DUKE POWER COMPANY

EMERGENCY DOSE ASSESSMENT MANUAL

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"Off-Site Dose Projections for
McGuire Nuclear Station"

K E Harris — Approved By

5/9/90 — Date

Rev. 5
May 9, 1990

OFF-SITE DOSE PROJECTIONS FOR McGUIRE NUCLEAR STATION

1.0 Purpose

1.1 To describe a method for projecting dose commitment from a noble gas and/or iodine release, through the containment, the unit vent and/or the steam relief valves, during an emergency. Where appropriate, the Dose Assessment Coordinator, or designee, may deviate from this procedure due to varying plant conditions.

2.0 References

2.1 HP/0/B/1003/08, Determination of Radiation Monitor Setpoints (EMF's).

2.2 HP/0/B/1009/02, Alternative Method for Determining Dose Rate Within the Reactor Building.

2.3 HP/0/B/1009/10, Releases of Liquid Radioactive Material Exceeding Technical Specifications.

2.4 HP/1/B/1009/15 and HP/2/B/1009/15, Post-Accident Containment Air Sampling System Operating Procedures.

2.5 HP/0/B/1009/06, Procedure for Quantifying High Level Radioactivity Releases During Accident Conditions.

2.6 McGuire Nuclear Station Technical Specifications 3.6.1.2.

2.7 Offsite Dose Calucation Manual (ODCM).

2.8 Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors".

2.9 Regulatory Guide 1.109, "Calculations of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I".

2.10 NuReg-0396, EPA 520/1-78-016, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants".

2.11 NuReg-0654, FEMA-REP-1,Rev.1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants".

2.12 Letter from F.G. Hudson; September 30, 1985, re: Release Rate Information from McGuire and Catawba Nuclear Station.

2.13 McGuire Nuclear Station Class A Computer Model Validation.

3.0 Limits and Precautions

3.1 This procedure is an alternative method of dose assessment to the Class A Atmospheric Dispersion Model computer code.

3.2 This procedure applies to releases made from McGuire Nuclear Station only. Many of the values contained in this procedure are site specific.

3.3 It is assumed that the whole body dose from an iodine release is very small compared to the thyroid dose; therefore, iodine whole body dose is not considered here.

3.4 This procedure considers all releases to be ground level releases and that all meteorological data are 15 minute averages.

3.5 Once a zone has been added to the list of affected zones, it shall not be removed except under the direction of the Dose Assessment Coordinator.

3.6 Once the Crisis Management Center (CMC) has been activated, the doses calculated by the Technical Support Center (TSC) dose assessment group, shall be compared with those calculated by the CMC before an evacuation recommendation is made.

3.7 EMF's 38, 39, and 40 will isolate on a phase A containment isolation (1 psig in containment). Therefore, EMF's 38L, 38H, 39L, 39H, 40 and 48 should not be considered valid when containment pressure is $\geq$ 1 psig.

3.8 The sample pump to EMF's 35, 36, and 37 will trip when there is a Trip 1 on EMF 36 HH. Therefore, EMF's 35L, 35H, 36L, 36H, and 37 should not be considered valid when EMF 36 HH is $\geq$ Trip 1 (usually set at 5-7 R/Hr).

4.0 Procedure

NOTE: Much of the information for the meteorology assessment can be obtained on the OAC, (Tech. Spec. 04 program). See Enclosure 5.14 for instructions.

4.1 Meteorology Assessment

4.1.1 Acquire the following information and record on the Dose Assessment Report and Meteorology Worksheet (Enclosures 5.1 and 5.2 respectively).

4.1.1.1 Lower tower wind speed (WS) in miles per hour.

4.1.1.1.1 Use upper tower wind speed if lower tower wind speed is not available.

4.1.1.2 Upper tower wind direction in degrees from North (North = 0).

4.1.1.2.1 Use lower tower wind direction if upper tower wind direction is not available.

4.1.1.2.2 If the wind speed or wind direction can not be obtained from plant systems, obtain them from the National Weather Service (phone 399-6000). If the NWS information is unavailable, then obtain data from the CNS Control Room (8-831-2338).

4.1.1.3 Temperature gradient (ΔT) in degrees centigrade.

4.1.1.4 Using Enclosure 5.3, determine the stability class based on ΔT. If ΔT is unknown, then the following applies:

4.1.1.4.1 If between 1000 - 1600 hours, use stability class D;

4.1.1.4.2 If between 1600 - 1000 hours, use stability class G.

4.1.1.5 If necessary, use forecasted meteorological data for calculating doses due to changing meteorological conditions.

4.1.2 Determine the atmospheric dispersion parameters, $\overline{X/Q}$ (sec/m^3), for .5, 2, 5 and 10 miles (record on Enclosure 5.1).

4.1.2.1 Using ΔT, determine the two hour relative concentration value (C_H) from Enclosure 5.3.

4.1.2.2 Convert the C_H values to X/Q:

$$\overline{X/Q} = \frac{C_H}{\overline{WS}}$$

4.1.3 Using Enclosure 5.4, circle on Enclosure 5.1 the protective action zones (PAZ), based upon wind speed and wind direction.

4.1.4 Recheck meteorological conditions approximately every 15 minutes to ensure that other zones have not been affected.

4.2 Source Term Assessment - Steam Relief Valves (Enclosure 5.5)

NOTE: Much of the information for Steam Relief Valve source term assessment can be obtained from the OAC (General 19 program). See Enclosure 5.14 for instructions.

4.2.1 Determine the Sub-Noble Gas Release Rates, SQ_{NG} (Ci/sec), by the following method:

4.2.1.1 For Unit 1 - EMF24, EMF25, EMF26 and EMF27
For Unit 2 - EMF10, EMF11, EMF12, and EMF13

$$SQ_{NG} = mR/hr \times \frac{1}{VOPEN} \times LBM \times CF$$

where:

mR/hr = EMF reading
Unit 1 = EMF's 24, 25, 26, 27
Unit 2 = EMF's 10, 11, 12, 13
VOPEN = time the valve is open in seconds
LBM = lbm released for the time the valve was open
CF = the correction factor per Enclosure 5.6

$$\text{Units} = \frac{Ci}{lbm\ mR/hr}$$

4.2.2 Determine the Noble Gas Release Rate, Q_{NG} (Ci/sec):

$$Q_{NG} = SQ_{NG} \text{ (1EMF24 or 2EMF10)} + SQ_{NG} \text{ (1EMF25 or 2EMF11)} + SQ_{NG} \text{ (1EMF26 or 2EMF12)} + SQ_{NG} \text{ (1EMF27 or 2EMF13)}$$

4.2.3 Determine the Iodine release rate, Q_I (Ci/sec):

$$Q_I = Q_{NG} \times \text{I/Xe ratio}$$

where:

I/Xe ratio = ratio of I-131 eqv./Xe-133 eqv. from Enclosure 5.7

4.2.4 Record Q_{NG} and Q_I from the steam relief valves on Enclosure 5.1.

4.3 Source Term Assessment - Containment (Enclosure 5.8)

NOTE: Some of the information for Containment source term assessment can be obtained from the OAC (Tech Spec 04 program). See Enclosure 5.14 for instructions.

4.3.1 Determine the Noble Gas Release Rate, Q_{NG} (Ci/sec) based on one of the following methods:

NOTE: See Limit and Precaution 3.7.

4.3.1.1 Based on an EMF reading, where;

$$Q_{NG} = EMF \times CF \times LR$$

where:

EMF = 39(L), if EMF39(L) < 1E7 cpm,

EMF = 39(H), if EMF39(L) is offscale and EMF39(H) > 100 cpm,

EMF = 51A or 51B; if EMF39(H) is offscale

CF = the correction factor per Enclosure 5.9

LR = Leak Rate, (ml/hr) by one of the following methods:

based on containment pressure:

LR = RLR (from Enclosure 5.10)

based on an opening in containment:

LR = OIC (from Enclosure 5.11)

based on design leak rate:

LR = 1.714E5 (reference 2.13) assuming bypass leakage of 0.07.

4.3.1.2 Based on PAGS sample or sample collected in accordance with reference 2.5, where;

$$Q_{NG} = \text{Conc.} \times CF \times LR$$

where:

Conc = the Xe-133 equivalent concentration (μCi/ml) from Reference 2.4 or 2.5

CF = 2.78E-10 $\frac{\text{Ci hr}}{\text{sec } \mu\text{Ci}}$

LR = leak rate, as determined in step 4.3.1.1 above

4.3.2 Determine the Iodine Release Rate Q_I (Ci/sec), based on one of the following methods:

4.3.2.1 Based on Q_{NG};

$$Q_I = Q_{NG} \times \text{I/Xe ratio}$$

where:

Q_{NG} = noble gas release rate as

determined in Step 4.3.1 above

I/Xe ratio = ratio of I-131 eqv./Xe-133 eqv. from Enclosure 5.7.

4.3.2.2 Based on EMF40:

$$Q_I = \frac{\Delta CPM}{\Delta min} \times 6.54E\text{-}20 \frac{Ci\ hr\ min}{sec\ ml\ cpm} \times LR$$

where:

ΔCPM = reading from EMF40

Δmin = the time interval for EMF40 observation (normally 15 minutes)

LR = leak rate as determined in step 4.3.1.1 above

6.54E-20 = (4.0E-5 μCi/cpm x .1667 min/ft^3 x 3.53E-5 ft^3/ml x 1Ci/1E6 μCi x 1 hr/3600 sec)

4.0E-5 = correlation factor for EMF40 from Reference 2.1

.1667 min/ft^3 = inverse of EMF flow rate

4.3.2.3 Based on PAGS sample or sample collected in accordance with reference 2.5.

$$Q_I = Conc \times 2.78E\text{-}10 \frac{Ci\ hr}{sec\ \mu Ci} \times LR$$

where:

Conc = I-131 equivalent concentration (μCi/ml) from Reference 2.4 or reference 2.5

LR = leak rate as determined in step 4.3.1.1 above

4.3.3 Record Q_{NG} and Q_I from containment on Enclosure 5.1.

4.4 Source Term Assessment - Unit Vent (Enclosure 5.12)

NOTE: Some of the information for Unit Vent source term assessment can be obtained from the OAC (Tech Spec 04 program). See Enclosure 5.14 for instructions.

4.4.1 Determine the Noble Gas Release Rate, Q_{NG} (Ci/sec), based on one of the following methods:

4.4.1.1 Based on an EMF reading, where

NOTE: See Limit and Precaution 3.8.

$$Q_{NG} = EMF \times CF \times CFM$$

where:

EMF = 36(L) if EMF36(L) < 1E7 cpm

EMF = 36(H) if EMF36(L) is offscale and EMF36(H) is > 100 cpm

EMF = 36(HH) if EMF36(H) is offscale

CF = the correction factor per Enclosure 5.13

CFM = unit vent flow rate (ft^3/min)

4.4.1.2 Based on unit vent sample, where;

$$Q_{NG} = Conc. \times CF \times CFM$$

where:

Conc = the Xe-133 equivalent concentration (μCi/ml) from Reference 2.5

CF = 4.72E-4 $\frac{Ci\ min\ ml}{sec\ ft^3\ \mu Ci}$

CFM = Unit vent flow (ft^3/min)

4.4.2 Determine the Iodine Release Rate Q_I (Ci/sec) based on one of the following methods:

4.4.2.1 Based on Q_{NG};

$$Q_I = Q_{NG} \times I/Xe\ ratio$$

where:

Q_{NG} = noble gas release rate as determined in step 4.4.1 above

I/Xe ratio = ratio of I-131 eqv./Xe-133 eqv. from Enclosure 5.7

4.4.2.2 Based on EMF37:

$$Q_I = \frac{\Delta CPM}{\Delta min} \times 1.11E\text{-}13 \frac{Ci\ min\ min}{sec\ ft^3\ cpm} \times CFM$$

where:

ΔCPM = reading from EMF37

Δmin = the time interval for EMF37 observation (normally 15 minutes)

CFM = unit vent flow (ft^3/min)

1.11E-13 = (4.0E-5 μCi/cpm x .1667 min/ft^3 x 1 Ci/1E6 μCi x 1 min/60 sec)

4.0E-5 = correlation factor for EMF 37 from Reference 2.1

.1667 ft^3/min = inverse of EMF flow rate

4.4.2.3 Based on unit vent sample:

$$Q_I = Conc \times 4.72E\text{-}4 \frac{Ci\ min\ ml}{sec\ ft^3\ \mu Ci} \times CFM$$

where:

Conc = I-131 equivalent concentration (μCi/ml) from Reference 2.5

CFM = unit vent flow rate (ft^3/min)

4.4.3 Record Q_{NG} and Q_I from the unit vent on Enclosure 5.1.

4.5 Dose Assessment (Enclosure 5.1)

4.5.1 Determine the total Noble Gas and Iodine Release Rates (TQ_{NG} and TQ_I) by summing Q_{NG} and Q_I from all releases.

4.5.2 Determine the Projected Whole Body Dose Rate, DRwb (Rem/hr), due to noble gases for .5, 2, 5 and 10 miles:

$$DRwb = \overline{X/Q} \times TQ_{NG} \times 33.6 \frac{\text{Rem m}^3}{\text{hr Ci}}$$

where:

33.6 is the adult whole body dose conversion factor from Reference 2.9 in $\frac{\text{Rem m}^3}{\text{hr Ci}}$

4.5.3 Determine the Projected Whole Body Dose, Dwb (rem), due to noble gases for .5, 2, 5 and 10 miles:

$$Dwb = DRwb \times 2 \text{ hr}$$

where:

dose is integrated over 2 hour time period

4.5.4 Determine the Projected Child Thyroid Dose Rate, DRct (Rem/hr), due to iodine for .5, 2, 5 and 10 miles:

$$DRct = \overline{X/Q} \times TQ_{I} \times 2.26E6 \frac{\text{Rem m}^3}{\text{hr Ci}}$$

where:

2.26E6 is the child thyroid dose conversion factor from Reference 2.13 in $\frac{\text{Rem m}^3}{\text{hr Ci}}$

4.5.5 Determine the Projected Child Thyroid Dose, Dct(Rem), due to iodine for .5, 2, 5 and 10 miles:

$$Dct = DRct \times 2 \text{ hr}$$

where:

dose is integrated over 2 hour time period

4.6 Protective Action Recommendations (Enclosure 5.1, page 2 of 2):

4.6.1 Record the next sequential report number.

4.6.2 Circle the PAZs and the actions for the current and previous protective action recommendations.

4.6.3 If the projected dose in a PAZ is < 1 Rem whole body and < 5 Rem thyroid, then recommend no protective action (action A).

4.6.4 If the projected dose in a PAZ is 1 - 5 Rem whole body or 5 - 25 Rem thyroid, then recommend evacuation of children and pregnant women and shelter others (action B and E).

4.6.5 If the projected dose in a PAZ is > 5 Rem whole body or > 25 Rem thyroid, then recommend evacuation of everyone (action C).

4.6.6 If the dose rate at the site boundary is $\geq$ 5.0E-4 Rem/hr whole body, then recommend an Alert.

4.6.7 If the dose rate at the site boundary is $\geq$ .05 Rem/hr whole body or $\geq$ .25 Rem/hr thyroid, then recommend a Site Area Emergency if readings last 30 minutes.

4.6.8 If the dose rate at the site boundary is $\geq$ .5 Rem/hr whole body or $\geq$ 2.5 Rem/hr thyroid, then recommend a Site Area Emergency if readings last 2 minutes.

4.6.9 If the dose rate at the site boundary is $\geq$ 1 Rem/hr whole body of $\geq$ 5 Rem/hr thyroid, then recommend a General Emergency.

5.0 Enclosures

5.1 Dose Assessment Report

5.2 Meteorology Worksheet

5.3 Two-hour Relative Concentration Factors (C_H)

5.4 Protective Action Zones Determination

5.5 Source Term Assessment - Steam Relief Valves

5.6 EMF24, EMF25, EMF26, EMF27 or EMF10, EMF11, EMF12, EMF13 Noble Gas Correction Factors (Steam Line Monitors)

5.7 I-131 eqv./Xe-133 eqv. Ratio

5.8 Source Term Assessment - Containment

5.9 Containment Monitors - Correction Factors

5.10 Containment Leakage Rate versus Pressure

5.11 Containment Leakage Rate versus Pressure and Size Opening

5.12 Source Term Assessment - Unit Vent

5.13 Unit Vent Monitors - Correction Factors

5.14 OAC Instructions

McGUIRE NUCLEAR STATION
DOSE ASSESSMENT REPORT

t • _____

Report # _____

Reactor Trip _____/_____ (date/time)

Projection based on data on _____/_____ (date/time)

Prepared by: _____

Meteorology Assessment [ ] Current [ ] Hypothetical

Wind Speed _____ mph

Wind Direction _____ degrees from North

Temperature Gradient (ΔT) _____ C

Stability Class A B C D E F G

Miles	0 - 2	2 - 5	5 - 10
PAZ	L B M C	N A D O R	E F G H I J K P Q S

Total Source Term Assessment [ ] Current [ ] Hypothetical

Steam Relief Enclosure 5.5		Containment Enclosure 5.8		Unit Vent Enclosure 5.12		Total (Ci/sec)	
_____ Ci/sec	+	_____ Ci/sec	+	_____ Ci/sec	=	_____	= TQ_{NG}
_____ Ci/sec	+	_____ Ci/sec	+	_____ Ci/sec	=	_____	= TQ_I

Dose Assessment

$\frac{C_H}{WS} = \overline{X/Q}$

<---< Adult whole body <---<

2 hr Dose (rem) <--< 2 x DRwb (rem/hr) <--< 33.6 x TQ_{NG} (Ci/sec) x $\overline{X/Q}$

>---> Child thyroid >--->

$\overline{X/Q}$ x TQ_I (Ci/sec) x 2.26E6 >--> DRct (rem/hr) x 2 >--> 2 hr Dose (rem

				TQ_{NG}	$\overline{X/Q}$ (sec/m³) Distance miles		TQ_I				
_____	= 2 x	_____	= 33.6 x	_____	.5	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	2	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	5	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	10	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	1	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	4	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	7	_____	_____	x 2.26E6 =	_____	x 2 =	_____
_____	= 2 x	_____	= 33.6 x	_____	8	_____	_____	x 2.26E6 =	_____	x 2 =	_____

Field Data

Adult whole body

Location	Dose Rate Rem/hr	2hr Dose Rem
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Child thyroid

Location	Dose Rate Rem/hr	2hr Dose Rem
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Emergency [ ] Drill

McGUIRE NUCLEAR STATION
DOSE ASSESSMENT REPORT

To: Emergency Coordinator _____ Report # _____

The emergency condition:

_____ (a) Does not involve the release of radioactive material from the plant.
_____ (b) Involves the potential for a release, but no release has occurred.
_____ (c) Involves the release of radioactive material.

The following protective actions are recommended:

Miles	PAZ	Current Actions	Previous Actions
0 - 2	L,B,M,C	A B C E	A B C E
2 - 5	N,A,D,O,R	A B C E	A B C E
5 - 10	E,F,G,H,I,J,K,P,Q,S	A B C E	A B C E

A - Monitor environmental radiation levels. No specific actions.
(Less than 1 Rem Whole Body and less than 5 Rem Thyroid)

B - Remain indoors with windows closed, turn off air conditioners and other ventilation, monitor EBS stations. Control access. (Action E also)
(1-5 Rem Whole Body or 5-25 Rem Thyroid)

C - Evacuate; seek shelter if immediate evacuation is not possible. Monitor environmental radiation levels. Control access.
(Greater than 5 Rem Whole Body or greater than 25 Rem Thyroid)

E - Pregnant women and children evacuate and go to designated shelter.
(1-5 Rem Whole Body or 5-25 Rem Thyroid)

* - based on field data

Emergency Classification based on Radiological Data

[ ] Recommend Alert
(Dose rate at 0.5 miles is > .5 mR/hr Whole Body)

[ ] Potential Site Area Emergency if readings last 30 minutes
[ ] Recommend Site Area Emergency Now, readings have lasted 30 minutes
(Dose rate at 0.5 miles is > .05 Rem/hr Whole Body or > .25 Rem/hr Thyroid)

[ ] Recommend Site Area Emergency if readings last 2 minutes
(Dose rate at 0.5 miles is > .5 Rem/hr Whole Body or > 2.5 Rem/hr Thyroid)

[ ] Recommend General Emergency
(Dose rate at 0.5 miles is > 1 Rem/hr Whole Body or > 5 Rem/hr Thyroid)

Comments:

_____
_____
_____
_____

Doses concur with CMC? (Yes/No/NA)

_____ /
Dose Assessment Coordinator Date/Time

[ ] Emergency
[ ] Drill

McGUIRE NUCLEAR STATION
METEOROLOGY

Unit: _____ Report #: _____

Reactor Trip: ____/____

Prepared by: _____

Wind speed (WS) _____ mph

Wind direction _____ °N

ΔT _____ °C

Default Data

1000 to 1600 hrs.	Wind speed (WS) _____	mph
	Wind direction _____	°N
	Stability Class ___D___	°C
1600 to 1000 hrs.	Wind speed (WS) _____	mph
	Wind direction _____	°N
	Stability Class ___G___	°C

NOTE: If the wind speed or wind direction cannot be obtained from plant systems, obtain them from the National Weather Service, 399-6000. If NWS information is unavailable, then obtain data from the Catawba Nuclear Station Control Room, 8-831-2338.

McGUIRE NUCLEAR STATION

TWO-HOUR RELATIVE CONCENTRATION FACTORS (C_H)

Temperature Gradient	Stability Class	Distance (Miles)										
		.5	1	2	3	4	5	6	7	8	9	10
1) $\Delta T < -.6$	A	1.4E-5	1.2E-6	5.9E-7	4.1E-7	3.2E-7	2.5E-7	2.0E-7	1.9E-7	1.8E-7	1.6E-7	1.5E-7
2) $-.6 \leqq \Delta T < -.5$	C	1.5E-4	4.5E-5	1.3E-5	6.3E-6	3.9E-6	2.7E-6	1.9E-6	1.4E-6	1.1E-6	8.3E-7	7.8E-7
3) $-.5 \leqq \Delta T < -.2$	D	3.8E-4	1.4E-4	4.9E-5	2.7E-5	1.7E-5	1.2E-5	9.2E-6	7.3E-6	6.0E-6	5.0E-6	4.3E-6
4) $-.2 \leqq \Delta T < +.4$	E	6.9E-4	2.5E-4	9.6E-5	5.5E-5	3.5E-5	2.5E-5	2.0E-5	1.6E-5	1.3E-5	1.1E-5	9.7E-6
5) $+.4 \leqq \Delta T < +1.2$	F	1.1E-3	5.1E-4	2.0E-4	1.2E-4	8.2E-5	6.3E-5	5.1E-5	4.3E-5	3.8E-5	3.3E-5	3.0E-5
6) $+1.2 \leqq \Delta T$	G	1.8E-3	1.1E-3	4.3E-4	2.7E-4	2.0E-4	1.7E-4	1.3E-4	1.2E-4	8.6E-5	7.8E-5	7.3E-5

NOTE: If ΔT is unavailable use: 1000-1600 hours Use Stability Class D

1600-1000 hours Use STability Class G

There is no B Stability Class for McGuire.

McGUIRE NUCLEAR STATION

PROTECTIVE ACTION ZONES DETERMINATION

Determine the affected zones (based on wind direction) from the table below and record on Enclosure 5.1.

NOTE: If wind speed is less than or equal to 5 mph - the affected zones for 0 - 5 miles shall be L,B,M,C,N,A,D,O,R

Wind Direction Degrees from North)	0 - 5 Miles	5 - 10 Miles
0 - 22.5	L,B,M,C,D,O,R	E,S,F
22.6 - 45.0	L,B,M,C,D,O,R	E,Q,S
45.1 - 67.5	L,B,M,C,D,O,R	E,Q,S
67.6 - 90.0	L,B,M,C,D,O,R,N	P,Q,S
90.1 - 112.5	L,B,M,C,O,R,N	K,P,Q,S
112.6 - 135.0	L,B,M,C,O,N,R,A	I,K,P,Q,S
135.1 - 157.5	L,B,M,C,O,A,N	I,K,P,Q
157.6 - 180.0	L,B,M,C,A,N	I,J,K,P
180.1 - 202.5	L,B,M,C,A,N	G,H,I,J,K,P
202.6 - 225.0	L,B,M,C,A,N,D	G,H,I,J,K,P
225.1 - 247.5	L,B,M,C,A,D	F,G,H,I,J
247.6 - 270.0	L,B,M,C,A,D	F,G,H,I,J
270.1 - 292.5	L,B,M,C,A,D	E,F,G,H,J
292.6 - 315.0	L,B,M,C,A,D	E,F,G
315.1 - 337.5	L,B,M,C,D,R	E,F,G
337.6 - 359.9	L,B,M,C,D,R	E,F,S

EDA-3
Enclosure 5.5
(BLUE)

McGUIRE NUCLEAR STATION
SOURCE TERM ASSESSMENT - STEAM RELIEF VALVES

Report # _____

Reactor Trip ____/____ (date/time)

Projection based on data on ____/____ (date/time)

Calculations based on _____ Melted Core _____ LOCA

NOBLE GAS

based on EMF24 or EMF10

_____ mR/hr x ___1___ / _____ sec x _____ lbm x _____ Ci*/lbm mR/hr = _____ Ci/sec

+

based on EMF25 or EMF11

_____ mR/hr x ___1___ / _____ sec x _____ lbm x _____ Ci*/lbm mR/hr = _____ Ci/sec

+

based on EMF26 or EMF12

_____ mR/hr x ___1___ / _____ sec x _____ lbm x _____ Ci*/lbm mR/hr = _____ Ci/sec

+

based on EMF27 or EMF13

_____ mR/hr x ___1___ / _____ sec x _____ lbm x _____ Ci*/lbm mR/hr = _____ Ci/sec

+

Total from all Steam Relief Valves, Q_{NG} = _____ Ci/sec

IODINE

From all Steam Relief valves

_____ Ci/sec(Q_{NG}) x _____ I-131 eqv./Xe-133 eqv. ratio (Enclosure 5.7) = _____ Ci/sec (Q_I)

[ ] Emergency [ ] Drill Prepared by: _____

EDA-3
Enclosure 5.6
(BLUE)

McGUIRE NUCLEAR STATION
STEAM LINE MONITOR
NOBLE GAS CORRECTION FACTOR
EMF24, EMF25, EMF26, EMF27 or
EMF10, EMF11, EMF12, EMF13

Time Since Trip (hrs)	Correction Factor
≥ 0	6.3820×10^{-3}
≥ 2	1.1255×10^{-2}
≥ 4	1.2763×10^{-2}
≥ 8	1.4736×10^{-2}
≥ 24	1.6476×10^{-2}
≥ 48	1.6476×10^{-2}
≥ 100	1.6476×10^{-2}
≥ 250	1.6476×10^{-2}
≥ 500	1.6476×10^{-2}
≥ 720	1.6476×10^{-2}

* units in $\frac{\text{Ci}}{\text{lbm mR/hr}}$

* Enclosure 5.6 is the correlation factor per Reference 2.13 x 2.83E4 $\frac{\text{ml}}{\text{ft}^3}$ x .41 $\frac{\text{ft}^3}{\text{lbm}}$ x $\frac{\text{Ci}}{\text{1E6 } \mu\text{Ci}}$

.41 = specific gravity of steam per Reference 2.13.

McGUIRE NUCLEAR STATION
I-131 eqv./Xe-133 eqv. Ratio

NOTE: For containment releases in which I/Xe ratio is utilized to determine I-131 equiv. concentration, apply the appropriate correction from the table below.

Time Since Trip (hrs)	Column 1 Ratio based on LOCA	Column 2 Ration based on Melted Core
≥ 0	2.91E-3	2.24E-3
≥ 2	3.61E-3	9.66E-3
≥ 4	4.05E-3	1.59E-2
≥ 8	4.64E-3	2.85E-2
≥ 24	5.08E-3	7.52E-2
≥ 48	5.11E-3	1.11E-1
≥ 100	5.42E-3	1.33E-1
≥ 250	7.00E-3	1.80E-1
≥ 500	1.09E-2	2.90E-1
≥ 720	1.53E-2	4.33E-1

* Enclosure 5.7 is from Reference 2.13.

NOTE: For vent releases in which I/Xe ratio is utilized to determine I-131 equiv. concentration, apply the appropriate correction from the table below:

1. LOCA, use column 1 (based on LOCA).
2. LOCA through charcoal filters, divide column 1 value by 100.
3. Core damage, use column 2 (based on Core Melt).
4. Core damage through charcoal filters, divide column 2 values by 100.
5. Tube rupture, use 1.53E-5. (Column 1 value at ≥ 720 hrs. divided by 1000).
6. New fuel accident, use 2.217E-4. (Column 2 value at ≥ 100 hrs. divided by 600).
7. Old fuel accident, use 7.217E-4. (Column 2 value at ≥ 720 hrs. divided by 600).
8. Gas decay tank, assume no radioiodine released, only noble gases are considered to be released from gas tank.

NOTE: For steam releases in which I/Xe ratio is utilized to determine I-131 equiv. concentration, apply the appropriate correction from the table below:

1. Design basis primary coolant, divide column 1 value by 100.
2. Iodine spiked primary coolant, use column 1.
3. Core damage, divide column 2 value by 100.

EDA-3
Enclosure 5.8
(YELLOW)

McGUIRE NUCLEAR STATION
SOURCE TERM ASSESSMENT - CONTAINMENT

Report # _____

Reactor Trip _____/_____ (date/time)

Projection based on data on _____/_____ (date/time)

Calculations based on _____ Melted Core _____ LOCA
Containment pressure _____ psig
LR = _____ ml/hr
LR based on: (circle one) Realistic Leak Rate

Opening in Containment
Opening size: _____

Design Leak Rate
(1.714E5) assuming
bypass leakage of 0.07

NOBLE GAS

based on (check one)

EMF39(L) [ ] if < 1E7 cpm

EMF39(H) [ ] if > 100 cpm

EMF51 [ ] if 39(H) is offscale

EMF		CF		LR		Q_{NG}
_____ cpm or R/hr	x	_____ (Encl. 5.9)	x	_____ ml/hr	=	_____ Ci/sec

based on PAGS sample

_____ µCi/ml x 2.78E-10 Ci hr/sec µCi x _____ mℓ/hr = _____ Ci/sec

IODINE

based on Q_{NG}

_____ Ci/sec x _____ I-131 eqv./Xe-133 eqv. ratio (Encl. 5.7) = Q_I _____ Ci/sec

based on EMF40

LR

_____ Δcpm / _____ Δmin x 6.54E-20 Ci hr min/sec ml cpm x _____ ml/hr = _____ Ci/sec

based on PAGS sample

_____ µCi/ml x 2.78E-10 Ci hr/sec µCi x _____ ml/hr = _____ Ci/sec

[ ] Emergency [ ] Drill

Prepared by: _____

McGUIRE NUCLEAR STATION
CONTAINMENT MONITORS NOBLE GAS CORRECTION FACTORS

EMF39L

Time Since Trip (hrs)	Correction Factor based on LOCA	Correction Factor based on Melted Core
≥ 0	6.394E-18	6.672E-17
≥ 2	6.394E-18	4.448E-17
≥ 4	6.394E-18	3.058E-17
≥ 8	6.394E-18	2.113E-17
≥ 24	6.394E-18	1.112E-17
≥ 48	6.394E-18	1.056E-17
≥ 100	6.394E-18	1.390E-17
> 250	6.394E-18	1.446E-17
≥ 500	6.394E-18	9.730E-18
≥ 720	6.394E-18	6.394E-18

Units in $\frac{\text{Ci hr}}{\text{sec ml cpm}}$

EMF39H

Time Since Trip (hrs)	Correction Factor based on LOCA	Correction Factor based on Melted Core
≥ 0	5.56E-14	1.429E-13
≥ 2	5.56E-14	1.003E-13
≥ 4	5.56E-14	1.232E-13
≥ 8	5.56E-14	1.195E-13
≥ 24	5.56E-14	7.339E-14
≥ 48	5.56E-14	6.060E-14
≥ 100	5.56E-14	5.699E-14
≥ 250	5.56E-14	5.588E-14
≥ 500	5.56E-14	5.560E-14
≥ 720	5.56E-14	5.560E-14

Units in $\frac{\text{Ci hr}}{\text{sec ml cpm}}$

EMF51 A or B

Time Since Trip (hrs)	Correction Factor based on LOCA	Correction Factor based on Melted Core
≥ 0	3.781E-10	1.190E-9
≥ 2	3.114E-10	5.894E-10
≥ 4	2.780E-10	4.726E-10
≥ 8	2.446E-10	3.392E-10
≥ 24	2.335E-10	1.890E-10
≥ 48	2.335E-10	1.668E-10
≥ 100	2.335E-10	1.612E-10
≥ 250	2.335E-10	1.557E-10
≥ 500	2.335E-10	1.251E-10
≥ 720	2.335E-10	1.056E-10

Units in $\frac{\text{Ci hr}}{\text{sec ml R/hr}}$

* Enclosure 5.9 is the correlation factor per Reference 2.13 x $\frac{\text{hr}}{\text{3600 sec}}$ x $\frac{\text{Ci}}{\text{1E6 μCi}}$

McGUIRE NUCLEAR STATION
CONTAINMENT LEAKAGE RATE VERSUS PRESSURE

PSIG	ml/hr
$\geq$ 0	1.460E4
$\geq$ 2	3.175E4
$\geq$ 4	5.821E4
$\geq$ 8	9.779E4
$\geq$ 10	1.114E5
$\geq$ 11	1.164E5
$\geq$ 12	1.199E5
$\geq$ 13	1.235E5
$\geq$ 14	1.260E5
= 15	1.285E5
> 15	Use design leak rate (1.714E5 mℓ/hr)

* Enclosure 5.10 is the realistic leakage rate (m^3/sec) per Reference 2.12 x 1E6 ml/m^3 x 3600 sec/hr x 0.07 (0.07 per Reference 2.6).

McGUIRE NUCLEAR STATION
CONTAINMENT LEAKAGE RATE VERSUS PRESSURE AND SIZE OPENING

1" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	2.209E8	>5.0	3.908E8	>12.5	5.862E8
>2.50	2.889E8	>7.5	4.588E8	>15.0	6.287E8
>3.75	3.483E8	>10.0	5.268E8		

For 2" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	8.496E8	>5.0	1.512E9	>12.5	2.243E9
>2.50	1.121E9	>7.5	1.784E9	>15.0	2.464E9
>3.75	1.342E9	>10.0	2.022E9		

For 4" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	3.144E9	>5.0	5.692E9	>12.5	8.496E9
>2.50	4.248E9	>7.5	6.797E9	>15.0	9.176E9
>3.75	5.098E9	>10.0	7.731E9		

For 6" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	7.137E9	>5.0	1.291E10	>12.5	1.937E10
>2.50	9.516E9	>7.5	1.529E10	>15.0	2.124E10
>3.75	1.138E10	>10.0	1.716E10		

For 8" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	1.257E10	>5.0	2.243E10	>12.5	3.381E10
>2.50	1.648E10	>7.5	2.634E10	>15.0	3.568E10
>3.75	1.971E10	>10.0	3.042E10		

For 12" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	2.719E10	>5.0	5.012E10	>12.5	7.476E10
>2.50	3.738E10	>7.5	5.947E10	>15.0	8.156E10
>3.75	4.452E10	>10.0	6.712E10		

For 18" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	5.522E10	>5.0	1.003E11	>12.5	1.529E11
>2.50	7.476E10	>7.5	1.189E11	>15.0	1.665E11
>3.75	8.836E10	>10.0	1.351E11		

For 34" diameter opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	1.869E11	>5.0	3.398E11	>12.5	5.132E11
>2.50	2.583E11	>7.5	4.078E11	>15.0	5.607E11
>3.75	3.093E11	>10.0	4.588E11		

For Personnel Hatch Opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	2.379E12	>5.0	4.690E12	>12.5	6.967E12
>2.50	3.398E12	>7.5	5.573E12	>15.0	7.646E12
>3.75	4.111E12	>10.0	6.372E12		

For Equipment Hatch Opening

PSIG	ml/hr	PSIG	ml/hr	PSIG	ml/hr
>1.25	1.121E13	>5.0	2.022E13	>12.5	3.059E13
>2.50	1.478E13	>7.5	2.379E13	>15.0	3.398E13
>3.75	1.767E13	>10.0	2.719E13		

* Enclosure 5.11 is the containment leakage for an opening size in standard cubic feet per min (scfm) x 2.83E4 ml/ft^3 x 60 min/hr.

EDA-3
Enclosure 5.12
(GREEN)

McGUIRE NUCLEAR STATION
SOURCE TERM ASSESSMENT - UNIT VENT

Report # _____

Reactor Trip _____/_____ (date/time)

Projection based on data on _____/_____ (date/time)

Calculations based on _____ Melted Core _____ LOCA

CFM = _____ ft^3/min

NOBLE GAS

based on (check one)

EMF36(L) [ ] if < 1E7 cpm

EMF36(H) [ ] if > 100 cpm

EMF36(HH) [ ] if 36(H) is offscale

EMF		CF		CFM		Q_{NG}
_____ cpm or R/hr	x	_____ (Encl. 5.13)	x	_____ $\frac{ft^3}{min}$	=	_____ $\frac{Ci}{sec}$

based on Unit Vent Sample

_____ µCi/ml x 4.72E-4 $\frac{Ci\ min\ ml}{sec\ ft^3\ \mu Ci}$ x _____ $\frac{ft^3}{min}$ = _____ $\frac{Ci}{sec}$

IODINE

based on Q_{NG}

_____ $\frac{Ci}{sec}$ x _____ I-131 eqv./Xe-133 eqv. ratio (Encl. 5.7) = _____ $\frac{Ci}{sec}$ Q_I

based on EMF37 CFM

_____ Δcpm / _____ Δmin x 1.11E-13 $\frac{Ci\ min\ min}{sec\ ml\ cpm}$ x _____ $\frac{ft^3}{min}$ = _____ $\frac{Ci}{sec}$

based on Unit Vent Sample

_____ µCi/ml x 4.72E-4 $\frac{Ci\ min\ ml}{sec\ ft^3\ \mu Ci}$ x _____ $\frac{ft^3}{min}$ = _____ $\frac{Ci}{sec}$

[ ] Emergency [ ] Drill

Prepared by: _____

McGUIRE NUCLEAR STATION
UNIT VENT MONITORS NOBLE GAS CORRECTION FACTORS

Correction Factors for Melted Core Accidents with or without charcoal.

Time Since Trip (hrs)	EMF36L based on Melted Core $\left(\frac{\text{Ci min}}{\text{sec ft}^3 \text{ cpm}}\right)$	EMF36H based on Melted Core $\left(\frac{\text{Ci min}}{\text{sec ft}^3 \text{ cpm}}\right)$	EMF 36HH based on Melted Core $\left(\frac{\text{Ci min}}{\text{sec ft}^3 \text{ R/hr}}\right)$
≥ 0	1.133E-10	2.426E-7	1.887E-3
≥ 2	7.552E-11	1.704E-7	1.179E-3
≥ 4	5.192E-11	2.091E-7	9.905E-4
≥ 8	3.587E-11	2.030E-7	6.367E-4
≥ 24	1.888E-11	1.246E-7	2.931E-4
≥ 48	1.794E-11	1.029E-7	2.405E-4
≥ 100	2.360E-11	9.676E-8	2.358E-4
≥ 250	2.454E-11	9.481E-8	2.358E-4
≥ 500	1.652E-11	9.440E-8	2.358E-4
≥ 720	1.086E-11	9.440E-8	2.358E-4

Correction Factors for All Other Accidents

Accident	EMF 36L $\left(\frac{\text{Ci min}}{\text{sec ft}^3 \text{ cpm}}\right)$	EMF 36H $\left(\frac{\text{Ci min}}{\text{sec ft}^3 \text{ cpm}}\right)$	EMF 36HH $\left(\frac{\text{Ci min}}{\text{sec ft}^3 \text{ R/hr}}\right)$
New Fuel	2.360E-11	9.676E-8	2.358E-4
All Other Accidents*	1.086E-11	9.440E-8	2.358E-4

*Accidents include LOCA with or without charcoal, Tube Rupture, WGDT, and Old Fuel.

* Enclosure 5.13 is the correlation factor per Reference 2.13 x

$$2.83E4 \frac{\text{ml}}{\text{ft}^3} \times \frac{\text{min}}{60 \text{ sec}} \times \frac{\text{Ci}}{1E6\ \mu\text{Ci}}$$

INSTRUCTIONS ON HOW TO OBTAIN DATA FROM THE OPERATOR AID COMPUTER OAC

1) Tech Spec 04 Program (Plant Data and Status Summary)

   a) At the OAC in the TSC or Computer Room, press [Tech Spec] 04
   b) Then press [Print] amd [Enter]
   c) The report will print out

2) General 19 Program (Main Steam Release Program)

   a) At the OAC in the TSC or Computer Room, press [General] 19
   b) Then press [Print] and [Enter]
   c) Using the arrow pointer keys, highlight "Main Steam Release" and press enter
   d) The report will print out