UNION ELECTRIC Callaway Plant	CALLAWAY PLANT EMERGENCY PREPAREDNESS DEPARTMENT CALCULATION COVER SHEET	EPCI - 94 - 05 Rev. 0
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I. SUBJECT:

Unit Vent Monitor Readings for Site and General Emergencies.

II. PURPOSE AND SCOPE:

A. Purpose

The purpose of this calculation is to determine unit vent monitor (GT-RE-21B) values, in μCi/sec, that will be used as indicators for determining whether a site or general emergency should be declared following a release of radioactive materials from the Callaway Plant unit vent.

B. Scope

This analysis will determine the release rate values for the unit vent monitor (GT-RE-21B) which will result in a Site Emergency or General Emergency based on new accident source terms (ref. 2) and criteria established in NUMARC/NESP-007 (ref. 1).

III. RESULTS:

A. Site Emergency

A value of ≥2.35E+8 μCi/sec should be used for a Site Emergency declaration in Group 1.C.1 of the EALs (ref. 3).

B. General Emergency

A value of ≥2.35E+9 μCi/sec should be used for a General Emergency declaration in Group 1.D.1 of the EALs (ref. 3).

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CHECKLIST	
Purpose & Scope	☒
Results	☒
Assumptions	☒
References	☒
Attachments	☒
Analysis	☒

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IV. ASSUMPTIONS:

1. For the Site and General Emergency values, it is assumed that all the activity released is from a Loss of Coolant accident. This is a conservative assumption, since the LOCA isotopic spectrum gives the lowest Unit Vent Release Rate Value for the projected dose at the EAB (using 100 mrem TEDE and 500 mrem CDE Thyroid).

2. A release duration of one hour is assumed. This is consistent with NUMARC EAL Guidance (ref. 1).

3. It is assumed that the release occurs with the reactor at 100% power. No holdup time in the containment or reactor building is used. Therefore, no decay of short-lived radionuclides is assumed.

4. An average X/Q value of 1.3E-6 sec/m^3 was used as an average of all wind directions from FSAR Table 2.3-82.

V. REFERENCES:

1. "Methodology for Development of Emergency Action Levels", NUMARC/NESP-007, Rev. 2, January, 1992.

2. "EP Dose Assessment Source Term", U.E. Calculation ZZ-341, Rev. 0, June, 1994.

3. "Classification of Emergencies", EIP-ZZ-00101, Rev. 17, June, 1994.

4. "PC Dose Calculation Bases", Calc EPCI-94-03, Rev. 0, September, 1994.

5. "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", EPA-400-R-92-001, October, 1991.

VI. ATTACHMENTS:

Attachment 1-a "Site and General Emergency Release Rate Values-LOCA".
Attachment 1-b "Site and General Emergency Release Rate Values-SGTR".

VII. ANALYSIS:

For the Site and General Emergency EAL Indicators, two source terms were evaluated; a LOCA into the auxiliary building and through the unit vent, and a Steam Generator Tube Rupture with a release through the condenser and then through the condenser air removal system to the unit vent. The bases for these source terms are provided in Reference 2.

The Site Emergency Action Level Indicator for "Abnormal Rad Levels/Radiological Effluent" as described in the NUMARC/NESP-007 EAL document (ref. 1) provides a corresponding integrated child thyroid dose of 500 mR and a whole body dose of 100 mR at the site boundary (EAB) as a basis for monitor values. For a general emergency based on the same event, the doses are 1000 mR (whole body) and 5000 mR (thyroid). The basis also references EPA Protective Action Guidelines for the 1:5 ratio for whole body and child thyroid doses. This EPA document has subsequently been updated (ref. 5) and now uses the adult thyroid as the limiting organ for radioiodines. The adult thyroid dose was used in this analysis.

Additionally, the NUMARC EAL bases document suggest that a one hour release duration be assumed in establishing values in the EAL. This duration was used in this analysis. Equation 1 of Reference 4 was used to derive the release rate for a LOCA and a filtered Steam Generator Tube Rupture. Results are provided in Attachment 1-a for the LOCA and Attachment 1-b for the filtered Steam Generator Tube Rupture. Based on these results, the thyroid dose from a LOCA has the most limiting release rate. These values are summarized in the results section of this analysis (Section II), and will be used as EAL Indicators for the Unit Vent Wide Range Gas Monitor (GT-RE-21B).

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EIP 0101

Site and General Emergency Release Rate Values
LOCA

ISOTOPE	ACTIVITY RELEASED (Ci)	% ACTIVITY Dec equiv	EPA-400 Table 5-1 TEDE DOSE RATE FACTOR rem-cm3/uCi-Hr	EPA-400 Table 5-4 Thyroid DOSE RATE FACTOR rem-cm3/uCi-Hr	Unit Conversion mrem-m3/rem-cm3	WEIGHTED TEDE DOSE RATE FACTOR mrem-m3/uCi-Hr	WEIGHTED Thyroid DOSE RATE FACTOR mrem-m3/uCi-Hr
Kr-83m	2.79E+03	0.002	0.00E+00		1.00E-03	0.00E+00	0.00E+00
Kr-85	2.62E+04	0.014	1.30E+00		1.00E-03	1.87E-05	0.00E+00
Kr-85m	1.44E+04	0.008	9.30E+01		1.00E-03	7.36E-04	0.00E+00
Kr-87	8.01E+03	0.004	5.10E+02		1.00E-03	2.25E-03	0.00E+00
Kr-88	2.52E+04	0.014	1.30E+03		1.00E-03	1.80E-02	0.00E+00
Kr-89	5.72E+02	0.000	1.20E+03		1.00E-03	3.77E-04	0.00E+00
I-131	2.37E+03	0.001	5.30E+04	1.30E+06	1.00E-03	6.90E-02	1.69E+00
Xe-131m	1.67E+04	0.009	4.90E+00		1.00E-03	4.50E-05	0.00E+00
I-132	1.16E+02	0.000	4.90E+03	7.70E+03	1.00E-03	3.12E-04	4.91E-04
I-133	8.24E+02	0.000	1.50E+04	2.20E+05	1.00E-03	6.79E-03	9.96E-02
Xe-133	1.65E+06	0.907	2.00E+01		1.00E-03	1.81E-02	0.00E+00
Xe-133m	2.54E+04	0.014	1.70E+01		1.00E-03	2.37E-04	0.00E+00
I-134	9.75E+01	0.000	3.10E+03	1.30E+03	1.00E-03	1.66E-04	6.97E-05
I-135	3.32E+02	0.000	8.10E+03	3.80E+04	1.00E-03	1.48E-03	6.93E-03
Xe-135	4.40E+04	0.024	1.40E+02		1.00E-03	3.39E-03	0.00E+00
Xe-135m	1.22E+03	0.001	2.50E+02		1.00E-03	1.68E-04	0.00E+00
Xe-138	4.82E+03	0.003	7.20E+02		1.00E-03	1.91E-03	0.00E+00
Total NG	1.82E+06	1.002			DOSE CONVERSION FACTOR	1.23E-01	1.80E+00
Total I2	3.74E+03						
I2/NG ratio	2.06E-03						

S.E.	X/Q sec/m3	Release Rate uCi/sec	DCF mrem-m3/uCi-hr	MCF Unitless	Release Duration hr	Dose mr
TEDE	1.30E-06	6.88E+08	1.23E-01	1.10	1	100
CDE Thy	1.30E-06	2.35E+08	1.80E+00	1.10	1	500

G.E.	X/Q sec/m3	Release Rate uCi/sec	DCF mrem-m3/uCi-hr	MCF Unitless	Release Duration hr	Dose mr
TEDE	1.30E-06	6.88E+09	1.23E-01	1.10	1	1000
CDE Thy	1.30E-06	2.35E+09	1.80E+00	1.10	1	5000

AT[redacted]

E[redacted]00101

Site and General E[redacted]ncy Release Rate Values

SGTR (filtered through Unit Vent)

ISOTOPE	ACTIVITY RELEASED (Ci)	Filter Corr. Fact	CORRECTED ACTIVITY RELEASED (Ci)	% ACTIVITY Dec. equiv.	EPA-400 Table 5-1 TEDE DOSE RATE FACTOR rem-cm3/uCi-Hr	EPA-400 Table 5-4 Thyroid DOSE RATE FACTOR rem-cm3/uCi-Hr	Unit Conversion mrem-m3/rem-cm3	WEIGHTED TEDE DOSE RATE FACTOR mrem-m3/uCi-Hr	WEIGHTED Thyroid DOSE RATE FACTOR mrem-m3/uCi-Hr
Kr-83m	4.82E+00	1	4.82E+00	0.004	0.00E+00		1.00E-03	0.00E+00	0.00E+00
Kr-85	1.77E+00	1	1.77E+00	0.001	1.30E+00		1.00E-03	1.72E-06	0.00E+00
Kr-85m	2.38E+01	1	2.38E+01	0.018	9.30E+01		1.00E-03	1.65E-03	0.00E+00
Kr-87	1.39E+01	1	1.39E+01	0.010	5.10E+02		1.00E-03	5.30E-03	0.00E+00
Kr-88	4.45E+01	1	4.45E+01	0.033	1.30E+03		1.00E-03	4.32E-02	0.00E+00
Kr-89	1.20E+00	1	1.20E+00	0.001	1.20E+03		1.00E-03	1.08E-03	0.00E+00
I-131	3.13E-01	.01	3.13E-03	0.000	5.30E+04	1.30E+06	1.00E-03	1.24E-04	3.04E-03
Xe-131m	4.19E+00	1	4.19E+00	0.003	4.90E+00		1.00E-03	1.53E-05	0.00E+00
I-132	1.07E-01	.01	1.07E-03	0.000	4.90E+03	7.70E+03	1.00E-03	3.92E-06	6.15E-06
I-133	4.37E-01	.01	4.37E-03	0.000	1.50E+04	2.20E+05	1.00E-03	4.90E-05	7.18E-04
Xe-133	1.14E+03	1	1.14E+03	0.852	2.00E+01		1.00E-03	1.70E-02	0.00E+00
Xe-133m	2.29E+01	1	2.29E+01	0.017	1.70E+01		1.00E-03	2.91E-04	0.00E+00
I-134	4.42E-02	.01	4.42E-04	0.000	3.10E+03	1.30E+03	1.00E-03	1.02E-06	4.29E-07
I-135	2.13E-01	.01	2.13E-03	0.000	8.10E+03	3.80E+04	1.00E-03	1.29E-05	6.05E-05
Xe-135	6.81E+01	1	6.81E+01	0.051	1.40E+02		1.00E-03	7.12E-03	0.00E+00
Xe-135m	3.11E+00	1	3.11E+00	0.002	2.50E+02		1.00E-03	5.81E-04	0.00E+00
Xe-137	2.15E+00	1	2.15E+00	0.002	1.10E+02		1.00E-03	1.77E-04	0.00E+00
Xe-138	1.05E+01	1	1.05E+01	0.008	7.20E+02		1.00E-03	5.65E-03	0.00E+00
Total NG	1.34E+03		1.34E+03	1.002			DOSE CONVERSION FACTC	8.23E-02	3.82E-03
Total I2	1.11E+00		1.11E-02						
I2/NG ratio	8.32E-04		8.32E-06						

S.E.	X/Q sec/m3	Release Rate uCi/sec	DCF mrem-m3/uCi-hr	MCF Unitless	Release Duration hr	Dose mr
TEDE	1.30E-06	1.03E+09	8.23E-02	1.10	1	100
CDE Thy	1.30E-06	1.11E+11	3.82E-03	1.10	1	500

G.E.	X/Q sec/m3	Release Rate uCi/sec	DCF mrem-m3/uCi-hr	MCF Unitless	Release Duration hr	Dose mr
TEDE	1.30E-06	1.03E+10	8.23E-02	1.10	1	1000
CDE Thy	1.30E-06	1.11E+12	3.82E-03	1.10	1	5000

TABLE 4-1
EMERGENCY ACTION LEVELS

Group 1 ABNORMAL RADIATION EVENTS
Offsite Events

UNUSUAL EVENT	ALERT	SITE EMERGENCY	GENERAL EMERGENCY
A. Any Unplanned Release of Radioactivity to the Environment That Exceeds **2 Times** the Radiological Effluent Control Limits in the ODCM, (APA-ZZ-01003) for ≥**60** minutes. MODES: At All Times	B. Any Unplanned Release of Radioactivity to the Environment That Exceeds **200 Times** the Radiological Effluent Control Limits in the ODCM, (APA-ZZ-01003) for ≥**15** minutes. MODES: At All Times	C. **EAB** Dose Resulting From an Actual or Imminent Release of Gaseous Radioactivity Exceeds **100 mrem** TEDE or **500 mrem** CDE Thyroid for the Actual or Projected Duration of the Release. MODES: At All Times	D. **EAB** Dose Resulting From an Actual or Imminent Release of Gaseous Radioactivity Exceeds **1000 mrem** TEDE or **5000 mrem** CDE Thyroid for the Actual or Projected Duration of the Release. MODES: At All Times
Indicators 1. All of the following: a. A valid alarm and reading on any effluent monitor: HB-RE-18 (Channel 186) GT-RE-21B (Channel 213) GH-RE-10B (Channel 103) b. The valid reading is 2 times the Hi Hi alarm setpoint (trip setpoint) value. c. The release cannot be terminated within 60 minutes of the alarm actuation. OR 2. Both of the following: a. Confirmed sample analysis indicates that a release exceeding 2 times the applicable values of the ODCM (APA-ZZ-01003), has occurred. b. The release cannot be terminated within 60 minutes.	**Indicators** 1. All of the following: a. A valid alarm and reading on any effluent monitor: HB-RE-18 (Channel 186) GT-RE-21B (Channel 213) GH-RE-10B (Channel 103) b. The valid reading is 200 times the Hi Hi alarm setpoint (trip setpoint) value. c. The release cannot be terminated within 15 minutes of the alarm actuation. OR 2. Both of the following: a. Confirmed sample analysis indicates that a release exceeding 200 times the applicable values of the ODCM (APA-ZZ-01003), has occurred. b. The release cannot be terminated within 15 minutes.	**Indicators** Any of the following: *1. A valid reading on the Unit Vent monitor, GT-RE-21B (Channel 213) > 2.35E+8 µCi/sec for 15 minutes. 2. A valid dose projection indicates >100 mrem TEDE or >500 mrem CDE thyroid dose at the **EXCLUSION AREA BOUNDARY** using inplant rad data or field monitoring team survey results. 3. Field survey results at the EAB corresponding to > 100 mrem/hr TEDE for 1 hour (or expected to continue for 1 hour) or > 500 mrem/hr CDE thyroid for 1 hour of inhalation. *Declare the event using this indicator only if an actual dose assessment per Indicator 2 cannot be performed in 15 minutes.	**Indicators** Any of the following: *1. A valid reading on the Unit Vent monitor GT-RE-21B (Channel 213) > 2.35E+9 µCi/sec for 15 minutes. 2. A valid dose projection indicates >1,000 mrem TEDE or >5000 mrem CDE thyroid dose at the **EXCLUSION AREA BOUNDARY** using inplant rad data or field monitoring team survey results. 3. Field survey results at the EAB corresponding to > 1,000 mrem/hr TEDE for 1 hour (or expected to continue for 1 hour) or > 5,000 mrem/hr CDE thyroid for 1 hour of inhalation. *Declare the event using this indicator only if an actual dose assessment per Indicator 2 cannot be performed in 15 minutes.