George Murphy, McGuire Regulatory Affairs at (980) 875-5715.

A handwritten signature in black ink, appearing to read "SD Capps", is written over the printed name.

Steven D. Capps

- Enclosure: Annual Radioactive Effluent Release Report
- Compact Disc: Offsite Dose Calculation Manual (ODCM)

cc: Catherine Haney, Regional Administrator  
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Mr. John Zeiler  
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McGuire Nuclear Station

**Enclosure**

Annual Radioactive Effluent Release Report



# **McGuire Nuclear Station Units 1 and 2**

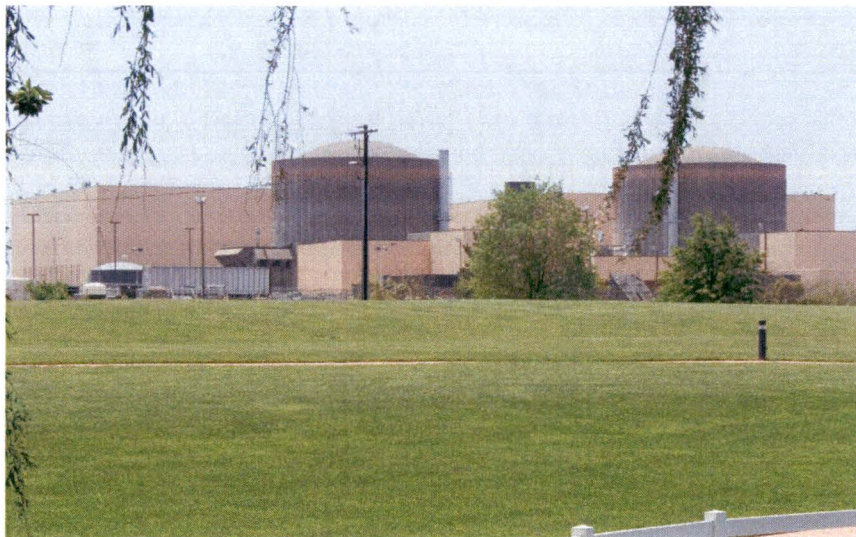
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## **Annual Radioactive Effluent Release Report**

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**January 1, 2015 through December 31, 2015**

**Dockets 50-369 and 50-370**



# **Introduction**

The Annual Radioactive Effluent Release Report is pursuant to McGuire Nuclear Station Technical Specification 5.6.3 and Selected Licensee Commitment 16.11.17. The below listed attachments to this report provide the required information. In addition, the ODCM is included pursuant to McGuire Nuclear Station Technical Specification 5.5.1.

Attachment 1	Summary of Gaseous and Liquid Effluents
Attachment 2	Supplemental Information
Attachment 3	Solid Radioactive Waste Disposal
Attachment 4	Meteorological Data
Attachment 5	Unplanned Offsite Releases
Attachment 6	Assessment of Radiation Dose from Radioactive Effluents to Members of the Public
Attachment 7	Information to Support the NEI Ground Water Protection Initiative
Attachment 8	Inoperable Equipment
Attachment 9	Summary of Changes to the Offsite Dose Calculation Manual
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Attachment 11	Summary of Major Modifications to the Radioactive Waste Treatment Systems
Attachment 12	Errata to a Previous Year's ARERR

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 1**

**Summary of Gaseous and Liquid Effluents**

This attachment includes a summary of the quantities of radioactive liquid and gaseous effluents as outlined in Regulatory Guide 1.21, Appendix B.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Summation of All Releases**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
1. Total Release	Ci	4.52E-01	4.17E-01	4.86E-01	3.84E-01	1.74E+00
2. Avg. Release Rate	μCi/sec	5.81E-02	5.31E-02	6.11E-02	4.83E-02	5.51E-02
B. Iodine-131						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Release Rate	μCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Particulates Half-Life ≥ 8 days						
1. Total Release	Ci	0.00E+00	9.60E-06	0.00E+00	0.00E+00	9.60E-06
2. Avg. Release Rate	μCi/sec	0.00E+00	1.22E-06	0.00E+00	0.00E+00	3.05E-07
D. Tritium						
1. Total Release	Ci	1.14E+01	1.18E+01	2.50E+01	3.07E+01	7.89E+01
2. Avg. Release Rate	μCi/sec	1.47E+00	1.50E+00	3.15E+00	3.86E+00	2.50E+00
E. Carbon-14						
1. Total Release	Ci	5.32E+00	5.56E+00	4.78E+00	5.30E+00	2.10E+01
2. Avg. Release Rate	μCi/sec	6.84E-01	7.07E-01	6.02E-01	6.67E-01	6.65E-01
F. Gross Alpha						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Release Rate	μCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00



**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Elevated Releases - Continuous Mode \***

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* McGuire Nuclear Station Units 1 and 2 do not have elevated releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Gaseous Effluents - Elevated Releases - Batch Mode \*

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* McGuire Nuclear Station Units 1 and 2 do not have elevated releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Ground Releases - Continuous Mode**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Iodines						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Particulates Half-Life ≥ 8 days						
Co-60	Ci	0.00E+00	9.60E-06	0.00E+00	0.00E+00	9.60E-06
Total for Period	Ci	0.00E+00	9.60E-06	0.00E+00	0.00E+00	9.60E-06
D. Tritium						
H-3	Ci	1.12E+01	1.17E+01	2.15E+01	3.05E+01	7.50E+01
E. Carbon-14						
C-14	Ci	1.60E+00	1.67E+00	1.43E+00	1.59E+00	6.30E+00
F. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Gaseous Effluents - Ground Releases - Batch Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
AR-41	Ci	3.99E-01	3.98E-01	3.97E-01	3.70E-01	1.56E+00
KR-85	Ci	0.00E+00	0.00E+00	3.96E-04	0.00E+00	3.96E-04
XE-133	Ci	4.51E-02	1.74E-02	8.72E-02	1.27E-02	1.62E-01
XE-135	Ci	7.12E-03	1.78E-03	1.56E-03	1.24E-03	1.17E-02
Total for Period	Ci	4.52E-01	4.17E-01	4.86E-01	3.84E-01	1.74E+00
B. Iodines						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Particulates Half-Life $\geq$ 8 days						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Tritium						
H-3	Ci	1.66E-01	4.52E-02	3.47E+00	1.78E-01	3.86E+00
E. Carbon-14						
C-14	Ci	3.72E+00	3.89E+00	3.35E+00	3.71E+00	1.47E+01
F. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents - Mixed-Mode Releases - Continuous Mode \***

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* McGuire Nuclear Station Units 1 and 2 do not have mixed-mode releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Gaseous Effluents - Mixed-Mode Releases - Batch Mode \*

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
B. Iodines						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
C. Particulates Half-Life $\geq$ 8 days						
N/A	Ci	-	-	-	-	-
Total for Period	Ci	-	-	-	-	-
D. Tritium						
N/A	Ci	-	-	-	-	-
E. Carbon-14						
N/A	Ci	-	-	-	-	-
F. Gross Alpha						
Total for Period	Ci	-	-	-	-	-

\* McGuire Nuclear Station Units 1 and 2 do not have mixed-mode releases.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Summation of All Releases

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products *						
1. Total Release	Ci	1.21E-02	1.34E-02	3.46E-02	9.34E-03	6.94E-02
2. Avg. Diluted Conc.	µCi/ml	2.39E-13	1.99E-13	3.06E-13	1.43E-13	2.14E-13
3. Batch Releases	µCi/ml	1.43E-11	1.38E-11	3.77E-11	1.04E-11	1.91E-11
B. Tritium						
1. Total Release	Ci	2.37E+02	1.70E+02	6.87E+02	2.70E+02	1.37E+03
2. Avg. Diluted Conc.	µCi/ml	8.49E-09	4.97E-09	1.86E-07	1.01E-08	2.88E-08
3. Batch Releases	µCi/ml	2.80E-07	1.76E-07	7.46E-07	3.01E-07	3.75E-07
C. Dissolved & Entrained Gases						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Batch Releases	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Batch Releases	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E. Volume of Liquid Waste						
1. Continuous Releases	liters	5.12E+07	5.05E+07	2.22E+08	9.39E+07	4.17E+08
2. Batch Releases	liters	8.71E+05	7.34E+05	1.81E+06	1.31E+06	4.72E+06
F. Volume of Dilution Water						
1. Continuous Releases	liters	4.01E+10	4.54E+10	2.28E+10	9.20E+10	2.00E+11
2. Batch Releases	liters	8.48E+11	9.69E+11	9.16E+11	8.97E+11	3.63E+12

\* Excludes tritium, dissolved and entrained noble gases, and gross alpha.

**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Continuous Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
H-3	Ci	1.56E-01	1.13E-01	4.17E+00	5.55E-01	5.00E+00
C. Dissolved & Entrained Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00



**Attachment 1**  
**Summary of Gaseous and Liquid Effluents**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents - Batch Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Fission and Activation Products</b>						
AG-108M	Ci	1.57E-06	0.00E+00	0.00E+00	0.00E+00	1.57E-06
BR-82	Ci	3.06E-07	0.00E+00	0.00E+00	0.00E+00	3.06E-07
CE-144	Ci	0.00E+00	0.00E+00	1.06E-05	0.00E+00	1.06E-05
CO-57	Ci	0.00E+00	0.00E+00	8.00E-06	0.00E+00	8.00E-06
CO-58	Ci	8.67E-04	4.99E-04	1.54E-03	1.05E-03	3.96E-03
CO-60	Ci	1.73E-03	2.14E-03	2.32E-02	3.53E-03	3.06E-02
CR-51	Ci	0.00E+00	0.00E+00	0.00E+00	4.87E-05	4.87E-05
CS-134	Ci	0.00E+00	0.00E+00	1.65E-06	0.00E+00	1.65E-06
CS-137	Ci	1.67E-04	2.87E-04	3.60E-04	2.66E-04	1.08E-03
CU-67	Ci	0.00E+00	0.00E+00	2.57E-06	0.00E+00	2.57E-06
FE-55	Ci	2.37E-04	0.00E+00	1.54E-03	0.00E+00	1.78E-03
FE-59	Ci	0.00E+00	4.10E-06	0.00E+00	0.00E+00	4.10E-06
LA-140	Ci	0.00E+00	0.00E+00	1.78E-06	0.00E+00	1.78E-06
MN-54	Ci	1.02E-04	1.02E-04	1.48E-03	2.05E-04	1.89E-03
NB-95	Ci	1.08E-05	4.24E-05	3.71E-04	3.08E-06	4.28E-04
NI-63	Ci	3.84E-03	2.67E-03	2.07E-03	3.11E-03	1.17E-02
RB-89	Ci	1.09E-05	0.00E+00	0.00E+00	0.00E+00	1.09E-05
RU-106	Ci	0.00E+00	0.00E+00	0.00E+00	2.56E-05	2.56E-05
SB-124	Ci	9.48E-04	8.76E-04	4.46E-05	0.00E+00	1.87E-03
SB-125	Ci	4.19E-03	6.79E-03	3.84E-03	1.10E-03	1.59E-02
TE-134	Ci	1.01E-05	0.00E+00	0.00E+00	0.00E+00	1.01E-05
W-187	Ci	0.00E+00	0.00E+00	1.22E-05	0.00E+00	1.22E-05
ZN-65	Ci	0.00E+00	0.00E+00	2.10E-05	0.00E+00	2.10E-05
ZR-95	Ci	2.68E-06	7.72E-06	8.57E-05	0.00E+00	9.61E-05
Total for Period	Ci	1.21E-02	1.34E-02	3.46E-02	9.34E-03	6.94E-02
<b>B. Tritium</b>						
H-3	Ci	2.37E+02	1.70E+02	6.83E+02	2.70E+02	1.36E+03
<b>C. Dissolved &amp; Entrained Gases</b>						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>D. Gross Alpha</b>						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 2**  
**Supplemental Information**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 2**

**Supplemental Information**

This attachment includes supplemental information to the gaseous and liquid effluents report.

## Attachment 2 Supplemental Information

### McGuire Nuclear Station Units 1 & 2 Period 1/1/2015 - 12/31/2015

#### I. Regulatory Limits - Per Unit

##### A. Noble Gases - Air Dose

1. Calendar Quarter Gamma Dose	= 5	mRAD
2. Calendar Quarter Beta Dose	= 10	mRAD
3. Calendar Year Gamma Dose	= 10	mRAD
4. Calendar Year Beta Dose	= 20	mRAD

##### B. Liquid Effluents - Dose

1. Calendar Quarter Total Body Dose	= 1.5	mREM
2. Calendar Quarter Organ Dose	= 5	mREM
3. Calendar Year Total Body Dose	= 3	mREM
4. Calendar Year Organ Dose	= 10	mREM

##### C. Gaseous Effluents - Iodine-131 & 133, Tritium, and Particulates with Half-lives > 8 days

1. Calendar Quarter Organ Dose	= 7.5	mREM
2. Calendar Year Organ Dose	= 15	mREM

#### II. Maximum Permissible Effluent Concentrations

##### A. Gaseous Effluents

1. Information found in Offsite Dose Calculation Manual

##### B. Liquid Effluents

1. Information found in 10 CFR Part 20, Appendix B, Table 2, Column 2

#### III. Average Energy

(not applicable)

#### IV. Measurements and Approximations of Total Radioactivity

Analyses of specific radionuclides in selected or composited samples as described in the Selected Licensee Commitments are used to determine the radionuclide composition of the effluent. A summary description of the method used for estimating overall errors associated with radioactivity measurements is provided as part of this attachment.

#### V. Batch Releases

##### A. Liquid Effluents

1. Total Number of Batch Releases	=	2.48E+02
2. Total Time (min) for Batch Releases	=	1.51E+04
3. Maximum Time (min) for a Batch Release	=	2.89E+02
4. Average Time (min) for Batch Releases	=	6.10E+01
5. Minimum Time (min) for a Batch Release	=	1.00E+00
6. Average Dilution Water Flow During Release (gpm)	=	1.82E+06

##### B. Gaseous Effluents

1. Total Number of Batch Releases	=	3.80E+01
2. Total Time (min) for Batch Releases	=	1.04E+06
3. Maximum Time (min) for a Batch Release	=	4.47E+04
4. Average Time (min) for Batch Releases	=	2.75E+04
5. Minimum Time (min) for a Batch Release	=	1.80E+01

#### VI. Abnormal Releases

See Attachment 5, Unplanned Offsite Releases.

## **Attachment 2 Supplemental Information**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

### **Carbon-14**

Carbon-14 (C-14), with a half-life of 5730 years, is a naturally occurring isotope of carbon produced by cosmic ray interactions in the atmosphere. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally or from weapons testing.

In Regulatory Guide 1.21, Revision 2, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste", the NRC recommends U.S. nuclear power plants evaluate whether C-14 is a "principal radionuclide", and if so, report the amount of C-14 released. Improvements over the years in effluent management practices and fuel performance have resulted in a decrease in gaseous radionuclide (non-C-14) concentrations, and a change in the distribution of gaseous radionuclides released to the environment. As a result, many sites show C-14 has become a "principal radionuclide" for the gaseous effluent pathway, as defined in Regulatory Guide 1.21, Rev. 2. McGuire Nuclear Station 2015 ARERR contains estimates of C-14 radioactivity released in 2015, and estimates of public dose resulting from the C-14 effluent.

Because the dose contribution of C-14 from liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of C-14 in liquid radioactive waste is not required (Ref. Reg. Guide 1.21, Rev. 2). The quantity of gaseous C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. Reg. Guide 1.21, Rev. 2). Many documents provide information related to the magnitude of C-14 in typical effluents from commercial nuclear power plants. Those documents suggest that nominal annual releases of C-14 in gaseous effluents are approximately 5 to 7.3 curies from PWRs (Ref. Reg. Guide 1.21, Rev. 2). A more recent study recommends a higher C-14 gaseous source term scaling factor of approximately 9.0 to 9.8 Ci/GWe-yr for a PWR (Westinghouse) (Ref. EPRI 1021106). For the McGuire Nuclear Station 2015 ARERR a source term scaling factor of 9.4 Ci/GWe-yr is assumed. Using a source term scaling factor of 9.4 Ci/GWe-yr and actual electric generation (MWe-hrs) from McGuire Nuclear Station in 2015 results in a site total C-14 gaseous release estimate to the environment of 20.96 Curies. 70% of the C-14 gaseous effluent is assumed to be from batch releases (e.g. WGDTS), and 30% of C-14 gaseous effluent is assumed to be from continuous releases through the unit vents (ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).

C-14 releases in PWRs occur primarily as a mix of organic carbon and carbon dioxide released from the waste gas system. Since the PWR operates with a reducing chemistry, most, if not all, of the C-14 species initially produced are organic (e.g., methane). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as a gaseous species. Any time the RCS liquid or gas is exposed to an oxidizing environment (e.g. during shutdown or refueling), a slow transformation from an organic to an inorganic chemical form can occur. Various studies documenting measured C-14 releases from PWRs suggest a range of 70% to 95% organic with an average of 80% organic with the remainder being CO<sub>2</sub> (Ref. EPRI TR-105715). For the McGuire Nuclear Station 2015 ARERR a value of 80% organic C-14 is assumed.

Public dose estimates from airborne C-14 are performed using dose models in NUREG-0133 and Regulatory Guide 1.109. The dose models and assumptions used are documented in the McGuire ODCM. The estimated C-14 dose impact on the maximum organ dose from airborne effluents released from McGuire Nuclear Station in 2015 is well below the 10CFR50, Appendix I, ALARA design objective (i.e., 15 mrem/yr per unit).

**Attachment 2**  
**Supplemental Information**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Overall Estimate of Error for Effluent Radioactivity Release Reported**

The estimated percentage of overall error for both Liquid and Gaseous effluent release data at McGuire Nuclear Station has been determined to be  $\pm 30.3\%$ . This value was derived by taking the square root of the sum of the squares of the following discrete individual estimates of error:

1. Flow Rate Determining Devices =  $\pm 20\%$
2. Counting Statistical Error =  $\pm 20\%$
3. Calibration Error =  $\pm 10\%$
4. Calibration Source Error =  $\pm 2.5\%$
5. Sample Preparation Error =  $\pm 3\%$

**Attachment 2  
Supplemental Information**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Summary of Changes in Land Use Census Affecting Effluent Dose Calculations**

The 2015 Land Use Census was performed June 8-9, 2015, and the results were certified and made available for use on June 29, 2015. The following are changes to residences, gardens, and milk animals from the previous year.

**Residences**

No changes to nearest residence in each sector.

**Gardens**

The non-irrigated garden in the NNE sector at 2.53 miles was replaced by a non-irrigated garden at 1.40 miles. The non-irrigated garden in the NE sector at 1.80 miles was replaced by a non-irrigated garden at 2.38 miles.

**Milk Animals**

No changes to nearest milk animal in each sector.

**Environmental Monitoring Locations**

No changes to environmental monitoring locations in each sector.

**Attachment 3**  
**Solid Radioactive Waste Disposal**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 3**

**Solid Radioactive Waste Disposal**

This attachment includes a summary of the solid waste shipped off-site for burial and/or disposal, including:

- Container volume
- Total Curie content
- Principal Radionuclides
- Source/Type of waste
- Solidification agent or absorbent
- Type of shipping container
- Number of shipments
- Other relevant information as necessary

### Attachment 3 Solid Radioactive Waste Disposal

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Type of Waste Shipped	Number of Shipments	Number of Containers	Waste Class	Container Type	Solidification Agent	Burial Volume (m <sup>3</sup> )	Total Activity (Curies)
<b>1. <u>Waste from Liquid Systems</u></b>							
a. Dewatered Powdex Resin (brokered)	0	-	-	-	-	-	-
b. Dewatered Powdex Resin	0	-	-	-	-	-	-
c. Dewatered Bead Resin (brokered)	0	-	-	-	-	-	-
d. Dewatered Bead Resin	0	-	-	-	-	-	-
e. Dewatered Radwaste System Resin	0	-	-	-	-	-	-
f. Dewatered Primary Bead Resins (brokered)	2	2	C	B	N/A	5.66	9.63E+02
g. Dewatered Mechanical Filter Media	0	-	-	-	-	-	-
h. Dewatered Mechanical Filter Media (brokered)	1	1	C	B	N/A	4.47	1.56E+01
	1	1	A	DBP	N/A	2.06	1.48E+00
i. Solidified Waste	0	-	-	-	-	-	-
<b>2. <u>Dry Solid Waste</u></b>							
a. Dry Active Waste (compacted)	0	-	-	-	-	-	-
b. Dry Active Waste (non-compacted)	0	-	-	-	-	-	-
c. Dry Active Waste (brokered / compacted)	0	-	-	-	-	-	-
d. Dry Active Waste (brokered / non-compacted)	17	46	A/U	DBP/A	N/A	97.05	3.858E-01
e. Sealed Sources / Smoke Detectors	0	-	-	-	-	-	-
f. Sealed Sources	0	-	-	-	-	-	-
g. Irradiated Components	0	-	-	-	-	-	-
<b>3. <u>Total Waste</u></b>	<b>21</b>	<b>50</b>				<b>109.24</b>	<b>9.805E+02</b>



### Attachment 3 Solid Radioactive Waste Disposal

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Type of Waste Shipped	Radionuclide	% Abundance
<b>1. <u>Waste from Liquid Systems</u></b>		
a. Dewatered Powdex Resin (brokered)	N/A	N/A
b. Dewatered Powdex Resin	N/A	N/A
c. Dewatered Bead Resin (brokered)	N/A	N/A
d. Dewatered Bead Resin	N/A	N/A
e. Dewatered Radwaste System Resin	N/A	N/A
f. Dewatered Primary Bead Resins (brokered)		
	<b><u>2015-0010</u></b>	
	Mn-54	1.07
	Co-57	0.02
	Co-58	0.26
	Co-60	12.47
	Cs-137	0.11
	Fe-55	12.75
	Ni-63	72.46
	C-14	0.04
	Sb-125	0.19
	Zn-65	0.13
	Ni-59	0.51
	<b><u>2015-0023</u></b>	
	Mn-54	1.85
	Co-57	0.03
	Co-58	0.42
	Co-60	12.33
	Cs-137	0.10
	Fe-55	12.64
	Ni-63	71.66
	C-14	0.04
	Sb-125	0.14
	Zn-65	0.28
	Ni-59	0.50
g. Dewatered Mechanical Filter Media	N/A	N/A
h. Dewatered Mechanical Filter Media (brokered)		
	<b><u>2015-0006</u></b>	
	Mn-54	1.76
	Co-57	0.04
	Co-60	72.48
	Cs-137	0.56
	Fe-55	17.37
	Ni-63	6.75
	Ce-144	0.11
	Sr-90	0.77
	Zn-65	0.10
	Am-241	0.02
	Cm-243	0.03

### Attachment 3 Solid Radioactive Waste Disposal

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

<u>2015-0014</u>		Ag-110m	0.14
		Cr-51	2.48
		Mn-54	4.46
		Co-57	0.10
		Co-58	6.60
		Co-60	39.30
		Cs-137	0.07
		Fe-55	33.56
		Fe-59	0.13
		Ni-63	2.90
		H-3	1.20
		C-14	0.53
		Nb-95	0.98
		Ce-144	0.10
		Sb-124	0.12
		Sb-125	0.99
		Zr-95	2.14
		Sr-90	0.07
		Sn-113	0.15
		Zn-65	0.67
		Tc-99	0.03
		Ni-59	3.29
i. Solidified Waste		N/A	N/A
<hr/>			
2.	<u>Dry Solid Waste</u>		
a.	Dry Active Waste (compacted)	N/A	N/A
b.	Dry Active Waste (non-compacted)	N/A	N/A
c.	Dry Active Waste (brokered / compacted)	N/A	N/A
d.	Dry Active Waste (brokered / non-compacted)		
<u>2015-0001</u>		Cr-51	16.46
		Mn-54	3.25
		Co-57	0.12
		Co-58	20.37
		Co-60	28.46
		Cs-137	0.16
		Fe-55	17.78
		Fe-59	0.79
		Nb-95	4.93
		Ce-144	0.47
		Sb-124	0.21
		Zr-95	6.03
		Sn-113	0.33
		Zn-65	0.63
<u>2015-0002</u>		Cr-51	30.82
		Mn-54	2.33
		Co-57	0.09
		Co-58	19.94
		Co-60	18.95
		Cs-137	0.11
		Fe-55	11.99
		Fe-59	0.98
		Nb-95	7.34
		Ce-144	0.34
		Sb-124	0.22
		Zr-95	6.15
		Sn-113	0.28
		Zn-65	0.46

### Attachment 3 Solid Radioactive Waste Disposal

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

<u>2015-0003</u>	Cr-51	42.64
	Mn-54	1.67
	Co-57	0.06
	Co-58	17.98
	Co-60	12.75
	Cs-137	0.07
	Fe-55	8.18
	Fe-59	1.06
	Nb-95	8.83
	Ce-144	0.24
	Sb-124	0.21
	Zr-95	5.74
	Sn-113	0.22
	Zn-65	0.34
 <u>2015-0004</u>	Cr-51	2.44
	Mn-54	0.82
	Co-57	0.01
	Co-58	2.97
	Co-60	75.08
	Fe-55	14.17
	Fe-59	0.11
	Ni-63	1.25
	C-14	0.08
	Nb-95	0.85
	Ni-59	0.01
	Ce-144	0.01
	Sb-124	0.01
	Sb-125	0.03
	Zr-95	0.97
	Sr-89	0.02
	Sn-113	0.02
	Zn-65	1.15
 <u>2015-0005</u>	Cr-51	40.40
	Mn-54	1.79
	Co-57	0.07
	Co-58	18.50
	Co-60	13.76
	Cs-137	0.08
	Fe-55	8.82
	Fe-59	1.05
	Nb-95	8.60
	Ce-144	0.26
	Sb-124	0.21
	Zr-95	5.86
	Sn-113	0.24
	Zn-65	0.36
 <u>2015-0007</u>	Cr-51	22.55
	Mn-54	2.81
	Co-57	0.10
	Co-58	20.47
	Co-60	23.59
	Cs-137	0.13
	Fe-55	14.92
	Fe-59	0.89
	Ni-63	0.09
	Nb-95	6.49
	Ce-144	0.40
	Sb-124	0.22
	Sb-125	0.03
	Zr-95	6.44
	Sn-113	0.32
	Zn-65	0.55

**Attachment 3  
Solid Radioactive Waste Disposal**

**McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015**

<u><b>2015-0008</b></u>	Cr-51	26.73
	Mn-54	2.66
	Co-57	0.10
	Co-58	15.86
	Co-60	25.83
	Cs-137	0.15
	Fe-55	15.86
	Fe-59	0.76
	Nb-95	5.94
	Ce-144	0.38
	Sb-124	0.17
	Zr-95	4.82
	Sn-113	0.25
	Zn-65	0.50
 <u><b>2015-0009</b></u>	Cr-51	15.17
	Mn-54	2.84
	Co-57	0.07
	Co-58	11.53
	Co-60	21.51
	Cs-137	0.03
	Fe-55	16.10
	Fe-59	0.50
	Ni-63	2.44
	H-3	0.05
	C-14	0.01
	Nb-95	16.75
	Ce-144	0.11
	Sb-124	0.27
	Sb-125	0.91
	Zr-95	10.91
	Sr-90	0.01
	Sn-113	0.42
	Zn-65	0.37
 <u><b>2015-0012</b></u>	Cr-51	30.29
	Mn-54	2.35
	Co-57	0.09
	Co-58	20.21
	Co-60	19.00
	Cs-137	0.11
	Fe-55	12.06
	Fe-59	0.99
	Nb-95	7.35
	Ce-144	0.34
	Sb-124	0.22
	Zr-95	6.24
	Sn-113	0.28
	Zn-65	0.47

**Attachment 3  
Solid Radioactive Waste Disposal**

**McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015**

<b><u>2015-0013</u></b>	Cr-51	6.57
	Mn-54	3.72
	Co-57	0.09
	Co-58	10.56
	Co-60	30.80
	Cs-137	0.05
	Fe-55	22.70
	Fe-59	0.35
	Ni-63	3.55
	H-3	0.08
	C-14	0.02
	Nb-95	9.42
	Ce-144	0.14
	Sb-124	0.23
	Sb-125	1.28
	Zr-95	9.50
	Sr-90	0.01
	Sn-113	0.46
	Zn-65	0.47
 <b><u>2015-0015</u></b>	 Cr-51	 17.07
	Mn-54	2.65
	Co-57	0.06
	Co-58	11.58
	Co-60	19.69
	Cs-137	0.03
	Fe-55	14.80
	Fe-59	0.53
	Ni-63	2.22
	H-3	0.05
	C-14	0.01
	Nb-95	18.26
	Ce-144	0.10
	Sb-124	0.28
	Sb-125	0.84
	Zr-95	11.06
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.35
 <b><u>2015-0017</u></b>	 Cr-51	 17.43
	Mn-54	2.62
	Co-57	0.06
	Co-58	11.59
	Co-60	19.44
	Cs-137	0.03
	Fe-55	14.60
	Fe-59	0.54
	Ni-63	2.19
	H-3	0.05
	C-14	0.01
	Nb-95	18.44
	Ce-144	0.10
	Sb-124	0.28
	Sb-125	0.83
	Zr-95	11.04
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.34

**Attachment 3**  
**Solid Radioactive Waste Disposal**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

<u><b>2015-0019</b></u>	Cr-51	16.89
	Mn-54	2.67
	Co-57	0.06
	Co-58	11.57
	Co-60	19.90
	Cs-137	0.03
	Fe-55	14.93
	Fe-59	0.53
	Ni-63	2.24
	H-3	0.05
	C-14	0.01
	Nb-95	18.05
	Ce-144	0.10
	Sb-124	0.28
	Sb-125	0.85
	Zr-95	11.07
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.35
<u><b>2015-0020</b></u>	Cr-51	16.69
	Mn-54	2.68
	Co-57	0.06
	Co-58	11.61
	Co-60	20.02
	Cs-137	0.03
	Fe-55	15.00
	Fe-59	0.53
	Ni-63	2.26
	H-3	0.05
	C-14	0.01
	Nb-95	17.97
	Ce-144	0.10
	Sb-124	0.28
	Sb-125	0.85
	Zr-95	11.09
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.35
<u><b>2015-0021</b></u>	Cr-51	16.53
	Mn-54	2.71
	Co-57	0.06
	Co-58	11.59
	Co-60	20.18
	Cs-137	0.03
	Fe-55	15.14
	Fe-59	0.53
	Ni-63	2.28
	H-3	0.05
	C-14	0.01
	Nb-95	17.82
	Ce-144	0.10
	Sb-124	0.28
	Sb-125	0.86
	Zr-95	11.06
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.35

### Attachment 3 Solid Radioactive Waste Disposal

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

<u>2015-0022</u>		
	Cr-51	16.18
	Mn-54	2.72
	Co-57	0.06
	Co-58	11.63
	Co-60	20.42
	Cs-137	0.03
	Fe-55	15.32
	Fe-59	0.52
	Ni-63	2.31
	H-3	0.05
	C-14	0.01
	Nb-95	17.65
	Ce-144	0.10
	Sb-124	0.27
	Sb-125	0.87
	Zr-95	11.07
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.36
<u>2015-0025</u>		
	Cr-51	15.88
	Mn-54	2.77
	Co-57	0.06
	Co-58	11.49
	Co-60	20.94
	Cs-137	0.03
	Fe-55	15.68
	Fe-59	0.51
	Ni-63	2.37
	H-3	0.05
	C-14	0.01
	Nb-95	17.24
	Ce-144	0.10
	Sb-124	0.27
	Sb-125	0.89
	Zr-95	10.91
	Sr-90	0.01
	Sn-113	0.41
	Zn-65	0.36
e. Sealed Sources / Smoke Detectors	N/A	N/A
f. Sealed Sources	N/A	N/A
g. Irradiated Components	N/A	N/A

**Attachment 4  
Meteorological Data**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 4**

**Meteorological Data**

This attachment includes a summary of meteorological joint frequency distributions of wind speed, wind direction, and atmospheric stability (hours of occurrence).



# Attachment 4 Meteorological Data

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	1.01-1.25	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.26-1.50	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.51-2.00	1	2	1	0	0	0	0	0	0	0	1	0	0	0	0	0
	2.01-3.00	4	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0
	3.01-4.00	3	7	4	1	0	0	0	0	0	0	1	0	0	0	0	0
	4.01-5.00	0	8	10	2	0	0	0	0	1	0	0	0	0	0	1	0
	5.01-6.00	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0
	6.01-8.00	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1
	8.01-10.00	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	10.01-max	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
B	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.01-1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.26-1.50	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	1.51-2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2.01-3.00	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	3.01-4.00	4	1	2	1	2	1	1	0	1	0	1	0	1	0	0	0
	4.01-5.00	1	1	3	0	0	0	0	0	0	2	5	3	0	0	0	0
	5.01-6.00	1	1	0	0	0	0	0	0	0	0	2	1	0	0	0	1
	6.01-8.00	3	0	0	0	0	0	0	0	0	0	0	1	0	0	1	4
	8.01-10.00	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3

# Attachment 4 Meteorological Data

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
C	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.01-1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.26-1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1.51-2.00	1	1	0	1	0	0	0	1	1	0	0	0	0	1	1	0
	2.01-3.00	10	4	2	7	5	1	0	0	5	2	2	4	1	1	0	1
	3.01-4.00	7	3	9	7	2	0	1	0	2	7	5	9	0	0	0	1
	4.01-5.00	1	5	1	3	0	0	0	0	0	4	14	7	0	0	1	1
	5.01-6.00	5	1	2	0	0	0	0	0	0	1	7	1	0	0	0	10
	6.01-8.00	11	3	1	0	0	0	0	0	0	0	4	4	2	0	9	10
	8.01-10.00	3	2	0	0	0	0	0	0	0	0	0	0	0	0	1	4
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
D	0.46-0.75	0	0	1	0	2	1	1	2	0	2	1	1	0	0	1	2
	0.76-1.00	4	5	1	1	1	2	0	1	2	3	1	1	0	3	2	2
	1.01-1.25	5	8	3	6	2	1	2	6	5	2	3	4	4	5	5	11
	1.26-1.50	22	22	10	11	5	9	11	5	17	13	15	11	17	12	8	22
	1.51-2.00	63	68	84	42	25	26	46	28	48	42	64	53	37	24	27	33
	2.01-3.00	119	156	245	125	119	78	90	47	108	194	313	141	65	37	34	40
	3.01-4.00	36	109	353	134	66	44	24	9	27	105	228	74	26	28	52	36
	4.01-5.00	47	75	268	49	7	4	8	7	2	32	85	38	22	16	45	40
	5.01-6.00	30	45	109	2	2	0	1	1	0	3	44	14	8	6	23	35
	6.01-8.00	26	36	74	0	0	0	0	0	0	0	25	9	6	5	19	22
	8.01-10.00	8	2	1	0	0	0	0	0	0	0	1	2	2	0	4	14
	10.01-max	3	0	0	0	0	0	0	0	0	0	0	0	0	2	5	5

# Attachment 4 Meteorological Data

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
E	0.46-0.75	0	1	1	0	0	3	1	2	2	5	1	2	5	2	0	0
	0.76-1.00	5	3	4	0	2	5	4	8	7	12	9	4	7	8	3	4
	1.01-1.25	18	8	7	2	4	2	8	7	13	15	13	21	12	9	7	12
	1.26-1.50	7	9	5	3	10	7	8	15	27	27	25	27	17	14	8	8
	1.51-2.00	17	16	17	8	5	11	27	48	76	55	58	56	28	14	14	16
	2.01-3.00	23	19	17	9	9	14	60	13	62	119	130	48	26	21	19	8
	3.01-4.00	7	9	24	10	4	2	8	3	2	23	36	6	7	10	14	7
	4.01-5.00	3	2	23	0	0	0	2	0	0	1	16	7	3	2	7	2
	5.01-6.00	2	1	9	2	0	0	0	0	1	1	11	2	3	0	4	5
	6.01-8.00	2	3	0	1	0	0	0	0	0	0	1	1	2	2	5	3
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	0.46-0.75	0	1	0	0	0	0	0	2	6	11	5	9	1	1	1	1
	0.76-1.00	0	2	0	0	1	0	2	2	5	13	21	27	4	1	2	1
	1.01-1.25	0	0	0	0	0	0	1	5	5	25	23	12	10	2	0	0
	1.26-1.50	0	1	0	0	2	0	1	5	18	21	16	7	6	3	3	1
	1.51-2.00	0	1	1	1	0	0	3	12	28	28	23	17	9	5	0	1
	2.01-3.00	0	1	0	0	0	0	1	2	18	11	18	11	8	3	2	1
	3.01-4.00	0	0	0	0	0	0	0	0	0	0	0	2	0	2	3	0
	4.01-5.00	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
	5.01-6.00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	6.01-8.00	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Attachment 4  
Meteorological Data**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Stability Class	Wind Speed (mph)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
G	0.46-0.75	0	0	0	0	0	0	2	0	4	8	13	4	5	1	3	0
	0.76-1.00	0	0	0	0	0	0	0	0	5	32	50	18	5	4	2	2
	1.01-1.25	0	0	1	1	0	0	0	0	10	35	15	5	3	1	0	0
	1.26-1.50	0	0	0	0	0	0	0	0	3	17	9	2	3	0	0	0
	1.51-2.00	0	0	0	0	0	0	0	0	6	7	5	4	1	0	0	0
	2.01-3.00	0	0	0	0	0	0	0	0	2	2	3	1	0	0	0	0
	3.01-4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	4.01-5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5.01-6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Attachment 5**  
**Unplanned Offsite Releases**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 5**

**Unplanned Offsite Releases**

This attachment includes a summary of the unplanned offsite releases of gaseous and liquid radioactive effluents.

**Attachment 5**  
**Unplanned Offsite Releases**

**McGuire Nuclear Station Units 1 & 2**  
**Period 1/1/2015 - 12/31/2015**

McGuire Nuclear Station experienced no unplanned offsite liquid effluent releases in 2015.

McGuire Nuclear Station experienced two (2) unplanned offsite gaseous effluent releases in 2015. Summaries are described on the following pages.

**Attachment 5  
Unplanned Offsite Releases**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

July 7, 2015

Memorandum To: Annual Radioactive Effluent Release Report

CC: Steve Mooneyhan, Chris Whitener, Chris Courtenay, Kay Crane, Jimmy Glenn, Matt Shipman, Phil Keller

From: William C. Spencer  
RP Staff  
Radiation Protection  
McGuire Nuclear Station

**Re: Unplanned release to the Unit 2 Vent, Reference NCR # 1929988**

**Event Summary:**

See referenced NCR for details.

On 7/7/2015 maintenance was performing a planned work activity on waste gas (WG) compressor B. The activity breeched the WG system at ~13:42 hrs. The system breach allowed release of the WG shutdown tank A via the B WG Compressor Separator Drain valve to the B WEFT Sump area. At 13:54 EMF 41 (Aux Bld gas monitor) point 10 received trip 2 alarm at greater than 120 cpm. Max cpm seen at this monitoring point was 730 cpm. The auxiliary building ventilation was placed into filtered mode. The Unit 2 Vent gas monitor 2 EMF 36(L) increased from ~26 cpm background (bkg) to 46 cpm max and remained elevated above bkg over a period of 48 minutes. The control room received a trip 1 on 2 EMF 36(L). Noble gas activity was also released in the B Compressor room as indicated by EMF 41 point 4 response (250cpm). Work was stopped and workers were evacuated from the area. Rad surveys were performed. No workers were contaminated and no noble gas activity was identified in local work area samples. It was later discovered that WG shutdown tank A had released 554 cubic ft in a period of ~17 minutes into the Auxiliary Building ventilation. Following subsequent monitoring and release termination, EMF's 41 and 2 EMF36 (L) returned to normal indication. VA system was realigned to a normal configuration. No increased cpm above bkg was identified in the Unit 1 Vent.

No WG sample was available from the affected tank. Xe-133 noble gas equivalent activity was conservatively determined using the maximum cpm seen on the unit vent gas monitor during the release period. The total Noble gas activity released during the event from WG shutdown tank A was determined to be 2.78E-5 Curies. The release was reported on Gaseous Waste Release (GWR) # 2015039. No SLC or T/S limits were challenged by this release.

The total release of Noble gas radioactivity was evaluated against off site dose limits using current ODCM methodology on the attached spreadsheets. Procedure AD-RP-ALL-2003 "Investigation of Unusual Radiological Occurrences" was completed to document the event.

**Safety Significance:**

**The health and safety of the public were not compromised by this event. Calculated dose and doserate to the Total Body, Skin, Gamma Air, and Beta Air were all orders of magnitude below the limits specified by Selected Licensee Commitments and Code of Federal Regulations.**

W.C. Spencer  
RP Staff Support  
Radiation Protection  
McGuire Nuclear Station

Chris Whitener  
Supervising Scientist  
Radiation Protection  
McGuire Nuclear Station

**Attachment 5  
Unplanned Offsite Releases**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

*September 3, 2015*

Memorandum To: Annual Radioactive Effluent Release Report

CC: Steve Mooneyhan, Chris Whitener, Chris Courtenay, Kay Crane, Jimmy Glenn

From: William C. Spencer  
RP Staff  
Radiation Protection  
McGuire Nuclear Station

**Re: Unplanned release to the Unit 2 Vent, Reference NCR # 1950338**

**Event Summary:**

See referenced NCR for details.

On 9/3/2015 ~11:00 Operations was operating the NB Evaporator with discharge to the Unit 1 RMWST. The A WG Compressor spuriously tripped. This allowed pressure to build in the Evaporator shell. At 11:25 the Unit 2 Vent gas rad monitor increased to 121 cpm above background (bkg) and reached Trip 1 alarm. Water was also seen coming from the ventilation duct on 716 elevation. The water was determined to be absent any gamma nuclides (clean). Control room Operations notified RP Shift to investigate. RP trending of the Unit 2 radiation monitor 2 EMF 36L indicated an increased count rate over an 18 minute time frame. No vent sample was able to be collected. The highest count rate seen from the gas monitor was 143 cpm. Normal bkg determined to be 22 cpm. The average count rate during the release was 40 cpm above bkg.

Operations secured the NB Evaporator. It is believed that the Evaporator Rupture disc failed which allowed gas to release as designed to the Auxiliary building ventilation system to the Unit 2 Vent.

A conservative calculation using Xe-133 noble gas equivalent activity was used to evaluate the release. No gas sample from the evaporator shell was available. Unit 2 vent flow and 2 EMF 36L gas monitor average response during the release period was used to quantify Noble gas released. The total Noble gas activity released during the event was conservatively determined to be 6.28E-2 Curies. The release was reported on Gaseous Waste Release (GWR) report # 2015056. No SLC or T/S limits were challenged by this release.

The total release of Noble gas radioactivity was evaluated against off site dose limits using current ODCM methodology on the attached spreadsheets. Procedure AD-RP-ALL-2003 "Investigation of Unusual Radiological Occurrences" was completed to document the event.

**Safety Significance:**

**The health and safety of the public were not compromised by this event. Calculated dose and doserate to the Total Body, Skin, Gamma Air, and Beta Air were all significantly below the limits specified by Selected Licensee Commitments and Code of Federal Regulations.**

W.C. Spencer  
RP Staff Support  
Radiation Protection  
McGuire Nuclear Station

Chris Whitener  
Supervising Scientist  
Radiation Protection  
McGuire Nuclear Station



**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 6**

**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**  
**(includes fuel cycle dose calculation results)**

This attachment includes an assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents released from the site for each calendar quarter for the calendar year of the report as well as the total dose for the calendar year.

This attachment also includes an assessment of radiation doses to the maximum exposed member of the public from all uranium fuel cycle sources within 8 km of the site for the calendar year of this report to show conformance with 40 CFR Part 190.

Methods for calculating the dose contribution from liquid and gaseous effluents are given in the Offsite Dose Calculation Manual (ODCM).

**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Gaseous Effluents Dose Summary**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Noble Gases</b>						
1. Maximum Gamma Air	mRAD	9.03E-03	8.95E-03	8.98E-03	8.31E-03	3.53E-02
(a) Limit	mRAD	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
(b) % of Limit		9.03E-02	8.95E-02	8.98E-02	8.31E-02	1.76E-01
2. Maximum Beta Air	mRAD	3.32E-03	3.20E-03	3.37E-03	2.97E-03	1.29E-02
(a) Limit	mRAD	2.00E+01	2.00E+01	2.00E+01	2.00E+01	4.00E+01
(b) % of Limit		1.66E-02	1.60E-02	1.69E-02	1.48E-02	3.21E-02

Receptor Location **0.5 miles NNE**

**B. Iodine, H-3, & Particulates**

1. Maximum Organ Dose	mREM	8.15E-01	8.52E-01	7.32E-01	8.11E-01	3.21E+00
(a) Limit	mREM	1.50E+01	1.50E+01	1.50E+01	1.50E+01	3.00E+01
(b) % of Limit		5.43E+00	5.68E+00	4.88E+00	5.41E+00	1.07E+01

Receptor Location **1.0 miles NNE**

Critical Age **CHILD**

Critical Organ **BONE**

Critical Pathway **VEGETATION**

**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**Liquid Effluents Dose Summary**

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
<b>A. Batch Mode</b>						
1. Maximum Organ Dose	mREM	2.99E-02	1.98E-02	8.11E-02	3.32E-02	1.63E-01
(a) Limit	mREM	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
(b) % of Limit		2.99E-01	1.98E-01	8.11E-01	3.32E-01	8.16E-01
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Organ		Liver	Liver	GILLI	Liver	Liver
(e) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water
2. Maximum Total Body Dose	mREM	2.92E-02	1.87E-02	7.97E-02	3.21E-02	1.59E-01
(a) Limit	mREM	3.00E+00	3.00E+00	3.00E+00	3.00E+00	6.00E+00
(b) % of Limit		9.72E-01	6.22E-01	2.66E+00	1.07E+00	2.65E+00
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water
<b>B. Continuous Mode</b>						
1. Maximum Organ Dose	mREM	4.00E-04	2.60E-04	1.91E-02	6.36E-04	1.04E-02
(a) Limit	mREM	1.00E+01	1.00E+01	1.00E+01	1.00E+01	2.00E+01
(b) % of Limit		4.00E-03	2.60E-03	1.91E-01	6.36E-03	5.21E-02
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Organ		Liver	Liver	Liver	Liver	Liver
(e) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water
2. Maximum Total Body Dose	mREM	4.00E-04	2.60E-04	1.91E-02	6.36E-04	1.04E-02
(a) Limit	mREM	3.00E+00	3.00E+00	3.00E+00	3.00E+00	6.00E+00
(b) % of Limit		1.33E-02	8.66E-03	6.38E-01	2.12E-02	1.74E-01
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water

**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**40 CFR Part 190 Uranium Fuel Cycle Dose Calculation Results**

In accordance with the requirements of 40 CFR Part 190, the annual dose commitment to any member of the general public shall be calculated to assure that doses are limited to 25 millirems to the total body or any organ with the exception of the thyroid which is limited to 75 millirems. The fuel cycle dose assessment for McGuire Nuclear Station includes liquid and gaseous effluent dose contributions from McGuire Nuclear Station and direct and air-scatter dose from the onsite ISFSI. No other uranium fuel cycle facility contributes significantly to the maximum exposed individual. Included in the gaseous effluent dose calculations is an estimate of the dose contributed by Carbon-14 (Ref. Attachment 2, Supplemental Information, of this report for further information). The combined dose to a maximum exposed individual from effluent releases and direct and air-scatter dose from the ISFSI is below 40 CFR Part 190 limits as shown by the following summary.

*Note: The 40 CFR Part 190 effluent dose analysis to the maximum exposed individual from liquid and gas releases includes the dose from noble gases (i.e., total body and skin).*

**40 CFR Part 190 Effluent Dose Summary**

A. Maximum Organ Dose (other than TB)	3.23E+00 mREM
1. Location	1.0 miles NNE
2. Critical Age	CHILD
3. Critical Organ	BONE
4. Gas Contribution %	99.56%
5. Liquid Contribution %	0.44%
B. Maximum Total Body Dose	1.05E+00 mREM
1. Location	1.0 miles NNE
2. Critical Age	CHILD
3. Gas non-NG Contribution %	84.06%
4. Gas Contribution %	0.80%
5. Liquid Contribution %	15.14%

Direct and air-scatter radiation dose contributions from the onsite ISFSI have been determined from the 10 CFR 72.212 Evaluation Report, MAGNASTOR®, Revision 03. The maximum dose rate to the nearest real individual from the ISFSI is conservatively calculated to be less than 4 mrem/yr.

The attached excerpt from the 10 CFR 72.212 Evaluation Report, MAGNASTOR®, Revision 03 is provided to document the method used to calculate the dose from ISFSI as less than 4 mrem/yr to the nearest real individual.

Total dose from liquid and gaseous effluents from McGuire Nuclear Station and direct and air-scatter dose from the onsite ISFSI is conservatively estimated to be less than 8 mrem/yr to the nearest real individual. This meets the 40 CFR Part 190 requirements of an annual dose commitment to any member of the general public of less than 25 mrem total body or any organ and 75 mrem to the thyroid.

## **Attachment 6**

### **Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

#### **10 CFR 72.212 Evaluation Report, MAGNASTOR®, Revision 03**

#### **6.0 10 CFR 72.212(b)(5)(iii) Radioactive Materials in Effluents and Direct Radiation**

##### **6.1 Purpose**

10 CFR 72.212(b)(5)(iii) requires the general licensee to perform written evaluations, before use and before applying the changes authorized by an amended CoC to a cask loaded under the initial CoC or an earlier amended CoC, that establish that the requirements of 10 CFR 72.104 have been met. A copy of this record shall be retained until spent fuel is no longer stored under the general license issued under 10 CFR 72.210.

10 CFR 72.104 provides the regulatory criteria for radioactive materials in effluents and direct radiation from an independent spent fuel storage installation (ISFSI) during normal operation and anticipated occurrences. Specifically, 10 CFR 72.104(a) limits the annual dose equivalent to any real individual who is located beyond the controlled area to 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other critical organ. This dose equivalent must include contributions from (1) planned discharges of radioactive materials (radon and its decay products excepted) to the general environment, (2) direct radiation from ISFSI operations, and (3) any other radiation from uranium fuel cycle operations within the region. In addition, 10 CFR 72.104(b) requires that operational restrictions be established to meet as low as is reasonably achievable (ALARA) objectives for radioactive materials in effluents and direct radiation levels associated with ISFSI operations. Also, 10 CFR 72.104(c) requires that operational limits be established for radioactive materials in effluents and direct radiation levels associated with ISFSI operations to meet the above-mentioned dose limits.

This section provides the written evaluation required by 10 CFR 72.212(b)(5)(iii), demonstrating Duke Energy's compliance with the requirements of 10 CFR 72.104 for the MNS ISFSI.

##### **6.2 Evaluation**

This evaluation addresses the radiological dose rate from a composite population of all MNS ISFSI cask types.

##### **6.2.1 §72.104(a) -Dose Limits**

Duke Energy Engineering Instruction MCEI-0400-241 determined that the distance from the nearest residence to the ISFSI is 0.65 miles (1046 meters). Hence, it is conservative to assume that the closest real individual is at least 700 meters from the ISFSI.

Enercon determined the annual total dose (gamma plus neutron) at a distance of 700 meters from all currently loaded casks (10 TN-32A casks and 28 NAC-UMS® casks) to be approximately 1.62 mrem. The evaluation was based on actual cask average burn-up (as loaded) and considering cooling time on the storage pads as of September 1, 2010. The distance at which this dose is calculated (700 meters) is conservative compared to the distance to the closest real individual.

NAC International determined the annual total dose (gamma plus neutron) at a distance of 700 meters from a (future) 2x6 array of MAGNASTOR® casks to be approximately 1.01 mrem (2.02 mrem for two arrays). The evaluation was conservatively based on full cask loads of 37 fuel assemblies at the maximum allowable heat load of 35.5 kW. The distance at which this dose is calculated (700 meters) is conservative compared to the distance to the closest real individual.

The total calculated annual public dose from liquid and gaseous effluent pathways averaged over a ten-year period is less than 1 mrem (\*\*\*). No other uranium fuel cycle facility contributes significantly to the dose received by the closest real individual.

**Attachment 6**  
**Assessment of Radiation Dose from Radioactive Effluents to Members of the Public**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Based on the above, the calculated annual dose to the closest real individual due to the ISFSI, which is comprised of the currently existing ten TN-32A casks and 28 NAC-UMS<sup>®</sup> casks, and up to two 2x6 arrays of MAGNASTOR<sup>®</sup> casks (see Note below), is determined to be less than 4 mrem, and the estimated annual dose due to McGuire power generation is less than 1 mrem<sup>(\*\*\*)</sup>. Hence, the total annual dose to the closest real individual (less than 5 mrem) is within the 10 CFR 72.104(a) limit<sup>(\*\*\*\*)</sup>.

Note: As stated above, up to two 2x6 arrays of MAGNASTOR<sup>®</sup> casks are assumed in this evaluation. The first eight MAGNASTOR<sup>®</sup> casks are planned to be placed on a concrete pad currently containing four NAC-UMS<sup>®</sup> casks. This will conservatively count as one 2x6 array. Additional MAGNASTOR<sup>®</sup> casks will be placed on their own concrete pad (the second 2x6 array). Hence, this §72.104(a) evaluation bounds up to 20 MAGNASTOR<sup>®</sup> casks, arranged as described.

*\*\*\* At the time the 10 CFR 72.212 Evaluation Report, MAGNASTOR<sup>®</sup>, Revision 03, was generated, estimated annual dose from radioactive effluents from McGuire Nuclear Station was less than 1 mrem per year. After changes identified in the 2015 Land Use Census, dose from radioactive effluents is estimated at less than 4 mrem per year.*

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 7**

**Information to Support the NEI Ground Water Protection Initiative**

This attachment includes a summary of voluntary reports made in accordance with the NEI Ground Water Protection Initiative and a summary of ground water well sample data.

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Duke Energy implemented a Ground Water Protection program in 2007. This initiative was developed to ensure timely and effective management of situations involving inadvertent releases of licensed material to ground water. As part of this program, McGuire Nuclear Station monitored 94 wells, 4 surface water points, and 1 leachate pond in 2015.

Wells are typically sampled quarterly or semi-annually. Ground water samples are regularly analyzed for tritium and gamma emitters, with select wells being analyzed for difficult-to-detect radionuclides. No gamma or difficult-to-detect radionuclides, other than naturally occurring radionuclides, were identified in well samples during 2015. Results from sampling during 2015 confirmed existing knowledge of tritium concentrations in site ground water.

Results from sampling during 2015 are shown in the table below.

No events meeting the criteria for voluntary notification per NEI 07-07, Industry Ground Water Protection Initiative, occurred at McGuire Nuclear Station in 2015.

*Key to below table.*

NS	-	Not scheduled to be sampled, not sampled due to insufficient volume in well, or well inaccessible during outage.
pCi/l	-	picocuries per liter.
< MDA	-	less than minimum detectable activity, typically 250 pCi/l.
20,000 pCi/l	-	the Environmental Protection Agency drinking water standard for tritium. This standard applies only to water used for drinking.
1,000,000 pCi/l	-	the 10 CFR Part 20, Appendix B, Table 2, Column 2, Effluent Concentration Limit for tritium.



**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Well Name	Location / Description	Tritium Concentration (pCi/l)				# of Samples
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
M-100R	MNS GWPI / M-100R / SE of WC	3.08E+02	<MDA	<MDA	<MDA	4
M-101	MNS GWPI / M-101 / SE of WC	2.19E+02	<MDA	<MDA	<MDA	4
M-102	MNS GWPI / M-102 / SW of WC	3.55E+03	3.22E+03	2.91E+03	2.57E+03	4
M-103	MNS GWPI / M-103 / S of WC	1.25E+03	1.14E+03	1.05E+03	9.65E+02	4
M-103R	MNS GWPI / M-103R / S of WC	1.27E+03	1.11E+03	1.03E+03	1.02E+03	4
M-104DR	MNS GWPI / M-104DR / W of WC	1.56E+03	1.67E+03	1.39E+03	1.22E+03	4
M-104R	MNS GWPI / M-104R / W of WC	1.30E+03	1.24E+03	1.22E+03	1.32E+03	4
M-105	MNS GWPI / M-105 / Landfarm	NS	2.72E+02	NS	2.42E+02	2
M-20	MNS GWPI / M-20 / S of Hwy. 73	NS	5.23E+02	NS	5.90E+02	2
M-20R	MNS GWPI / M-20R / S of Hwy. 73	NS	5.48E+02	NS	5.28E+02	2
M-21	MNS GWPI / M-21 / S of Hwy. 73	NS	<MDA	NS	<MDA	2
M-22	MNS GWPI / M-22 / S of Hwy. 73	NS	<MDA	NS	<MDA	2
M-22R	MNS GWPI / M-22R / S of Hwy. 73	NS	<MDA	NS	<MDA	2
M-23	MNS GWPI / M-23 / S of Acs. Rd.	NS	<MDA	NS	<MDA	2
M-30	MNS GWPI / M-30 / WWCB	NS	<MDA	NS	<MDA	2
M-30R	MNS GWPI / M-30R / WWCB	NS	2.51E+02	NS	<MDA	2
M-31	MNS GWPI / M-31 / Access road	NS	<MDA	NS	<MDA	2
M-32	MNS GWPI / M-32 / Main entrance	NS	<MDA	NS	<MDA	2
M-34DR	MNS GWPI / M-34DR / Access road	<MDA	<MDA	<MDA	<MDA	4
M-34R	MNS GWPI / M-34R / Access road	<MDA	<MDA	<MDA	<MDA	4
M-35	MNS GWPI / M-35 / Access road	<MDA	<MDA	<MDA	<MDA	4
M-42	MNS GWPI / M-42 / U-2 Rx. Bldg.	3.02E+03	2.03E+03	2.44E+03	2.46E+03	4
M-48DR	MNS GWPI / M-48DR / U-2 SFP	3.26E+02	<MDA	<MDA	<MDA	4
M-48R	MNS GWPI / M-48R / U-2 SFP	8.79E+02	6.88E+02	6.36E+02	6.78E+02	4
M-53	MNS GWPI / M-53 / N of plant	8.42E+02	7.31E+02	8.16E+02	7.66E+02	4
M-55	MNS GWPI / M-55 / NAB	2.93E+02	<MDA	1.94E+02	<MDA	4
M-59	MNS GWPI / M-59 / U-2 Doghouse	1.05E+03	1.14E+03	1.15E+03	1.19E+03	4
M-60	MNS GWPI / M-60 / MOC Parking	NS	<MDA	NS	<MDA	2
M-62	MNS GWPI / M-62 / S of RWF	NS	<MDA	<MDA	2.69E+02	3
M-64	MNS GWPI / M-64 / Rdwst. Bldg.	9.27E+02	6.69E+02	5.21E+02	5.43E+02	4
M-66	MNS GWPI / M-66 / S of SSF	7.34E+02	6.84E+02	6.43E+02	7.33E+02	4
M-66R	MNS GWPI / M-66R / S of SSF	2.59E+02	<MDA	<MDA	<MDA	4
M-68	MNS GWPI / M-68 / U-1 RMWST	8.37E+02	7.31E+02	7.14E+02	7.40E+02	4
M-70	MNS GWPI / M-70 / U-1 SFP	5.40E+02	5.30E+02	5.17E+02	5.08E+02	4
M-70DR	MNS GWPI / M-70DR / U-1 SFP	<MDA	<MDA	<MDA	<MDA	4
M-70R	MNS GWPI / M-70R / U-1 SFP	2.84E+02	3.42E+02	<MDA	2.25E+02	4
M-72	MNS GWPI / M-72 / Rdwst. Trench	6.92E+02	6.36E+02	6.44E+02	7.24E+02	4
M-76	MNS GWPI / M-76 / W of U-1 SFP	NS	5.54E+02	3.98E+02	4.80E+02	3
M-82	MNS GWPI / M-82 / River	1.08E+03	1.24E+03	9.60E+02	1.09E+03	4
M-84	MNS GWPI / M-84 / River	3.35E+03	3.52E+03	3.51E+03	2.84E+03	4
M-84R	MNS GWPI / M-84R / River	3.96E+03	3.66E+03	3.21E+03	3.19E+03	4
M-85	MNS GWPI / M-85 / River	8.13E+02	7.25E+02	7.78E+02	6.92E+02	4
M-87	MNS GWPI / M-87 / Landfarm	4.59E+02	3.44E+02	4.51E+02	3.76E+02	4
M-89	MNS GWPI / M-89 / Landfarm	5.08E+02	3.52E+02	4.10E+02	3.52E+02	4

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Well Name	Location / Description	Tritium Concentration (pCi/l)				# of Samples
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
M-90	MNS GWPI / M-90 / Landfarm	NS	3.33E+02	NS	3.71E+02	2
M-91 <sup>(1)</sup>	MNS GWPI / M-91 / E of WC	4.47E+02	4.33E+02	4.37E+02	3.69E+02	4
M-91R <sup>(1)</sup>	MNS GWPI / M-91R / E of WC	5.16E+02	3.97E+02	4.50E+02	4.02E+02	4
M-92	MNS GWPI / M-92 / N of WC Ponds	NS	4.08E+02	NS	3.62E+02	2
M-92R	MNS GWPI / M-92R / N of WC Ponds	NS	<MDA	NS	<MDA	2
M-93 <sup>(1)</sup>	MNS GWPI / M-93 / N of IHUP	NS	5.22E+02	NS	5.94E+02	2
M-93R <sup>(1)</sup>	MNS GWPI / M-93R / N of IHUP	NS	3.01E+02	NS	<MDA	2
M-94 <sup>(1)</sup>	MNS GWPI / M-94 / SE of IHUP	NS	1.97E+02	NS	<MDA	2
M-95	MNS GWPI / M-95 / Lower Parking	NS	<MDA	NS	<MDA	2
M-95R	MNS GWPI / M-95R / Lower Parking	NS	<MDA	NS	<MDA	2
M-96	MNS GWPI / M-96 / West Parking	NS	<MDA	NS	<MDA	2
M-96R	MNS GWPI / M-96R / West Parking	NS	<MDA	NS	<MDA	2
M-97	MNS GWPI / M-97 / East Parking	NS	<MDA	NS	<MDA	2
M-98	MNS GWPI / M-98 / S of Amin. Bldg.	NS	<MDA	NS	<MDA	2
M-98R	MNS GWPI / M-98R / S of Amin. Bldg.	NS	<MDA	NS	<MDA	2
MNS_LEACHP	MNS Landfill 2 / Leachate Pond	NS	1.29E+03	NS	2.18E+02	2
MNS_MW-1	MNS Landfarm 2 / MW-1	NS	NS	NS	<MDA	1
MNS_MW-10A	MNS Landfill 2 / MW-10A	NS	<MDA	NS	<MDA	2
MNS_MW-1A	MNS Landfarm 2 / MW-1A	NS	NS	NS	<MDA	1
MNS_MW-2	MNS Landfarm 2 / MW-2	NS	NS	NS	<MDA	1
MNS_MW-2A	MNS Landfarm 2 / MW-2A	NS	NS	NS	<MDA	1
MNS_MW-3	MNS Landfarm 2 / MW-3	NS	NS	NS	<MDA	1
MNS_MW-3A	MNS Landfarm 2 / MW-3A	NS	NS	NS	<MDA	1
MNS_MW-4A	MNS Landfarm 2 / MW-4A	NS	NS	NS	<MDA	1
MNS_MW-5	MNS Landfarm 2 / MW-5	NS	NS	NS	NS	0
MNS_MW-5A	MNS Landfill 2 / MW-5A	NS	<MDA	NS	<MDA	2
MNS_MW-6	MNS Landfill 2 / MW-6	NS	<MDA	NS	<MDA	2
MNS_MW-6A	MNS Landfill 2 / MW-6A	NS	<MDA	NS	<MDA	2
MNS_MW-7	MNS Landfill 2 / MW-7	NS	<MDA	NS	NS	1
MNS_MW-7A	MNS Landfill 2 / MW-7A	NS	<MDA	NS	<MDA	2
MNS_MW-8	MNS Landfill 2 / MW-8	NS	<MDA	NS	<MDA	2
MNS_MW-8A	MNS Landfill 2 / MW-8A	NS	<MDA	NS	<MDA	2
MNS_MW-9	MNS Landfill 2 / MW-9	NS	<MDA	NS	<MDA	2
MNS_MW-9A	MNS Landfill 2 / MW-9A	NS	<MDA	NS	<MDA	2
MNS_SW-1	MNS Landfill 2 / SW-1	NS	<MDA	NS	<MDA	2
MNS_SW-2	MNS Landfill 2 / SW-2	NS	<MDA	NS	<MDA	2
MS-1	MNS GWPI / MS-1 / Surface Water	<MDA	<MDA	<MDA	<MDA	4
MS-2	MNS GWPI / MS-2 / Surface Water	3.50E+02	2.99E+02	3.96E+02	2.16E+02	4
MS-3	MNS GWPI / MS-3 / Surface Water	5.31E+02	4.90E+02	4.19E+02	3.18E+02	4
MS-4	MNS GWPI / MS-4 / Surface Water	6.00E+02	3.89E+02	NS	<MDA	3
MW-1_ML1	MNS Landfill 1 / MW-1	<MDA	NS	<MDA	NS	2
MW-11_ML1	MNS Landfill 1 / MW-11	<MDA	NS	<MDA	NS	2
MW-11D_ML1	MNS Landfill 1 / MW-11D	<MDA	NS	<MDA	NS	2
MW-12_ML1	MNS Landfill 1 / MW-12	<MDA	NS	NS	NS	1

**Attachment 7**  
**Information to Support the NEI Ground Water Protection Initiative**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Well Name	Location / Description	Tritium Concentration (pCi/l)				# of Samples
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
MW-12D_ML1	MNS Landfill 1 / MW-12D	<MDA	NS	<MDA	NS	2
MW-1D_ML1	MNS Landfill 1 / MW-1D	<MDA	NS	<MDA	NS	2
MW-2A_ML1	MNS Landfill 1 / MW-2A	<MDA	NS	<MDA	NS	2
MW-2D_ML1	MNS Landfill 1 / MW-2D	<MDA	NS	<MDA	NS	2
MW-3_ML1	MNS Landfill 1 / MW-3	<MDA	NS	<MDA	NS	2
MW-3D_ML1	MNS Landfill 1 / MW-3D	<MDA	NS	<MDA	NS	2
MW-4_ML1	MNS Landfill 1 / MW-4	<MDA	NS	<MDA	NS	2
MW-4D_ML1	MNS Landfill 1 / MW-4D	<MDA	NS	<MDA	NS	2
MW-4DR_ML1	MNS Landfill 1 / MW-4DR	<MDA	NS	<MDA	NS	2
MW-4R_ML1	MNS Landfill 1 / MW-4R	<MDA	NS	<MDA	NS	2
SW-1_ML1	MNS Landfill 1 / SW-1	<MDA	NS	<MDA	NS	2

(1) *Delta Gate Sampling request by McGuire Nuclear Station Radiation Protection on 10/28/2015.*

Well Name	Location / Description	Tritium Concentration (pCi/l)		# of Samples
		1st Qtr	2nd Qtr	
M-91	MNS GWPI / M-91 / E of WC		4.76E+02	1
M-91R	MNS GWPI / M-91R / E of WC		3.70E+02	1
M-93	MNS GWPI / M-93 / N of IHUP		4.82E+02	1
M-93R	MNS GWPI / M-93R / N of IHUP		<MDA	1
M-94	MNS GWPI / M-94 / SE of IHUP		<MDA	1

**Attachment 8  
Inoperable Equipment**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 8**

**Inoperable Equipment**

This attachment includes an explanation of inoperable instruments related to effluent monitoring in excess of allowed time defined by licensing bases and an explanation of unprotected permanent or temporary outside liquid storage tanks exceeding 10 Curies total activity (excluding tritium and dissolved or entrained noble gases).

**Attachment 8**  
**Inoperable Equipment**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

McGuire Nuclear Station did not experience inoperable equipment relevant to effluent monitoring in excess of SLC limits during 2015.

McGuire Nuclear Station did not experience an unprotected permanent or temporary outside liquid storage tanks exceeding 10 Curies total activity (excluding tritium and dissolved or entrained noble gases) during 2015.

**Attachment 9**  
**Summary of Changes to the Offsite Dose Calculation Manual**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 9**

**Summary of Changes to the Offsite Dose Calculation Manual Example**

This attachment includes a summary of changes to the ODCM and Radiological Effluent Controls.

**Attachment 9**  
**Summary of Changes to the Offsite Dose Calculation Manual**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

ODCM Revision 57

ODCM Revision 57 is provided in entirety on the enclosed CD.

All ODCM changes are reviewed by knowledgeable individual(s), and approved by either the Station Manager or Radiation Protection Manager. The changes below do not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

ODCM Revision 57 was approved by the Radiation Protection Manager on March 1, 2016. Some changes reflected in ODCM Revision 57 were implemented prior to March 1, 2016 under a different change and approval process (e.g., land use census), and in those cases the implementation date is noted below.

Section 3 - Page 13

Change EMF 50 Xe-133 correlation factor (CFXe-133) from 3.55E+06 cpm/ $\mu$ Ci/ml to 1.75E+06 cpm/ $\mu$ Ci/ml.

Primary calibration of EMF 50 was completed on 4/13/2015 by work-order 02157638-01 using procedure IP/0/B/3006/004C, 0EMF50L (RD-32) Waste Gas Monitor Alternative Transfer Calibration. Calibration methodology is documented in MNS calculation MCC-1346.05-00-0005. Primary calibration performed to reduce the number of spurious trips and alarms due to C-14 interference. Calibration performed to discriminate C-14, which updated the correlation factor. C-14 discrimination methodology documented in MNS Minor Modification MGMM-14236. Correlation factor changed because it was EMF 50's first primary calibration with C-14 discrimination. This change is representative of the new calibration methodology. It does not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

Revised statement:

"If the Xe-133 equivalent concentration is  $\leq 2.82\text{E-}05$   $\mu$ Ci/ml, then 2.82E-05 is used in the Trip 1 and Trip 2 setpoint calculations."

to:

"If the Xe-133 equivalent concentration is  $\leq 5.71\text{E-}05$   $\mu$ Ci/ml, then 5.71E-05 is used in the Trip 1 and Trip 2 setpoint calculations."

The concentration value listed previously (2.82E-05  $\mu$ Ci/ml) was used as default in the setpoint calculation when sample activity is low. This value was determined using the previous correlation factor and resulted in a setpoint of 100 cpm. To maintain the 100 cpm setpoint value, the concentration indicating low sample activity was updated (5.71 E-05  $\mu$ Ci/ml) using the new EMF 50 correlation factor.

**Attachment 9**  
**Summary of Changes to the Offsite Dose Calculation Manual**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Section 6 – Page 1

Changed reference to "Duke Power Company" to "Duke Energy" in 6.0.1:

"Lake Norman is impounded by Duke Power Company's Cowans Ford Dam Hydroelectric Station..."  
to:

"Lake Norman is impounded by Duke Energy's Cowans Ford Dam Hydroelectric Station..."

Section 6 – Page 4

Changed title of Table 6.0-3 to: "McGuire 2015 Land Use Census Results."

Land use census dates were changed to reflect 2015 census dates. The 2015 land use census was performed June 8-9, 2015, and the results were certified and made available for use on June 29, 2015.

The distance (miles) for the NNE sector garden was changed from 2.53 to 1.40.

The distance (miles) for the NE sector garden was changed from 1.80 to 2.38.

Reformatted notes into table.

Changes made to reflect 2015 Land Use Census results and provide better accuracy and clarity of receptor data.

Section 6 - Page 7

Changed title of Figure 6.0-3 to "MNS 2015 Land Use Census Map."

Figure 6.0-3 was regenerated using ESRI ArcGIS Version 9.3.1 software by Orbis, Incorporated, Charlotte, NC, to update map symbology.

Changes made to reflect 2015 Land Use Census results and provide better accuracy and clarity of receptor data.



**Attachment 9**  
**Summary of Changes to the Offsite Dose Calculation Manual**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Radiological Effluent Controls (SLC 16.11)

The McGuire Nuclear Station Radiological Effluent Controls are contained in SLC 16.11 as follows:

Liquid Effluents – Concentration  
16.11.1

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.1 Liquid Effluents – Concentration

- COMMITMENT**      The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS (see Figure 16.11.1-1) shall be limited:
- a.    For radionuclides other than dissolved or entrained noble gases, 10 times the effluent concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, and
  - b.    For dissolved or entrained noble gases, the concentration shall be limited to  $2 \times 10^{-4}$  microCurie/ml total activity.

**APPLICABILITY**      At all times.

#### REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.    Concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS not within limits.	A.1    Restore the concentration to within limits.	Immediately

#### TESTING REQUIREMENTS

TEST	FREQUENCY
<p>TR 16.11.1.1 -----NOTE-----</p> <p>The results of the radioactivity analyses shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits.</p> <p>-----</p> <p>Sample and analyze radioactive liquid wastes according to Table 16.11.1-1.</p>	According to Table 16.11.1-1

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents – Concentration  
16.11.1

TABLE 16.11.1-1  
(Page 1 of 3)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLING FREQUENCY	MINIMUM ANALYSIS FREQUENCY	TYPE OF ACTIVITY ANALYSIS	LOWER LIMIT OF DETECTION (LLD) microCi/ml <sup>(1)</sup>
1. Batch Waste Release Tanks (WMT and RMT) <sup>(4)</sup>	P Each Batch	P Each Batch	Principal Gamma Emitters <sup>(6)</sup>	$5 \times 10^{-7}$
			I-131	$1 \times 10^{-6}$
	P One Batch/M	M	Dissolved and Entrained Gases (Gamma emitters) <sup>(7)</sup>	$1 \times 10^{-5}$
	P Each Batch	M Composite <sup>(2)</sup>	H-3	$1 \times 10^{-5}$
			Gross Alpha	$1 \times 10^{-7}$
	P Each Batch	Q Composite <sup>(2)</sup>	Sr-89, Sr-90	$5 \times 10^{-8}$
2. Continuous Releases (VUCDT discharge, CWWTS outlet and Turbine Building Sump to RC) <sup>(5)</sup>	Continuous <sup>(3)</sup>	W Composite <sup>(3)</sup>	Principal Gamma Emitters <sup>(6)</sup>	$5 \times 10^{-7}$
			I-131	$1 \times 10^{-6}$
	M Grab Sample	M	Dissolved and Entrained Gases (Gamma emitters) <sup>(7)</sup>	$1 \times 10^{-5}$
	Continuous <sup>(3)</sup>	M Composite <sup>(3)</sup>	H-3	$1 \times 10^{-5}$
			Gross Alpha	$1 \times 10^{-7}$
	Continuous <sup>(3)</sup>	Q Composite <sup>(3)</sup>	Sr-89, Sr-90	$5 \times 10^{-8}$

TABLE 16.11.1-1  
(Page 2 of 3)

NOTES:

- (1) The LLD is defined, for purposes of these commitments, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{(2.71/T) + 4.65S_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above (as microCurie per unit mass or volume),

$S_b$  is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute),

E is the counting efficiency (as counts per disintegration),

V is the sample size (in units of mass or volume),

$2.22 \times 10^6$  is the number of disintegrations per minute per microCurie,

Y is the fractional radiochemical yield (when applicable),

$\lambda$  is the radioactive decay constant for the particular radionuclide,

$\Delta t$  is the elapsed time between midpoint of sample collection and time of counting (for plant effluents, not environmental samples), and

T is the background and sample counting time in minutes.

Typical values of E, V, Y and  $\Delta t$  shall be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

- (2) A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

Liquid Effluents – Concentration  
16.11.1

TABLE 16.11.1-1  
(Page 3 of 3)

- (3) To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected continuously or intermittently in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.
- (4) A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated and thoroughly mixed to assure representative sampling.
- (5) A continuous release is the discharge of liquid wastes of a nondiscrete volume; e.g., from a volume of system that has an input flow during the continuous release.
- (6) The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. The LLD for Ce-144 is  $5 \times 10^{-6}$  microCi/ml. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall be identified and reported in the Annual Radioactive Effluent Release Report.
- (7) The principal gas gamma emitters for which the LLD specification applies are Xe-133 and Xe-135. These are the reference nuclides in Regulatory Guide 1.21.

Attachment 9  
Summary of Changes to the Offsite Dose Calculation Manual

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Liquid Effluents – Concentration  
16.11.1

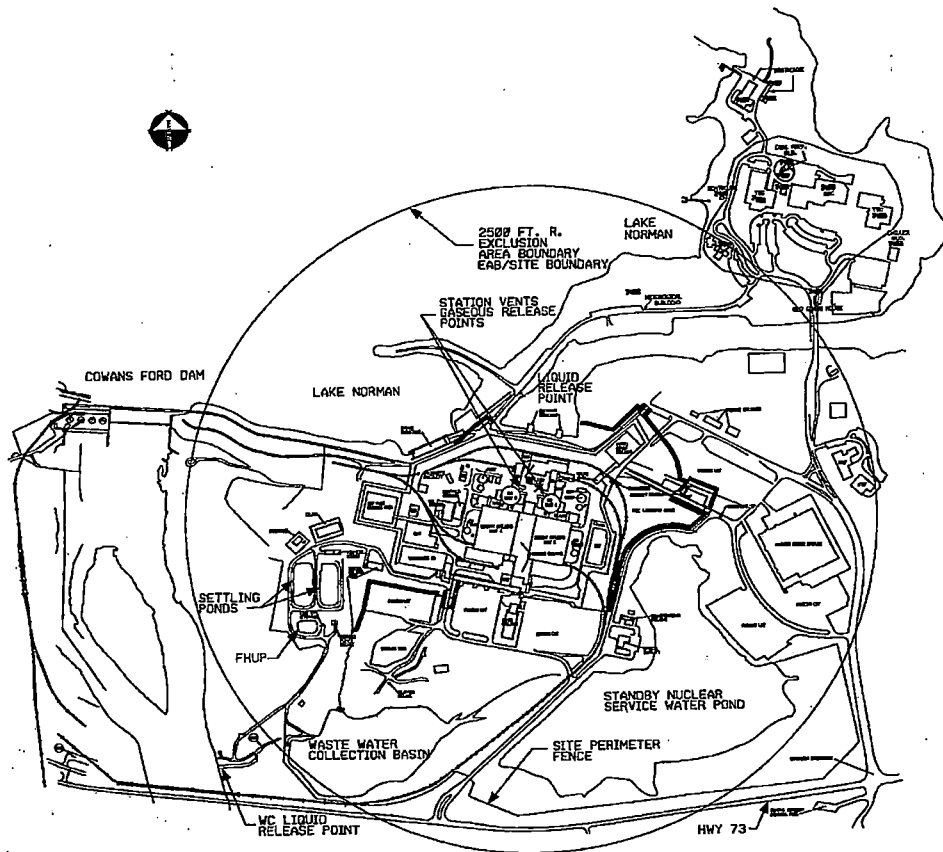


FIGURE 16.11.1-1 SITE BOUNDARY / EXCLUSION AREA BOUNDARY

## BASES

This commitment is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than 10 times the effluent concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within: (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC, and (2) the limits of 10 CFR Part 20.1301 to the population. The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its EC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2. This commitment applies to the release of liquid effluents from all reactors at the site.

The basic requirements for the Selected Licensee Commitments concerning effluents from nuclear power reactors are stated in 10CFR50.36a. These requirements indicate that compliance with effluent Selected Licensee Commitments will keep average annual releases of radioactive material in effluents to small percentages of the limits specified in the old 10CFR20.106 (new 10CFR20.1301). These requirements further indicate that operational flexibility is allowed, compatible with considerations of health and safety, which may temporarily result in releases higher than such small percentages, but still within the limits specified in the old 10CFR20.106 which references Appendix B, Table II concentrations (MPCs). These referenced concentrations are specific values which relate to an annual dose of 500 mrem. It is further indicated in 10CFR50.36a that when using operational flexibility, best efforts shall be exerted to keep levels of radioactive materials in effluents as low as is reasonably achievable (ALARA) as set forth in 10CFR50, Appendix I.

As stated in the Introduction to Appendix B of the new 10CFR20, the effluent concentration (EC) limits given in Appendix B, Table 2, Column 2, are based on an annual dose of 50 mrem. Since a release concentration corresponding to a limiting dose rate of 500 mrem/year has been acceptable as a SLC limit for liquid effluents, which applies at all times as an assurance that the limits of 10CFR50, Appendix I are not likely to be exceeded, it should not be necessary to reduce this limit by a factor of 10.

Operational history at Catawba/McGuire/Oconee has demonstrated that the use of the concentration values associated with the old 10CFR20.106 as SLC limits has resulted in calculated maximum individual doses to members of the public that are small percentages of the limits of 10CFR50, Appendix I. Therefore, the use of concentration values which correspond to an annual dose of 500 mrem should not have a negative impact on the ability to continue to operate within the limits of 10CFR50 Appendix I and 40CFR190.

Having sufficient operational flexibility is especially important in establishing a basis for effluent monitor setpoint calculations. As discussed above, the concentrations stated in the new 10CFR20, Appendix B, Table 2, Column 2, relate to a dose of 50 mrem in a year. When applied on an instantaneous basis, this corresponds to a dose rate of 50 mrem/year. This low value is impractical upon which to base effluent monitor setpoint calculations for many liquid effluent release situations when monitor background, monitor sensitivity, and monitor performance must be taken into account.

BASES (continued)

Liquid Effluents – Concentration  
16.11.1

Therefore, to accommodate operational flexibility needed for effluent releases, the limits associated with SLC 16.11.1 are based on ten times the concentrations stated in the new 10CFR20, Appendix B, Table 2, Column 2 to apply at all times. The multiplier of ten is proposed because the annual dose of 500 mrem, upon which the concentrations in the old 10CFR20, Appendix B, Table II, Column 2 are based, is a factor of ten higher than the annual dose of 50 mrem, upon which the concentrations in the new 10CFR20, Appendix B, Table 2, Column 2, are based. Compliance with the limits of the new 10CFR20.1301 will be demonstrated by operating within the limits of 10CFR50, Appendix I and 40CFR190.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J. K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

#### REFERENCES

1. McGuire Nuclear Station Offsite Dose Calculation Manual (ODCM)
2. International Commission on Radiological Protection (ICRP) Publication 2



Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.2 Radioactive Liquid Effluent Monitoring Instrumentation

**COMMITMENT**      The radioactive liquid effluent monitoring instrumentation channels shown in Table 16.11.2-1 shall be FUNCTIONAL with their Alarm/Trip Setpoints set to ensure that the limits of SLC 16.11.1 are not exceeded.

AND

The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

**APPLICABILITY**      As shown in Table 16.11.2-1.

REMEDIAL ACTIONS

-----NOTE-----

Separate Condition entry is allowed for each Function.

CONDITION		REQUIRED ACTION	COMPLETION TIME
A.	One or more radioactive liquid effluent monitoring channels Alarm/Trip setpoint less conservative than required.	A.1      Suspend the release of radioactive liquid effluents monitored by the affected channel.	Immediately
		<u>OR</u>	
		A.2      Declare the channel non-functional.	Immediately
		<u>OR</u>	
		A.3      Adjust setpoint to within limit.	Immediately
B.	One or more radioactive liquid effluent monitoring instrument channels non-functional.	B.1      Enter the Remedial Action specified in Table 16.11.2-1 for the channel(s).	Immediately

(continued)

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One channel non-functional.	C.1.1 Analyze two independent samples per TR 16.11.1.1.	Prior to initiating a release
	<u>AND</u>	
	C.1.2 Perform independent verification of the discharge line valving.	Prior to initiating a release
	<u>AND</u>	
	C.1.3.1 Perform independent verification of manual portion of the computer input for the release rate calculations performed by computer.	Prior to initiating a release
	<u>OR</u>	
	C.1.3.2 Perform independent verification of entire release rate calculations for calculations performed manually.	Prior to initiating a release
	<u>AND</u>	
	C.1.4 Restore channel to FUNCTIONAL status.	14 days
	<u>OR</u>	
	C.2 Suspend the release of radioactive effluents via this pathway.	Immediately

(continued)

McGuire Nuclear Station Units 1 & 2  
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Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. One or more channels non-functional.	D.1 Obtain grab samples from the effluent pathway.	Once per 12 hours during releases.
	<u>AND</u>	
	D.2 Perform an analysis of grab samples for radioactivity.	To meet LLD requirements per Table 16.11.1-1.
	<u>AND</u>	
	D.3 Restore the channel to FUNCTIONAL status.	30 days
E. One or more flow rate measurement channels non-functional.	E.1 <del>-----NOTE-----</del> Pump performance curves generated in place may be used to estimate flow.	
	Estimate the flow rate of the release.	Once per 4 hours during releases
	<u>AND</u>	
	E.2 Restore the channel to FUNCTIONAL status.	30 days
F. RC minimum flow interlock non-functional.	F.1 Verify that the number of pumps providing dilution is greater than or equal to the number of pumps required.	Once per 4 hours during releases
	<u>AND</u>	
	F.2 Restore the channel to FUNCTIONAL status.	30 days

(continued)

Attachment 9  
Summary of Changes to the Offsite Dose Calculation Manual

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

REMEDIAL ACTIONS (continued)

CONDITION		REQUIRED ACTION	COMPLETION TIME
G.	Required Action and associated Completion Time of Condition C, D, E or F not met.	G.1 Explain why the non-functionality was not corrected within the specified Completion Time in the Annual Radioactive Effluent Release Report.	In the next scheduled Annual Radioactive Effluent Release Report

Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

TESTING REQUIREMENTS

-----NOTE-----

Refer to Table 16.11.2-1 to determine which TRs apply for each Radioactive Liquid Effluent Monitoring channel.

TEST	FREQUENCY
TR 16.11.2.1 Perform CHANNEL CHECK.	24 hours
TR 16.11.2.2 -----NOTE----- The CHANNEL CHECK shall consist of verifying indication of flow. ----- Perform CHANNEL CHECK.	Every 24 hours during periods of release
TR 16.11.2.3 Perform SOURCE CHECK.	Prior to each release
TR 16.11.2.4 Perform SOURCE CHECK.	31 days
TR 16.11.2.5 -----NOTES----- 1. For Instrument 1, the COT shall also demonstrate that automatic isolation of the pathway occurs if the instrument indicates measured levels above the Alarm/Trip Setpoint.  2. For Instruments 1 and 2, the COT shall also demonstrate that control room alarm annunciation occurs if the instrument indicates measured levels above the Alarm/Trip Setpoint; circuit failure and, a downscale failure. ----- Perform CHANNEL OPERATIONAL TEST.	92 days
TR 16.11.2.6 Perform a CHANNEL CALIBRATION.	18 months

(continued)

Attachment 9  
Summary of Changes to the Offsite Dose Calculation Manual

McGuire Nuclear Station Units 1 & 2  
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Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

TESTING REQUIREMENTS (continued)

TEST	FREQUENCY
TR 16.11.2.7 -----NOTE----- The initial CHANNEL CALIBRATION shall be performed using standards certified by the National Institute of Standards and Technology (NIST) or using standards obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used. ----- Perform a CHANNEL CALIBRATION.	24 months

Attachment 9  
Summary of Changes to the Offsite Dose Calculation Manual

McGuire Nuclear Station Units 1 & 2  
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Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

TABLE 16.11.2-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS FUNCTIONAL	REMEDIAL ACTION	APPLICABILITY	TESTING REQUIREMENTS
1. Radioactivity Monitors Providing Alarm And Automatic Termination of Release				
a. Waste Liquid Effluent Line (EMF-49)	1 per station	A, C, G	During liquid effluent releases	TR 16.11.2.1 TR 16.11.2.3 TR 16.11.2.5 TR 16.11.2.7
b. EMF-49 Minimum Flow Device (2)	1 per station	C, G	During liquid effluent releases	TR 16.11.2.5 TR 16.11.2.7
c. Containment Ventilation Unit Condensate Line (EMF-44)	1	A, D, G	At all times	TR 16.11.2.1 TR 16.11.2.4 TR 16.11.2.5 TR 16.11.2.7
d. EMF-44 Minimum Flow Device (2)	1	D, G	At all times	TR 16.11.2.5 TR 16.11.2.7
2. Radioactivity Monitors Providing Alarm But Not Automatic Termination of Release				
a. Conventional Waste Water Treatment Line or Turbine Building Sump to RC (EMF- 31)	1	A, D, G	At all times	TR 16.11.2.1 TR 16.11.2.4 TR 16.11.2.5 TR 16.11.2.7
b. EMF-31 Minimum Flow Device (2)	1	D, G	At all times	TR 16.11.2.5 TR 16.11.2.7
3. Continuous Composite Samplers				
a. Containment Ventilation Unit Condensate Line	1	D, G	At all times	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
b. Conventional Waste Water Treatment Line	1 per station	D, G	At all times	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
c. Turbine Building Sump to RC	1	D, G	At all times	TR 16.11.2.2 TR 16.11.2.6

(Continued)

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Radioactive Liquid Effluent Monitoring Instrumentation  
16.11.2

4. Flow Rate Measurement Devices				
a. Waste Liquid Effluent Line	1 per station	E, G	During liquid effluent releases	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
b. Containment Ventilation Unit Condensate Line	1	E, G	At all times	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
c. Conventional Waste Water Treatment Line	1 per station	E, G	At all times	TR 16.11.2.2 TR 16.11.2.5 TR 16.11.2.6
d. Turbine Building Sump to RC	1	E, G	At all times	TR 16.11.2.2 TR 16.11.2.6
5. RC Minimum Flow Interlock (1)	1 per station	F, G	At all times	TR 16.11.2.5

NOTES:

1. Minimum flow dilution is assured by an interlock which terminates waste liquid release if the number of RC pumps running falls below the number of pumps required for dilution. The required number of RC pumps for dilution is determined per station procedures.
2. Radioactivity Monitor (EMF) shall not be declared functional unless both the EMF and the associated EMF's Minimum Flow Device are rendered functional.

BASES

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The minimum flow devices for EMFs listed in Table 16.11.2-1 are required to provide assurance of representative sampling during actual or potential releases of liquid effluents. An interlock between the EMF's minimum flow device and its associated flow rate measurement device disables the remove alarm during non-release timeframes for the purpose of the control room black board annunciator criteria that disable expected alarms. An EMF flow rate measurement device measures total flow of the effluent while the EMF minimum flow device measures the sample flow rate through the EMF. The Alarm/Trip Setpoints of these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the Alarm/Trip will occur prior to exceeding the limits stated in SLC 16.11.1. The FUNCTIONALITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50. The Turbine Building Sump to RC Discharge Flow Measurement and Sampler Devices are for monitoring only and do not alarm or have any controls that require a COT.

REFERENCES

1. McGuire Nuclear Station Offsite Dose Calculation Manual (ODCM)
2. 10 CFR Part 50, Appendix A



## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.3 Dose - Liquid Effluents

**COMMITMENT** The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released from each unit to UNRESTRICTED AREAS (see Figure 16.11.1-1) shall be limited:

- a. During any calendar quarter, to  $\leq 1.5$  mrem to the total body and to  $\leq 5$  mrem to any organ, and
- b. During any calendar year, to  $\leq 3$  mrem to the total body and to  $\leq 10$  mrem to any organ.

**APPLICABILITY** At all times.

### REMEDIAL ACTIONS

#### NOTES

Enter applicable Conditions and Required Actions of SLC 16.11.12, "Total Dose," when the limits of this SLC are exceeded by twice the specified limit.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated dose from release of radioactive materials in liquid effluents exceeding above limits.	<p>-----NOTE-----</p> <p>The Special Report shall include the results of radiological analyses of the drinking water source, and the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR 141, Safe Drinking Water Act, as applicable.</p> <p>A.1 Prepare and submit a Special Report to the NRC which identifies the causes for exceeding the limits, corrective actions taken to reduce releases, and actions taken to ensure that subsequent releases are within limits.</p>	30 days

#### TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.3.1 Determine cumulative dose contributions from liquid effluents for current calendar quarter and current calendar year in accordance with the methodology and parameters in the ODCM.	31 days

#### BASES

This commitment is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The commitment implements the guides set forth in Section II.A of Appendix I. The REMEDIAL ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies that can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR Part 141. These requirements are applicable only if the drinking water supply is taken from the river 3 miles downstream of the plant discharge.

The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in 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 Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

This commitment applies to the release of liquid effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the liquid effluents from the shared system are to be proportioned among the units sharing that system in accordance with the guidance given in NUREG-0133, Chapter 3.1.

Attachment 9  
Summary of Changes to the Offsite Dose Calculation Manual

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Dose - Liquid Effluents  
16.11.3

REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 40 CFR Part 141, Safe Drinking Water Act
3. 10 CFR Part 50, Appendix I
4. 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.
5. Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

Liquid Radwaste Treatment System  
16.11.4

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.4 Liquid Radwaste Treatment System

**COMMITMENT** The Liquid Radwaste Treatment System shall be FUNCTIONAL and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due to the liquid effluent from each unit to UNRESTRICTED AREAS (see Figure 16.11.1-1) would exceed 0.06 mrem to the total body or 0.2 mrem to any organ in a 31 day period.

**APPLICABILITY** At all times.

**REMEDIAL ACTIONS**

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Radioactive liquid waste being discharged without treatment and in excess of above limits.  <u>AND</u>  Any portion of Liquid Radwaste Treatment System not in operation.	A.1 Prepare and submit a Special Report to the NRC which identifies the reasons liquid radwaste was discharged without treatment, identification of non-functional equipment and reasons for non-functionality, corrective actions taken to restore the equipment to FUNCTIONAL status, and actions taken to prevent recurrence.	30 days

Liquid Radwaste Treatment System  
16.11.4

TESTING REQUIREMENTS

NOTE

The Liquid Radwaste Treatment System shall be demonstrated FUNCTIONAL by meeting SLC 16.11.1 and 16.11.3.

TEST	FREQUENCY
TR 16.11.4.1 Project liquid release doses from each unit to UNRESTRICTED AREAS, in accordance with the methodology and parameters in the ODCM, when water systems are being released without being processed by its radwaste treatment system.	31 days

BASES

The requirement that the appropriate portions of this system be used, when specified, provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

This commitment applies to the release of liquid effluents from each reactor at the site. For units with shared Radwaste Treatment Systems, the liquid effluents from the shared system are to be proportioned among the units sharing that system in accordance with the guidance given in NUREG-0133, Chapter 3.1.

REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 50
3. 10 CFR Part 50, Appendix I

Chemical Treatment Ponds  
16.11.5

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.5 Chemical Treatment Ponds

**COMMITMENT**      The quantity of radioactive material contained in each chemical treatment pond shall be limited by the following expression (excluding tritium and dissolved or entrained noble gases):

$$\frac{264}{V} \cdot \sum_j \frac{A_j}{(C_j \times 10)} < 1.0$$

Where:

$A_j$  = pond inventory limit for single radionuclide "j", in Curies

$C_j$  = 10 CFR 20, Appendix B, Table 2, Column 2, concentration for single radionuclide "j", microCuries/ml;

$V$  = design volume of liquid and slurry in the pond, in gallons; and

264 = conversion unit, microCuries/Curie per milliliter/gallon.

**APPLICABILITY**      At all times.

**REMEDIAL ACTIONS**

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Quantity of radioactive material in any of the chemical treatment ponds exceeding above limit.	A.1 Suspend all additions of radioactive material to the pond.	Immediately
	<p style="text-align: center;"><u>AND</u></p> <p>A.2 Initiate corrective action to reduce the pond contents to within limits.</p>	Immediately

Chemical Treatment Ponds  
16.11.5

TESTING REQUIREMENTS

TEST	FREQUENCY
<p>TR 16.11.5.1 Verify quantity of radioactive material in each batch of slurry (powdex resin) to be transferred to chemical treatment ponds is within limits by analyzing a representative sample of the slurry. Each batch to be transferred to the chemical treatment ponds is limited by:</p> $\sum_j \frac{Q_j}{(C_j \times 10)} < 6.0 \times 10^5 \frac{pCi/gm}{\mu Ci/ml}$	Prior to each transfer

BASES

The inventory limits of the chemical treatment ponds (CTP) are based on limiting the consequences of an uncontrolled release of the pond inventory. The expression in SLC 16.11.5 assumes the pond inventory is uniformly mixed, that the pond is located in an uncontrolled area as defined in 10 CFR Part 20, and that the concentration limit in Note 4 to Appendix B of 10 CFR Part 20 applies.

The batch limits of slurry to the chemical treatment ponds assure that radioactive material in the slurry transferred to the CTP are "as low as is reasonably achievable" in accordance with 10 CFR Part 50.36a. The expression in SLC 16.11.5 assures no batch of slurry will be transferred to the CTP unless the sum-of the ratios of the activity of the radionuclides to their respective concentration limitation is less than the ratio of the 10 CFR Part 50, Appendix I, Section II.A, total body dose level to the instantaneous whole body dose rate limitation, or that:

$$\sum_j \frac{c_j}{(C_j \times 10)} < \frac{3 \text{ mrem/yr}}{500 \text{ mrem/yr}} = 0.006$$

Where:

$c_j$  = Radioactive slurry concentration for radionuclide "j" entering the UNRESTRICTED AREA chemical treatment ponds, in microCuries/milliliter; and

$C_j$  = 10 CFR 20, Appendix B, Table 2, Column 2, concentration for single radionuclide "j", in microCuries/milliliter.

# BASES (continued)

For the design of filter/demineralizers using powder resin, the slurry wash volume and the weight of resin used per batch is fixed by the cell surface area, and the slurry volume to resin weight ratio is constant at 100 ml/gram of wet, drained resin with a moisture content of approximately 55 to 60% (bulk density of about 58 pounds per cubic feet). Therefore,

$$\sum_j \frac{c_j}{(C_j \times 10)} = \sum_j \frac{Q_j}{(C_j \times 10) (10^2 \text{ ml/gm}) (10^6 \text{ pCi/}\mu\text{Ci})} < 0.006, \text{ and}$$

$$\sum_j \frac{Q_j}{(C_j \times 10)} < 6.0 \times 10^5 \frac{\text{pCi/gm}}{\mu\text{Ci/ml}}$$

Where:

$Q_j$  = concentration of radioactive materials in wet, drained slurry (powdex resin) for radionuclide "j", excluding tritium, dissolved or entrained noble gases, and radionuclides with less than an 8-day half-life. The analysis shall include at least Ce-144, Cs-134, Cs-137, Co-58 and Co-60, in picoCuries/gram. Estimates of the Sr-89 and Sr-90 batch concentration shall be included based on the most recent monthly composite analysis (within 3 months); and

$C_j$  = 10 CFR 20, Appendix B, Table 2, Column 2, concentration for single radionuclide "j", in microCuries/milliliter.

The batch limits provide assurance that activity input to the chemical treatment ponds will be minimized, and a means of identifying radioactive material in the inventory limitation of SLC 16.11.5.

The basic requirements for the Selected Licensee Commitments concerning effluents from nuclear power reactors are stated in 10CFR50.36a. These requirements indicate that compliance with effluent Selected Licensee Commitments will keep average annual releases of radioactive material in effluents to small percentages of the limits specified in the old 10CFR20.106 (new 10CFR20.1301). These requirements further indicate that operational flexibility is allowed, compatible with considerations of health and safety, which may temporarily result in releases higher than such small percentages, but still within the limits specified in the old 10CFR20.106 which references Appendix B, Table II concentrations- (MPCs). These referenced concentrations are specific values which relate to an annual dose of 500 mrem. It is further indicated in 10CFR50.36a that when using operational flexibility, best efforts shall be exerted to keep levels of radioactive materials in effluents as low as is reasonably achievable (ALARA) as set forth in 10CFR50, Appendix I.



## BASES (continued)

As stated in the Introduction to Appendix B of the new 10CFR20, the effluent concentration (EC) limits given in Appendix B, Table 2, Column 2, are based on an annual dose of 50 mrem. Since a release concentration corresponding to a limiting dose rate of 500 mrem/year has been acceptable as a SLC limit for liquid effluents, which applies at all times as an assurance that the limits of 10CFR50, Appendix I are not likely to be exceeded, it should not be necessary to reduce this limit by a factor of 10.

Operational history at Catawba/McGuire/Oconee has demonstrated that the use of the concentration values associated with the old 10CFR20.106 as SLC limits has resulted in calculated maximum individual doses to members of the public that are small percentages of the limits of 10CFR50, Appendix I. Therefore, the use of concentration values which correspond to an annual dose of 500 mrem should not have a negative impact on the ability to continue to operate within the limits of 10CFR50, Appendix I and 40CFR190.

Having sufficient operational flexibility is especially important in establishing a basis for effluent monitor setpoint calculations. As discussed above, the concentrations stated in the new 10CFR20, Appendix B, Table 2, Column 2, relate to a dose of 50 mrem in a year. When applied on an instantaneous basis, this corresponds to a dose rate of 50 mrem/year. This low value is impractical upon which to base effluent monitor setpoint calculations for many liquid effluent release situations when monitor background, monitor sensitivity, and monitor performance must be taken into account.

Therefore, to accommodate operational flexibility needed for effluent releases, the limits associated with SLC 16.11.1 are based on ten times the concentrations stated in the new 10CFR20, Appendix B, Table 2, Column 2 to apply at all times. The multiplier of ten is proposed because the annual dose of 500 mrem, upon which the concentrations in the old 10CFR20, Appendix B, Table II, Column 2 are based, is a factor of ten higher than the annual dose of 50 mrem, upon which the concentrations in the new 10CFR20, Appendix B, Table 2, Column 2, are based. Compliance with the limits of the new 10CFR20.1301 will be demonstrated by operating within the limits of 10CFR50, Appendix I and 40CFR190.

## REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR 20, Appendix B
3. 10 CFR 50, Appendix I, Section II.A
4. 10 CFR 20
5. 10 CFR 50.36a

Dose Rate - Gaseous Effluents  
16.11.6

16.11 RADIOLOGICAL EFFLUENT CONTROL

16.11.6 Dose Rate - Gaseous Effluents

**COMMITMENT** The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY (see Figure 16.11.1-1) shall be limited to the following:

- a. For noble gases:  $\leq 500$  mrem/yr to the whole body and  $\leq 3000$  mrem/yr to the skin, and
- b. For Iodine - 131 and 133, for tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days:  $\leq 1500$  mrem/yr to any organ.

**APPLICABILITY** At all times.

**REMEDIAL ACTIONS**

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Dose rate not within limit.	A.1 Restore the release rate to within limits.	Immediately

**TESTING REQUIREMENTS**

TEST	FREQUENCY
TR 16.11.6.1 Verify dose rates due to noble gases in gaseous effluents are within limits in accordance with the methodology and parameters in the ODCM.	In accordance with the ODCM
TR 16.11.6.2 Verify dose rates due to radioactive materials, other than noble gases, in gaseous effluents are within limits in accordance with the methodology and parameters in the ODCM by obtaining representative samples and performing analyses in accordance with Table 16.11.6-1.	In accordance with Table 16.11.6-1

TABLE 16.11.6-1  
(Page 1 of 4)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) <sup>(1)</sup> ( $\mu\text{Ci/ml}$ )
1. Waste Gas Storage Tanks	P Each Tank Grab Sample	P Each Tank	Principal Gas Gamma Emitters <sup>(6)</sup>	$1 \times 10^{-4}$
2. Containment Purge	P Each PURGE Grab Sample	P Each PURGE	Principal Gas Gamma Emitters <sup>(6)</sup>	$1 \times 10^{-4}$
		M	H-3	$1 \times 10^{-6}$
3. Unit Vent	W <sup>(2)</sup> Grab Sample	W	Principal Gas Gamma Emitters <sup>(6)</sup>	$1 \times 10^{-4}$
			H-3	$1 \times 10^{-6}$
4.a. Radwaste Facility Vent	W Grab Sample	W	Principal Gas Gamma Emitters <sup>(6)</sup>	$1 \times 10^{-4}$
b. Waste Handling Building			H-3	$1 \times 10^{-6}$
c. Equipment Staging Building				
5. Unit Vents	Continuous <sup>(5)</sup>	W <sup>(8)</sup> Charcoal Sample	I-131	$1 \times 10^{-12}$
			I-133	$1 \times 10^{-10}$
	Continuous <sup>(5)</sup>	W <sup>(8)</sup> Particulate Sample	Principal Gamma Emitters <sup>(6)</sup> (I-131, Others)	$1 \times 10^{-11}$
	Continuous <sup>(5)</sup>	M Composite Particulate Sample	Gross Alpha <sup>(7)</sup>	$1 \times 10^{-11}$
	Continuous <sup>(5)</sup>	Q Composite Particulate Sample	Sr-89, Sr-90	$1 \times 10^{-11}$

TABLE 16.11.6-1  
(Page 2 of 4)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) <sup>(1)</sup> ( $\mu\text{Ci/ml}$ )
6. All Release Types as listed in 4 above.	Continuous <sup>(5)</sup>	W <sup>(8)</sup> Charcoal Sample	I-131	$1 \times 10^{-12}$
			I-133	$1 \times 10^{-10}$
	Continuous <sup>(5)</sup>	W <sup>(8)</sup> Particulate Sample	Principal Gamma Emitters <sup>(6)</sup> (I-131, Others)	$1 \times 10^{-11}$
	Continuous <sup>(5)</sup>	M Composite Particulate Sample	Gross Alpha <sup>(7)</sup>	$1 \times 10^{-11}$
	Continuous <sup>(5)</sup>	Q Composite Particulate Sample	Sr-89, Sr-90	$1 \times 10^{-11}$

TABLE 16.11.6-1  
(Page 3 of 4)

NOTES:

1. The LLD is defined, for purposes of these commitments, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{(2.71/T) + 4.65S_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

- LLD = the "a priori" lower limit of detection as defined above (as microCurie per unit mass or volume);
- $S_b$  = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute);
- $E$  = the counting efficiency (as counts per disintegration);
- $V$  = the sample size (in units of mass or volume);
- $2.22 \times 10^6$  = the number of disintegrations per minute per microCurie;
- $Y$  = the fractional radiochemical yield (when applicable);
- $\lambda$  = the radioactive decay constant for the particular radionuclide;
- $\Delta t$  = the elapsed time between midpoint of sample collection and time of counting (for plant effluents, not environmental samples); and
- $T$  = The background and sample counting time in minutes.

Typical values of  $E$ ,  $V$ ,  $Y$  and  $\Delta t$  shall be used in the calculation.

It should be recognized that the LLD is defined as an "a priori" (before the fact) limit representing the capability of a measurement system and not as an "a posteriori" (after the fact) limit for a particular measurement.

TABLE 16.11.6-1  
(Page 4 of 4)

NOTES:

2. Tritium grab samples shall be taken at least once per 24 hours when the refueling canal is flooded.
3. Not used.
4. Not used.
5. The ratio of the sample flow volume to the sampled stream flow volume shall be known for the time period covered by each dose or dose rate calculation made in accordance with SLCs 16.11.6, 16.11.8 and 16.11.9.
6. The principal gamma emitters for which the LLD specification applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, and Ce-141 in iodine and particulate releases. The LLD for Ce-144 is  $5 \times 10^{-9}$  microCi/ml. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report.
7. The composite filter(s) will be analyzed for alpha activity by analyzing the filter media used during the collection period.
8. Samples shall be changed at least once per 7 days and analyses shall be completed to meet LLD after changing, or after removal from sampler. If the particulate and charcoal sample frequency is changed to a 24 hour frequency the corresponding LLDs may be increased by a factor of 10 (i.e., LLD for I-131 from  $1 \times 10^{-12}$  to  $1 \times 10^{-11}$  microCi/ml).

Dose Rate - Gaseous Effluents  
16.11.6

## BASES

Specific release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the whole body, and 3000 mrem/year to the skin from noble gases, and 1500 mrem/year to any organ from Iodine 131, Iodine 133, tritium, and all radionuclides in particulate form with half-lives greater than eight days. This commitment applies to the release of gaseous effluents from all reactors at the site. The Exclusion Area Boundary (Site Boundary) is set as the boundary for gaseous effluent release limits. The Exclusion Area Boundary (EAB) is formed by a 2500 ft radius centered on the Reactor Buildings' centerlines as shown on Figure 16.11.1-1.

The basic requirements for the Selected Licensee Commitments concerning effluents from nuclear power reactors are stated in 10CFR50.36a. These requirements indicate that compliance with effluent Selected Licensee Commitments will keep average annual releases of radioactive material in effluents to small percentages of the limits specified in the old 10CFR20.106 (new 10CFR20.1301). These requirements further indicate that operational flexibility is allowed, compatible with considerations of health and safety, which may temporarily result in releases higher than such small percentages, but still within the limits specified in the old 10CFR20.106 which references Appendix B, Table II concentrations (MPCs). These referenced concentrations are specific values which relate to an annual dose of 500 mrem. It is further indicated in 10CFR50.36a that when using operational flexibility, best efforts shall be exerted to keep levels of radioactive materials in effluents as low as is reasonably achievable (ALARA) as set forth in 10CFR50, Appendix I.

As stated in the Introduction to Appendix B of the new 10CFR20, the effluent concentration (EC) limits given in Appendix B, Table 2, Column 1, are based on an annual dose of 50 mrem for isotopes for which inhalation or ingestion is limiting or 100 mrem for isotopes for which submersion (noble gases) is limiting. Since release concentrations corresponding to limiting dose rates of less than or equal to 500 mrem/year to the whole body, 3000 mrem/year to the skin from noble gases, and 1500 mrem/year to any organ from Iodine 131, Iodine 133, tritium and for all radionuclides in particulate form with half-lives greater than eight days at the site boundary has been acceptable as a SLC limit for gaseous effluents to assure that the limits of 10CFR50, Appendix I and 40CFR190 are not likely to be exceeded, it should not be necessary to restrict the operational flexibility by incorporating the EC value for isotopes based on ingestion/inhalation (50 mrem/year) or for isotopes with the EC based on submersion (100 mrem/year).

Having sufficient operational flexibility is especially important in establishing a basis for effluent monitor setpoint calculations. As discussed above, the concentrations stated in the new 10CFR20, Appendix B, Table 2, Column 1, relate to a dose of 50 or 100 mrem in a year. When applied on an instantaneous basis, this corresponds to a dose rate of either 50 or 100 mrem/year. These low values are impractical upon which to base effluent monitor setpoint calculations for many effluent release situations when monitor background, monitor sensitivity, and monitor performance must be taken into account. Therefore, to accommodate operational flexibility needed for effluent releases, the limits associated with SLC 16.11.6 will be maintained at the current dose rate limit for noble gases of 500 mrem/year to the whole body and 3000 mrem/year to the skin, for Iodine 131, Iodine 133, tritium and all radionuclides in particulate form with half-lives greater than eight days an instantaneous dose rate limit of 1500 mrem/year to any organ.

#### BASES (continued)

Compliance with the limits of the new 10CFR20.1301 will be demonstrated by operating within the limits of 10CFR50, Appendix I and 40CFR190. Operational history at Catawba/McGuire/Oconee has demonstrated that the use of the dose rate values listed above (i.e. 500 mrem/year, 3000 mrem/year and 1500 mrem/year) as SLC limits has resulted in calculated maximum individual doses to members of the public that are small percentages of the limits of 10CFR50, Appendix I and 40CFR190.

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J. K. "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

#### REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 20, Appendix B
3. 10 CFR Part 20
4. 10 CFR Part 50



Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.7 Radioactive Gaseous Effluent Monitoring Instrumentation

**COMMITMENT** The radioactive gaseous effluent monitoring instrumentation channels shown in Table 16.11.7-1 shall be FUNCTIONAL with Alarm/Trip Setpoints set to ensure that the limits of SLC 16.11.6 are not exceeded.

AND

The Alarm/Trip setpoints shall be determined and adjusted in accordance with the methodology and parameters in the ODCM.

-----NOTE-----

Brief periods of routine sampling (not to exceed 15 minutes) do not make the instrumentation non-functional.

**APPLICABILITY** As shown in Table 16.11.7-1.

**REMEDIAL ACTIONS**

-----NOTE-----

Separate Condition entry is allowed for each Function.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more radioactive gaseous effluent monitoring channels Alarm/Trip setpoint less conservative than required.	A.1 Suspend the release of radioactive gaseous effluents monitored by the affected channel.	Immediately
	<u>OR</u>	
	A.2 Declare the channel non-functional.	Immediately
	<u>OR</u>	
	A.3 Adjust setpoint to within limit.	Immediately

(continued)

Attachment 9  
Summary of Changes to the Offsite Dose Calculation Manual

McGuire Nuclear Station Units 1 & 2  
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Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more radioactive gaseous effluent monitoring instrument channels non-functional.	B.1 Enter the Remedial Action specified in Table 16.11.7-1 for the channel(s).	Immediately
C. One channel non-functional.	<p>C.1.1 Analyze two independent samples of the tank contents.</p> <p style="text-align: center;"><u>AND</u></p> <p>C.1.2 Perform independent verification of the discharge valve lineup.</p> <p style="text-align: center;"><u>AND</u></p> <p>C.1.3.1 Perform independent verification of manual portion of the computer input for the release rate calculations performed by computer.</p> <p style="text-align: center;"><u>OR</u></p> <p>C.1.3.2 Perform independent verification of entire release rate calculations for calculations performed manually.</p> <p style="text-align: center;"><u>AND</u></p> <p>C.1.4 Restore channel to FUNCTIONAL status.</p> <p style="text-align: center;"><u>OR</u></p> <p>C.2 Suspend the release of radioactive effluents via this pathway.</p>	<p>Prior to initiating a release</p> <p>Prior to initiating a release</p> <p>Prior to initiating a release</p> <p>Prior to initiating a release</p> <p>14 days</p> <p>Immediately</p>

(continued)

McGuire Nuclear Station Units 1 & 2  
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Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. One or more flow rate measurement channels non-functional.	D.1 Estimate the flow rate of the release.	Once per 4 hours during releases
	<u>AND</u>	
	D.2 Restore the channel to FUNCTIONAL status.	30 days
E. One or more noble gas activity monitor channels non-functional.	E.1 Obtain grab samples from the effluent pathway.	Once per 12 hours during releases
	<u>AND</u>	
	E.2 Perform an analysis of grab samples for radioactivity.	To meet LLD requirements per Table 16.11.6-1
	<u>AND</u>	
	E.3 Restore the channel to FUNCTIONAL status.	30 days
F. Noble gas activity monitor providing automatic termination of release non-functional.	F.1 Suspend PURGING or VENTING of radioactive effluents via this pathway.	Immediately
G. One or more sampler channels non-functional.	G.1 Perform sampling with auxiliary sampling equipment as required by Table 16.11.6-1.	Continuously
	<u>AND</u>	
	G.2 Restore the channel to FUNCTIONAL status.	30 days

(continued)

McGuire Nuclear Station Units 1 & 2  
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Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
H. One or more Sampler Minimum Flow Device Channels non-functional.	H.1 Verify flow through the sampling apparatus.	Once per 4 hours during releases
	<u>AND</u> H.2 Restore the channel to FUNCTIONAL status.	30 days
I. Required Action and associated Completion Time of Condition C, D, E, F, G, or H not met.	I.1 Explain why the non-functionality was not corrected within the specified Completion Time in the Annual Radioactive Effluent Release Report.	In the next scheduled Annual Radioactive Effluent Release Report

TESTING REQUIREMENTS

-----NOTE-----

Refer to Table 16.11.7-1 to determine which TRs apply for each Radioactive Gaseous Effluent Monitoring channel.

TEST	FREQUENCY
TR 16.11.7.1 Perform CHANNEL CHECK.	Prior to each release
TR 16.11.7.2 -----NOTE----- The SOURCE CHECK for these channels shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity or a simulated source of radioactivity such as a light emitting diode. ----- Perform SOURCE CHECK.	Prior to each release
TR 16.11.7.3 Perform CHANNEL CHECK.	24 hours
TR 16.11.7.4 Perform CHANNEL CHECK.	7 days

(continued)

Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

TESTING REQUIREMENTS (continued)

TEST	FREQUENCY
<p>TR 16.11.7.5 -----NOTE-----</p> <p>The SOURCE CHECK for these channels shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity or a simulated source of radioactivity such as a light emitting diode.</p> <p>-----</p> <p>Perform SOURCE CHECK.</p>	<p>31 days</p>
<p>TR 16.11.7.6 -----NOTES-----</p> <ol style="list-style-type: none"> <li>1. For noble gas activity monitors providing automatic termination of release, the COT shall also demonstrate that automatic isolation of the pathway occurs if the instrument indicates measured levels above the Alarm/Trip Setpoint.</li> <li>2. For all noble gas activity monitors, the COT shall also demonstrate that control room alarm annunciation occurs if the instrument indicates measured levels above the Alarm/Trip Setpoint; circuit failure and, a downscale failure.</li> </ol> <p>-----</p> <p>Perform CHANNEL OPERATIONAL TEST.</p>	<p>92 days</p>
<p>TR 16.11.7.7 -----NOTE-----</p> <p>For all noble gas activity monitors, the initial CHANNEL CALIBRATION shall be performed using standards certified by the National Institute of Standards and Technology (NIST) or using standards obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used.</p> <p>-----</p> <p>Perform a CHANNEL CALIBRATION.</p>	<p>18 months</p>

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Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

TABLE 16.11.7-1  
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RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENTS	MINIMUM CHANNELS FUNCTIONAL	REMEDIAL ACTION	APPLICABILITY	TESTING REQUIREMENTS
1. WASTE GAS HOLDUP SYSTEM				
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (Low Range- EMF-50 or 1EMF-36, low-range)	1 per station	A, C, I	During gas effluent releases.	TR 16.11.7.1 TR 16.11.7.2 TR 16.11.7.6 TR 16.11.7.7
b. Effluent System Flow Rate Measuring Device	1 per station	D, I	At all times except when isolation valve is closed & locked.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
2. Condenser Evacuation System - Noble Gas Activity Monitor (EMF-33)	1	A, E, I	When air ejectors are operable.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
3. Vent System				
a. Noble Gas Activity Monitor (Low Range - EMF-36)	1	A, E, I	At all times.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
b. Iodine Sampler	1	G, I	At all times, except during routine sampling.	TR 16.11.7.4
c. Particulate Sampler (EMF-35)	1	G, I	At all times, except during routine sampling.	TR 16.11.7.4
d. Unit Vent Flow Rate Monitor (Totalizer)	1	D, I	At all times.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
e. Iodine Sampler Minimum Flow Device	1	H, I	At all times, except during routine sampling.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
f. Particulate Sampler Minimum Flow Device (1)	1	G, I	At all times, except during routine sampling.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
4. Containment Purge System - Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (Low Range - EMF-39)	1	A, F, I	Modes 1 through 6, except when isolation valve is closed & locked.	TR 16.11.7.2 TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7

(continued)

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Summary of Changes to the Offsite Dose Calculation Manual

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Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

TABLE 16.11.7-1  
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RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENTS	MINIMUM CHANNELS FUNCTIONAL	REMEDIAL ACTION	APPLICABILITY	TESTING REQUIREMENTS
5. Auxiliary Building Ventilation System - Noble Gas Activity Monitor (EMF-41 or EMF-36)	1	A, E, I	At all times.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
6. Fuel Storage Area Ventilation System - Noble Gas Activity Monitor (EMF-42 or EMF-36)	1	A, E, I	At all times.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
7. Contaminated Parts Warehouse Ventilation System				
a. Noble Gas Activity Monitor (EMF-53)	1 per station	A, E, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
b. Flow Rate Monitor	1 per station	D, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
c. EMF-53 Sampler Minimum Flow Device (1)	1 per station	H, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
8. Radwaste Facility Ventilation System				
a. Noble Gas Activity Monitor (EMF-52)	1 per station	A, E, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
b. Flow Rate Monitor	1 per station	D, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
c. EMF-52 Sampler Minimum Flow Device (1)	1 per station	H, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7

(continued)

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Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

TABLE 16.11.7-1  
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RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENTS	MINIMUM CHANNELS FUNCTIONAL	REMEDIAL ACTION	APPLICABILITY	TESTING REQUIREMENTS
9. Equipment Staging Building Ventilation System				
a. Noble Gas Activity Monitor (EMF-59)	1 per station	A, E, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7
b. Flow Rate Monitor	1 per station	D, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
c. EMF-59 Sampler Minimum Flow Device (1)	1 per station	H, I	During gaseous effluent releases.	TR 16.11.7.3 TR 16.11.7.6 TR 16.11.7.7
10. Containment Air Release and Addition System - Noble Gas Activity Monitor (EMF-39L or EMF-36L)	1	A, E, I	At all times except when isolation valve is closed & locked.	TR 16.11.7.3 TR 16.11.7.5 TR 16.11.7.6 TR 16.11.7.7

NOTES:

1. Radioactivity monitor (EMF) shall not be declared FUNCTIONAL unless both the EMF and the associated EMF's Minimum Flow Device are rendered FUNCTIONAL.



Radioactive Gaseous Effluent Monitoring Instrumentation  
16.11.7

BASES

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The instrumentation consists of monitoring and sampling instrumentation. Monitors provide continuous display of process parameters with appropriate alarms and trip setpoints established. Samplers collect a portion of the desired process for subsequent laboratory analysis, and do not have alarm/trip capability. Samplers and the analysis program provide a method to assure that long term effluent release quantities do not exceed the requirements of SLC 16.11.6. Monitors provide assurance that instantaneous effluent releases do not exceed the requirements of SLC 16.11.6. The minimum flow devices for EMFs listed in Table 16.11.7-1 are required to provide assurance of representative sampling during actual or potential releases of gaseous effluents. The flow rate monitor quantifies the total gaseous effluent (both non-radioactive and radioactive) released to the environment. During routine sampling, instrumentation may be turned off for short periods of time (not to exceed 15 minutes) in order to meet analysis requirements of SLC 16.11.6. This is considered to be a normal function of the equipment. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the Alarm/Trip will occur prior to exceeding the limits stated in SLC 16.11.6. The FUNCTIONALITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

REFERENCES

1. McGuire Nuclear Station, Offsite Dose Calculation Manual
2. 10 CFR Part 50, Appendix A

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.8 Noble Gases

**COMMITMENT** Air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the SITE BOUNDARY (see Figure 16.11.1-1) shall be limited to the following:

- a. During any calendar quarter: Less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation, and
- b. During any calendar year: Less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

**APPLICABILITY** At all times.

### REMEDIAL ACTIONS

#### NOTES

Enter applicable Conditions and Required Actions of SLC 16.11.12, "Total Dose," when the limits of this SLC are exceeded by twice the specified limit.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated air dose from radioactive noble gases in gaseous effluents exceeding any of above limits.	A.1 Prepare and submit a Special Report to the NRC which identifies the causes for exceeding the limits, corrective actions taken to reduce releases, and actions taken to ensure that subsequent releases are within limits.	30 days

#### TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.8.1 Determine cumulative dose contributions from noble gases in gaseous effluents for current calendar quarter and current calendar year in accordance with the methodology and parameters in the ODCM.	31 days

#### BASES

This commitment is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I.

The REMEDIAL ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable."

The TESTING REQUIREMENTS implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially under-estimated.

The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in 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 Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977.

The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

This commitment applies at all times to the release of gaseous effluents from each reactor at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are to be proportioned among the units sharing that system in accordance with the guidance given in NUREG-0133, Chapter 3.1.

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Noble Gases  
16.11.8

REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 50, Appendix I

Dose - Iodine-131 and 133, Tritium and Radioactive Materials in Particulate Form  
16.11.9

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.9 Dose - Iodine-131 and 133, Tritium and Radioactive Materials in Particulate Form

**COMMITMENT** The dose to a MEMBER OF THE PUBLIC from Iodine-131 and 133, tritium, and all radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents released from each unit to areas at and beyond the SITE BOUNDARY (see Figure 16.11.1-1) shall be limited to the following:

- a. During any calendar quarter: less than or equal to 7.5 mrem to any organ, and
- b. During any calendar year: less than or equal to 15 mrem to any organ.

**APPLICABILITY** At all times.

**REMEDIAL ACTIONS**

**NOTES**

Enter applicable Conditions and Required Actions of SLC 16.11.12, "Total Dose," when the limits of this SLC are exceeded by twice the specified limit.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated dose from the release of Iodine 131 and 133, tritium, and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents exceeding any of the above limits.	A.1 Prepare and submit a Special Report to the NRC which identifies the causes for exceeding the limits, corrective actions taken to reduce releases, and actions taken to ensure that subsequent releases are within limits.	30 days

Dose - Iodine-131 and 133, Tritium and Radioactive Materials in Particulate Form  
16.11.9

TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.9.1 Determine cumulative dose contributions for Iodine 131 and 133, tritium, and radioactive material in particulate form with half lives greater than 8 days in gaseous effluents for current calendar quarter and current calendar year in accordance with the methodology and parameters in the ODCM.	31 days

BASES

This commitment is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I.

The REMEDIAL ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable.

The ODCM calculational methods specified in the TESTING REQUIREMENTS implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated.

The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in 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 Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors, Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for Iodine-131 and 133, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent upon the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: (1) individual inhalation of airborne radionuclides; (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man; (3) deposition onto grassy areas where milk animals and meat-producing animals graze with consumption of the milk and meat by man; and, (4) deposition on the ground with subsequent exposure of man.

Dose - Iodine-131 and 133, Tritium and Radioactive Materials in Particulate Form  
16.11.9

BASES (continued)

This commitment applies at all times to the release of gaseous effluents from each reactor at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are to be proportioned among the units sharing that system in accordance with the guidance given in NUREG 0133, Chapter 3.1.

REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 50, Appendix I

Gaseous Radwaste Treatment System  
16.11.10

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.10 Gaseous Radwaste Treatment System

**COMMITMENT** The VENTILATION EXHAUST TREATMENT and WASTE GAS HOLDUP SYSTEMS shall be FUNCTIONAL and appropriate portions of these systems shall be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases, from each unit, to areas at and beyond the SITE BOUNDARY (see Figure 16.11.1-1) would exceed:

- a. 0.2 mrad to air from gamma radiation, or
- b. 0.4 mrad to air from beta radiation, or
- c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

**APPLICABILITY** At all times.

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Radioactive gases being discharged without treatment and in excess of above limits.	A.1 Prepare and submit a Special Report to the NRC which identifies non-functional equipment and reasons for non-functionality, actions taken to restore the equipment to FUNCTIONAL status, and actions taken to prevent recurrence.	30 days



Gaseous Radwaste Treatment System  
16.11.10

TESTING REQUIREMENTS

NOTE

The installed Gaseous Radwaste Treatment System shall be demonstrated FUNCTIONAL by meeting SLC 16.11.6, 16.11.8 and 16.11.9.

TEST	FREQUENCY
TR 16.11.10.1 Project gaseous release doses from each unit to areas at and beyond the SITE BOUNDARY, in accordance with the methodology and parameters in the ODCM, when gaseous systems are being released without being processed by its radwaste treatment system.	31 days

BASES

The FUNCTIONALITY of the WASTE GAS HOLDUP SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these systems be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable."

This commitment implements the requirements of 19 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

This commitment applies at all times to the release of radioactive materials in gaseous effluents from each unit at the site. For units with shared Radwaste Treatment Systems, the gaseous effluents from the shared system are to be proportioned among the units sharing that system in accordance with NUREG-0133, Chapter 3.1.

REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 50, Appendix I
3. 10 CFR Part 50

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.11 Solid Radioactive Waste

COMMITMENT	<p data-bbox="503 517 1372 644">Radioactive wastes shall be processed and packaged to ensure compliance with the applicable requirements of 10 CFR Part 20, 10CFR Part 61, 10 CFR Part 71, and State regulations governing the transportation and disposal of radioactive wastes.</p> <p data-bbox="503 676 1372 921">The Solid Radwaste System or an approved alternative process shall be used in accordance with a PROCESS CONTROL PROGRAM (PCP) for the solidification of liquid or wet radioactive wastes or the dewatering of wet radioactive wastes to be shipped for direct disposal at a 10CFR61 licensed disposal site. Wastes shipped for off site processing in accordance with the processor's specifications and transportation requirements are not required to be solidified or dewatered to meet disposal requirements.</p> <ul data-bbox="503 953 1372 1368" style="list-style-type: none"><li data-bbox="503 953 1372 1049">• The PCP describes administrative and operational controls used for the solidification of liquid or wet solid radioactive wastes in order to meet applicable 10CFR61 waste form requirements.</li><li data-bbox="503 1081 1372 1176">• The PCP describes the administrative and operational controls used for the dewatering of wet radioactive wastes to meet 10CFR61 free standing water requirements.</li><li data-bbox="503 1208 1372 1368">• The process parameters used in establishing the PCP shall be based on demonstrated processing of actual or simulated liquid or wet solid wastes and must adequately verify that the final product of solidification or dewatering meets all applicable Federal, State and disposal site requirements.</li></ul>
APPLICABILITY	At all times.

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Solid Radioactive Waste  
16.11.11

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Applicable regulatory requirements for solidified or dewatered wastes are not satisfied.	A.1 Suspend shipments of defectively packaged solid radioactive wastes from the site.	Immediately
	<u>AND</u> A.2 Initiate action to correct the PROCESS CONTROL PROGRAM, procedures, or solid waste equipment as necessary to prevent recurrence.	Prior to next shipment for disposal of solidified or dewatered wastes.
B. A solidification test as described in the PCP fails to verify Solidification.	B.1 Suspend solidification of the batch under test and follow PCP guidance for test failures.	Immediately
	B.2 Once a subsequent test verifies Solidification, solidification of the batch may then be resumed as directed by the PCP. The PCP shall be modified as required to assure Solidification of subsequent batches of waste	Prior to next solidification for shipment of waste for disposal at a 10CFR61 disposal site.

(continued)

REMEDIAL ACTIONS (continued)

C. With solidification or dewatering for disposal not performed in accordance with the PROCESS CONTROL PROGRAM.	C.1 Reprocess the waste in accordance with PCP requirements.  <u>OR</u>  C.2 Follow PCP or procedure guidance for alternative free standing liquid verification to ensure the waste in each container meets disposal requirements and take appropriate administrative action to prevent recurrence.	Prior to shipment for disposal of the inadequately processed waste that requires solidification of dewatering
D. With the solid waste equipment incapable of meeting SLC 16.11.11 or not in service	D.1 Restore the equipment to FUNCTIONAL status or provide for alternative capability to process wastes as necessary to satisfy all applicable disposal requirements	In a time frame that supports the COMMITMENT section of SLC 16.11.11

TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.11.1 The Process Control Program shall be used to verify the Solidification of at least one representative test specimens from at least every tenth batch of each type of radioactive waste to be solidified for disposal at a 10CFR61 disposal site per the COMMITMENT of this SLC.	Every tenth batch of each type of radioactive waste to be solidified.

**BASES:**

This commitment implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and requirements to use a Process Control Program to meet applicable 10CFR61 waste form criteria for solidified and dewatered radioactive wastes.

**REFERENCES:**

1. 10CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"
2. 10 CFR Part 50, Appendix A
3. 10CFR20, "Standards for Protection Against Radiation"
4. 10CFR61, "Licensing Requirements for Land Disposal of Radioactive Waste"
5. 10CFR71, "Packaging and Transportation of Radioactive Materials"
6. DPCo Process Control Program Manual
7. NRC Generic Letter 84-12, "Compliance With 10 CFR Part 61 And Implementation Of the Radiological Effluent Technical Specifications (Rets) and Attendant Process Control Program (PCP)"
8. NRC Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications In the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of Rets to the Offsite Dose Calculation Manual or to the Process Control Program"

Total Dose  
16.11.12

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.12 Total Dose

**COMMITMENT**      The annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC, due to releases of radioactivity and radiation, from uranium fuel cycle sources shall be limited to  $\leq 25$  mrem to the whole body or any organ, except the thyroid, which shall be limited to  $\leq 75$  mrem.

**APPLICABILITY**      At all times.

### REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.      Calculated doses from releases exceeding twice the specified limits of SLC 16.11.3, 16.11.8 or 16.11.9.	A.1      Verify, by calculation, the cumulative dose from direct radiation contributions, the ISFSI, outside storage tanks, and radioactivity releases are within the total dose limit.	Immediately
	<p><u>AND</u></p> <p>A.2      -----NOTE----- Only required to be performed if the total dose limit is exceeded.</p> <p>Prepare and submit a Special Report to the NRC which identifies corrective actions to be taken to reduce subsequent releases to prevent recurrence and schedule for achieving conformance with specified limits.</p>	30 days

Total Dose  
16.11.12

## TESTING REQUIREMENTS

### NOTE

Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with SLC 16.11.3, 16.11.8 and 16.11.9, and in accordance with the methodology and parameters specified in the ODCM.

TEST	FREQUENCY
TR 16.11.12.1 Determine cumulative dose contributions from direct radiation from the units, the ISFSI, and from radwaste storage tanks in accordance with the methodology and parameters specified in the ODCM.	When calculated doses from effluent releases exceeds twice the limits of SLCs 16.11.3, 16.11.8 or 16.11.9

## BASES

This commitment is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The specification requires the preparation and submittal of a Special Report whenever the calculated doses from plant generated radioactive effluents and direct radiation exceed 25 mrem to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of 10 CFR Part 50, Appendix I, and if direct radiation doses from the units and outside storage tanks are kept small.

This Special Report, as defined in 10 CFR Part 20.2203(a)(4), shall include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report. It shall also describe levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 8 km must be considered.

If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in

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BASES (continued)

accordance with the provisions of 40 CFR Part 190.11 and 10 CFR Part 20.2203(a)(4), is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 and a variance is granted until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20, as addressed in SLCs 16.11.1 and 16.11.6.

An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

REFERENCES

1. McGuire Nuclear Station, Offsite Dose Calculation Manual
2. 10 CFR Part 20
3. 40 CFR Part 190
4. 10 CFR Part 50, Appendix I



Radiological Environmental Monitoring Program  
16.11.13

16.11 RADIOLOGICAL EFFLUENT MONITORING

16.11.13 Radiological Environmental Monitoring Program

**COMMITMENT**      The Radiological Environmental Monitoring Program shall be conducted as specified in Table 16.11.13-1.

**APPLICABILITY**      At all times.

**REMEDIAL ACTIONS**

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Radiological Environmental Monitoring Program not being conducted as specified in Table 16.11.13-1.	A.1 Identify the reasons for not conducting the program as required and the plans for preventing a recurrence in the Annual Radiological Environmental Operating Report.	Within the next scheduled Annual Radiological Environmental Operating Report
B. Radioactivity level of environmental sampling medium at a specified location in excess of reporting limits of Table 16.11.13-2.	B.1 Prepare and submit a Special Report that defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of SLC 16.11.3, 16.11.8, and 16.11.9.	30 days

(continued)

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Radiological Environmental Monitoring Program  
16.11.13

REMEDIAL ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Milk or fresh leafy vegetable samples unavailable from one or more required sample locations.	C.1 -----NOTE----- Specific locations from which samples were unavailable may be deleted from the program.  Revise the Radiological Environmental Monitoring Program to identify locations for obtaining replacement samples.	30 days
	<u>AND</u>  C.2 Identify the cause of the unavailability of samples and identify new location(s) for obtaining replacement samples in the next Annual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).	Within the next scheduled Annual Radioactive Effluent Release Report

TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.13.1 -----NOTES----- The maximum values for the lower limits of detection shall be as specified in Table 16.11.13-3.  The radiological environmental monitoring samples shall be collected from the locations given in the table and figure in the ODCM and shall be analyzed pursuant to the requirements of Tables 16.11.13-1.	In accordance with Table 16.11.13-1

TABLE 16.11.13-1  
(Page 1 of 6)  
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS <sup>(1)</sup>	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
1. Direct Radiation <sup>(2)</sup>	<p>Forty routine monitoring stations either with two or more dosimeters or with one instrument for measuring and recording dose rate continuously, placed as follows:</p> <p>An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY;</p> <p>An outer ring of stations, one in each meteorological sector in the 6- to 8-km range from the site; and</p> <p>The balance of the stations placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control stations.</p>	Quarterly	Gamma dose quarterly.

(continued)

TABLE 16.11.13-1  
(Page 2 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS <sup>(1)</sup>	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
2. Airborne Radioiodine and Particulates	<p>Samples from five locations:</p> <p>Three samples from close to the three SITE BOUNDARY locations, in different sectors, of the highest calculated annual average ground level D/Q.</p> <p>One sample from the vicinity of a community having the highest calculated annual average ground level D/Q.</p> <p>One sample from a control location, as for example 15-30 km distant and in the least prevalent wind direction<sup>(3)</sup>.</p>	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	<p><u>Radioiodine Canister:</u> I-131 analysis weekly.</p> <p><u>Particulate Sampler:</u> Gross beta radioactivity analysis following filter change<sup>(4)</sup>; Gamma isotopic analysis<sup>(5)</sup> of composite (by location quarterly).</p>
3. Waterborne a. Surface <sup>(6)</sup>	<p>One sample upstream.</p> <p>One sample downstream.</p>	Composite sample over 1-month period <sup>(7)</sup> .	Gamma isotope analysis <sup>(5)</sup> monthly. Composite for tritium analysis quarterly.
b. Ground	Samples from one or two sources only if likely to be affected <sup>(8)</sup>	Quarterly	Gamma isotopic <sup>(5)</sup> and tritium analysis quarterly.

(continued)

TABLE 16.11.13-1  
(Page 3 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS <sup>(1)</sup>	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
c. Drinking	One sample of each of one to three of the nearest water supplies that could be affected by its discharge.  One sample from a control location.	Composite sample over 2-week period <sup>(7)</sup> when I-131 analysis is performed; monthly composite otherwise.	I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than 1 mrem per year <sup>(9)</sup> . Composite for gross beta and gamma isotopic analyses <sup>(5)</sup> monthly. Composite for tritium analysis quarterly.
d. Sediment from the shoreline	One sample from downstream area with existing or potential recreational value.	Semiannually	Gamma isotopic analysis <sup>(5)</sup> semiannually.
4. Ingestion a. Milk	Samples from milking animals in three locations within 5-km distance having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year <sup>(9)</sup> .  One sample from milking animals at a control location 15 to 30 km distant and in the least prevalent wind direction.	Semimonthly when animals are on pasture; monthly at other times.	Gamma isotopic <sup>(5)</sup> and I-131 analysis semimonthly when animals are on pasture; monthly at other times.

(continued)

TABLE 16.11.13-1  
(Page 4 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

EXPOSURE PATHWAY AND/OR SAMPLE	NUMBER OF REPRESENTATIVE SAMPLES AND SAMPLE LOCATIONS <sup>(1)</sup>	SAMPLING AND COLLECTION FREQUENCY	TYPE AND FREQUENCY OF ANALYSIS
b. Fish and Invertebrates	One sample each commercially and recreationally important species in vicinity of plant discharge area.  One sample of same species in areas not influenced by plant discharge.	Sample in season, or semiannually if they are not seasonal	Gamma isotopic analysis <sup>(5)</sup> on edible portions
c. Food Products	One sample of each principal class of food products from any area that is irrigated by water in which liquid plant wastes have been discharged.  Samples of three different kinds of broad leaf vegetation grown nearest each of two different offsite locations of highest predicted annual average ground level D/Q if milk sampling is not performed.  One sample of each of the similar broad leaf vegetation grown 15 to 30 km distant in the least prevalent wind direction if milk sampling is not performed.	At time of harvest <sup>(10)</sup>  Monthly, when available.  Monthly, when available.	Gamma isotopic analyses <sup>(5)</sup> on edible portion.  Gamma isotopic <sup>(5)</sup> and I-131 analysis.  Gamma isotopic <sup>(5)</sup> and I-131 analysis.

Radiological Environmental Monitoring Program  
16.11.13

TABLE 16.11.13-1

(Page 5 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

NOTES:

1. Specific parameters of distance and direction sector from the centerline of one reactor, and additional description where pertinent, shall be provided for each and every sample location in Table 16.11.13-1 in a table and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report. It is recognized that, at times, it may not be possible or practical to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the Radiological Environmental Monitoring Program. In lieu of an Licensee Event Report, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next Annual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).
2. One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The forty stations is not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations; e.g., at an ocean site, some sections will be over water so that the number of dosimeters may be reduced accordingly. The frequency of analysis or readout for TLD systems will depend upon the characteristics of the specific system used and should be selected to obtain optimum dose information with minimal fading.
3. The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.
4. Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than ten times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.

Radiological Environmental Monitoring Program  
16.11.13

TABLE 16.11.13-1

(Page 6 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

NOTES (continued):

5. Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.
6. The "upstream sample" shall be taken at a distance beyond significant influence of the discharge. The "downstream" sample shall be taken in an area beyond but near the mixing zone. "Upstream" samples in an estuary must be taken far enough upstream to be beyond the plant influence. Salt water shall be sampled only when the receiving water is utilized for recreational activities.
7. A composite sample is one in which the quantity (aliquot) of liquid sampled is proportional to the quantity of flowing liquid and in which the method of sampling employed results in a specimen that is representative of the liquid flow. In this program composite sample aliquots shall be collected at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.
8. Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.
9. The dose shall be calculated for the maximum organ and age group, using the methodology and parameters in the ODCM.
10. If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuborous and root food products.



TABLE 16.11.13-2  
(Page 1 of 1)

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

ANALYSIS	REPORTING LEVELS				
	WATER (pCi/l)	AIRBOURNE PARTICULATE OR GASES (pCi/m <sup>3</sup> )	FISH (pCi/kg, wet)	MILK (pCi/l)	BROAD LEAF VEGETATION (pCi/kg, wet)
H-3	20,000 <sup>(1)</sup>	N/A	N/A	N/A	N/A
Mn-54	1,000	N/A	30,000	N/A	N/A
Fe-59	400	N/A	10,000	N/A	N/A
Co-58	1,000	N/A	30,000	N/A	N/A
Co-60	300	N/A	10,000	N/A	N/A
Zn-65	300	N/A	20,000	N/A	N/A
Zr-Nb-95	400	N/A	N/A	N/A	N/A
I-131	2	0.9	N/A	3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200	N/A	N/A	300	N/A

NOTES:

1. For drinking water samples. This is 40 CFR Part 141 value. If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

TABLE 16.11.13-3  
(Page 1 of 3)

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD) <sup>(1)(2)(3)</sup>

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m <sup>3</sup> )	FISH (pCi/kg, wet)	MILK (pCi/l)	BROAD LEAF VEGETATION (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4	0.01	N/A	N/A	N/A	N/A
H-3	2000*	N/A	N/A	N/A	N/A	N/A
Mn-54	15	N/A	130	N/A	N/A	N/A
Fe-59	30	N/A	260	N/A	N/A	N/A
Co-58, 60	15	N/A	130	N/A	N/A	N/A
Zn-65	30	N/A	260	N/A	N/A	N/A
Zr-95	15	N/A	N/A	N/A	N/A	N/A
Nb-95	15	N/A	N/A	N/A	N/A	N/A
I-131	1 <sup>(4)</sup>	0.07	N/A	1	60	N/A
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-140	15	N/A	N/A	15	N/A	N/A
La-140	15	N/A	N/A	15	N/A	N/A

\* If no drinking water pathway exists, a value of 3000 pCi/l may be used.

Radiological Environmental Monitoring Program  
16.11.13

TABLE 16.11.13-3  
(Page 2 of 3)

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)

NOTES:

1. The LLD is defined, for purposes of these commitments, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{(2.71/T) + 4.65S_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above (as picoCurie per unit mass or volume),

$s_b$  is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute),

E is the counting efficiency (as counts per disintegration),

V is the sample size (in units of mass or volume),

2.22 is the number of disintegrations per minute per picoCurie,

Y is the fractional radiochemical yield (when applicable),

$\lambda$  is the radioactive decay constant for the particular radionuclide,

$\Delta t$  is the elapsed time between sample collection (or end of the sample collection period) and time of counting (for environmental samples, not plant effluent samples), and

T is the background and sample counting time in minutes.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report.

Radiological Environmental Monitoring Program  
16.11.13

TABLE 16.11.13-3  
(Page 3 of 3)

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)

NOTES (continued):

2. This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report.
3. Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13.
4. LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic analysis may be used.

Radiological Environmental Monitoring Program  
16.11.13

BASES

The Radiological Environmental Monitoring Program is established to monitor the radiation and radionuclides in the environs of the plant. The program provides representative measurements of radioactivity in the highest potential exposure pathways, and verification of the accuracy of the effluent monitoring program and modeling of environmental exposure pathways. The program is contained in SLC 16.11.13 – 16.11.16 and conforms to the guidance of Appendix I to 10 CFR Part 50. The program includes the following:

1. Monitoring, sampling, analysis, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters in the ODCM,
2. A Land Use Census to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census, and
3. Participation in an Interlaboratory Comparison Program to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring.

The portion of the Radiological Environmental Monitoring Program required by this commitment provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the Radiological Effluent Monitoring Program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring. The initially specified monitoring program will be effective for at least the first 3 years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs required by Table 16.11.13-3 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

With the level of radioactivity in an environmental sampling medium at a specified location exceeding the reporting levels of Table 16.11.13-3 when averaged over any calendar quarter, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days a Special Report that defines the corrective actions to be

Radiological Environmental Monitoring Program  
16.11.13

BASES (continued)

taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of SLCs 16.11.6, 16.11.8, and 16.11.9. When more than one of the radionuclides in Table 16.11.13-2 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{limit level (1)}} + \frac{\text{concentration (2)}}{\text{limit level (2)}} + \dots \geq 1.0$$

When radionuclides other than those in Table 16.11.13-2 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to a MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of SLCs 16.11.6, 16.11.8 and 16.11.9. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report. The methodology and parameters used to estimate the potential annual dose to a MEMBER OF THE PUBLIC shall be indicated in this report.

Detailed discussion of the LLD, and other detection limits, can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J. K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 50, Appendix I

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.14 Land Use Census

**COMMITMENT** A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of:

- a. the nearest milk animal,
- b. the nearest residence, and
- c. the nearest garden of greater than 50 m<sup>2</sup> (500 ft<sup>2</sup>) producing broad leaf vegetation.

For elevated releases as defined in Regulatory Guide 1.111, Revision 1, July 1977, the land use census shall identify within a distance of 5 km (3 miles) the location in each of the 16 meteorological sectors of:

- a. all milk animals, and
- b. all gardens of greater than 50 m<sup>2</sup> producing broad leaf vegetation.

-----NOTE-----  
Broad leaf vegetation sampling of three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broad leaf vegetation sampling in Table 16.11.13-1 4c shall be followed, including analysis of control samples.  
-----

**APPLICABILITY** At all times.

### REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Location(s) identified which yields a calculated dose/dose commitment greater than values currently calculated in SLC 16.11.9.	A.1 Identify the new location in the Annual Radioactive Effluent Release Report.	In next scheduled Annual Radioactive Effluent Release Report

(continued)





## BASES

This commitment is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the Radiological Environmental Monitoring Program are made if required by the results of this census. The best information from the door-to-door survey, from aerial survey, or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m<sup>2</sup> provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/m<sup>2</sup>.

With a land use census identifying a location(s) which yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained in accordance with SLC 16.11.13, add the new location to the Radiological Environmental Monitoring Program. The sampling location(s), excluding the control station location, having the lowest calculated dose or dose commitment (via the same exposure pathway) may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted.

## REFERENCES

1. McGuire Nuclear Station, Off site Dose Calculation Manual
2. 10 CFR Part 50, Appendix I

Interlaboratory Comparison Program  
16.11.15

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.15 Interlaboratory Comparison Program

**COMMITMENT** Analyses shall be performed on radioactive materials, supplied as part of an Interlaboratory Comparison Program (ICP), that correspond to samples required by SLC 16.11.13.

**APPLICABILITY** At all times.

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Analyses not being performed as required.	A.1 Report corrective actions taken to prevent recurrence in the Annual Radiological Environmental Operating Report.	In next scheduled Annual Radiological Environmental Operating Report

TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.15.1 Report a summary of the results of the Interlaboratory Comparison Program in the Annual Radiological Environmental Operating Report.	12 months

## BASES

This requirement for participation in an Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

The Interlaboratory Comparison Program (ICP) shall be described in the Annual Radiological Environmental Operating Report.

## REFERENCES

1. 10 CFR Part 50, Appendix I

Annual Radiological Environmental Operating Report  
16.11.16

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.16 Annual Radiological Environmental Operating Report

COMMITMENT

Routine Annual Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted by May 15 of each year.

The Annual Radiological Environmental Operating Reports shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with pre-operational studies, with operational controls as appropriate, and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use censuses required by SLC 16.11.14.

The Annual Radiological Environmental Operating Reports shall include the results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in the Table and Figures in the ODCM, as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following:

- a summary description of the Radiological Environmental Monitoring Program;
- at least two legible maps covering all sampling locations keyed to a table giving distances and directions from the centerline of one reactor (one map shall cover stations near the site boundary; a second shall include the more distant stations);
- the results of licensee participation in the Interlaboratory Comparison Program, required by SLC 16.11.15;
- a discussion of all deviations from the sampling schedule of Table 16.11.13-1; and

COMMITMENT (continued)

- a discussion of all analyses in which the LLD required by Table 16.11.13-3 was not achievable.

A single submittal may be made for a multiple unit station..

APPLICABILITY

At all times.

REMEDIAL ACTIONS

None

TESTING REQUIREMENTS

None

BASES

None

REFERENCES

1. Technical Specification 5.6.2

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.17 Radioactive Effluent Release Reports

#### COMMITMENT

Routine Radioactive Effluent Release Reports covering the operation of the unit during the previous calendar year of operation shall be submitted before May 1 of each year.

The Radioactive Effluent Release Reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data provided for the reporting period using Appendix B as guidance.

The Radioactive Effluent Release Report shall include an annual summary of hourly meteorological data collected over the previous calendar year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. A five year average of representative onsite meteorological data shall be used in the gaseous effluent dose pathway calculations. Dispersion factors (X/Qs) and deposition factors (D/Qs) shall be generated using the computer code XOQDOQ (NUREG/CR-2919) which implements NRC Regulatory Guide 1.111. The meteorological conditions concurrent with the time of release shall be reviewed annually to determine if the five-year average values should be revised. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

The Radioactive Effluent Release Report shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation." Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

COMMITMENT (continued)

The Radioactive Effluent Release Reports shall include the following information for each type of solid waste shipped offsite or disposed of in the site landfill during the report period:

- a. Total container volume, in cubic meters,
- b. Total Curie quantity (determined by measurement or estimate),
- c. Principal radionuclides (determined by measurement or estimate),
- d. Type of waste (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms),
- e. Number of shipments, and
- f. Solidification agent or absorbent (e.g., cement, or other approved agents (media)).

The Radioactive Effluent Release Reports shall include a list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

The Radioactive Effluent Release Reports shall include any changes made during the reporting period to the PROCESS CONTROL PROGRAM (PCP) and to the OFFSITE DOSE CALCULATION MANUAL (ODCM), as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to SLC 16.11.14.

The Radioactive Effluent Release Reports shall also identify any licensee initiated major changes to the Radioactive Waste Systems (liquid, gaseous, and solid). Otherwise, this information may be included in the annual UFSAR update. The discussion of each change shall contain:

- a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR Part 50.59;
- b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;
- c. A detailed description of the equipment, components, and processes involved and the interfaces with other plant systems;
- d. An evaluation of the change, which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the License application and amendments thereto;

COMMITMENT (continued)

- e. An evaluation of the change, which shows expected maximum exposures to individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the License application and amendments thereto;
- f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period prior to when the changes are to be made;
- g. An estimate of the exposure to plant operating personnel as a result of the change; and
- h. Documentation of the fact that the change was reviewed and found acceptable by the Station Manager or the Chemistry Manager.

A single submittal may be made for a multiple unit station. The submittal should combine those sections that are common to all units at the station; however, for units with separate Radwaste Systems, the submittal shall specify the releases of radioactive material from each unit.

APPLICABILITY

At all times

REMEDIAL ACTIONS

None

TESTING REQUIREMENTS

None

BASES

None

REFERENCES

1. Technical Specification 5.6.3



Liquid Holdup Tanks  
16.11.18

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.18 Liquid Holdup Tanks

**COMMITMENT**      The quantity of radioactive material contained in each unprotected outdoor radwaste tank shall be limited to  $\leq 10$  Curies, excluding tritium and dissolved or entrained noble gases.

**APPLICABILITY**      At all times.

**REMEDIAL ACTIONS**

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.    Quantity of radioactive material in tank not within limit.	A.1    Suspend all additions of radioactive material to the tank.	Immediately
	<u>AND</u>	
	A.2    Reduce the tank contents to within limit.	48 hours
	<u>AND</u>	
	A.3    Describe the events leading to this condition in the next Annual Radioactive Effluent Release Report.	Within the next scheduled Annual Radioactive Effluent Release Report

**TESTING REQUIREMENTS**

TEST	FREQUENCY
TR 16.11.18.1 Verify the quantity of radioactive material contained in unprotected outdoor radwaste tanks is within limits by analyzing a representative sample of the tank's contents when radioactive materials are being added to the tank.	7 days

## BASES

The tanks applicable to this SLC include all those outdoor radwaste tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the Liquid Radwaste Treatment System.

Restricting the quantity of radioactive material contained in the specified tanks provides assurance that in the event of an uncontrolled release of the tanks' contents, the resulting concentrations would be less than the limits of 10 CFR Part 20, Appendix B, Table II, Column 2, at the nearest potable water supply and the nearest surface water supply in an UNRESTRICTED AREA.

## REFERENCES

None

## 16.11 RADIOLOGICAL EFFLUENT CONTROLS

### 16.11.19 Explosive Gas Mixture

**COMMITMENT**      The concentration of oxygen in the WASTE GAS HOLDUP SYSTEM shall be limited to  $\leq 2\%$  by volume whenever the hydrogen concentration exceeds 4% by volume.

**APPLICABILITY**      At all times.

#### REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Concentration of oxygen in the WASTE GAS HOLDUP SYSTEM $> 2\%$ but $\leq 4\%$ by volume.	A.1 Reduce oxygen concentration to within limits.	48 hours
B. Concentration of oxygen in the WASTE GAS HOLDUP SYSTEM $> 4\%$ and hydrogen concentration $> 4\%$ by volume.	B.1 Suspend all additions of waste gases to the system.	Immediately
	<u>AND</u> B.2 Reduce the concentration of oxygen to $\leq 4\%$ by volume.	Immediately
	<u>AND</u> B.3 Reduce oxygen concentration to within limits.	48 hours

#### TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.19.1 Verify the concentrations of hydrogen and oxygen in the WASTE GAS HOLDUP SYSTEM is within limits by monitoring waste gases in the WASTE GAS HOLDUP SYSTEM with the hydrogen and oxygen monitors required by SLC 16.7.8.	During WASTE GAS HOLDUP SYSTEM operation

#### BASES

This specification is provided to ensure that the concentration of potentially explosive gas mixtures contained in the WASTE GAS HOLDUP SYSTEM is maintained below the flammability limits of hydrogen and oxygen. Automatic control features are included in the system to prevent the hydrogen and oxygen concentrations from reaching these flammability limits. These automatic control features include isolation of the source of hydrogen and/or oxygen, automatic diversion to recombiners, or injection of dilutants to reduce the concentration below the flammability limits. Maintaining the concentration of hydrogen and oxygen below their flammability limits provides assurance that the releases of radioactive materials will be controlled in conformance with the requirements of General Design Criterion 60 of Appendix A to 10 CFR Part 50.

#### REFERENCES

None

Gas Storage Tanks  
16.11.20

16.11 RADIOLOGICAL EFFLUENT CONTROLS

16.11.20 Gas Storage Tanks

COMMITMENT      The quantity of radioactivity contained in each gas storage tank shall be limited  $\leq$  49,000 Curies noble gases (considered as Xe-133).

APPLICABILITY      At all times.

REMEDIAL ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A.    Quantity of radioactive material in tank not within limit.	A.1    Suspend all additions of radioactive material to the tank.	Immediately
	<u>AND</u> A.2    Reduce the tank contents to within limit.	48 hours

TESTING REQUIREMENTS

TEST	FREQUENCY
TR 16.11.20.1 Verify the quantity of radioactive material contained in each gas storage tank is within limit when radioactive materials are being added to the tank.	24 hours

## BASES

This SLC considers postulated radioactive releases due to a waste gas system leak or failure, and limits the quantity of radioactivity in each pressurized gas storage tank in the WASTE GAS HOLDUP SYSTEM to assure that a release would be substantially below the dose guideline values of 10 CFR Part 100 for a postulated event.

Restricting the quantity of radioactivity contained in each gas storage tank provides assurance that in the event of an uncontrolled release of the tank's contents, the resulting total body exposure to a MEMBER OF THE PUBLIC at the nearest exclusion area boundary will not exceed 0.5 rem. This is consistent with Standard Review Plan 11.3, Branch Technical Position ETSB 11-5, "Postulated Radioactive Releases Due to a Waste Gas System Leak or Failure," in NUREG-0800, July 1981.

## REFERENCES

None

**Attachment 10**  
**Summary of Changes to the Process Control Program**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 10**

**Summary of Changes to the Process Control Program**

This attachment includes a summary of changes to the PCP.

**Attachment 10**  
**Summary of Changes to the Process Control Program**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

The McGuire Nuclear Station PCP was not revised in 2015. The most recent revision was provided with the McGuire Nuclear Station 2014 ARERR.



**Attachment 11**  
**Summary of Major Modifications to the Radioactive Waste Treatment Systems**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 11**

**Summary of Major Modifications to the Radioactive Waste Treatment Systems**

This attachment includes a description of major modifications to the radioactive waste treatment systems that are anticipated to affect effluent releases.

**Attachment 11**  
**Summary of Major Modifications to the Radioactive Waste Treatment Systems**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

No major modifications to McGuire Nuclear Station liquid, gaseous, solid, or mobile radioactive waste treatment systems occurred in 2015.

**Attachment 12**  
**Errata to a Previous Year's ARERR Example**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

**ATTACHMENT 12**

**Errata to a Previous Year's ARERR**

This attachment includes any amended pages from a previous year's ARERR.

**Attachment 12**  
**Errata to a Previous Year's ARERR Example**

McGuire Nuclear Station Units 1 & 2  
Period 1/1/2015 - 12/31/2015

There are no changes to a previous year's ARERR.