

WISCONSIN PUBLIC SERVICE CORPORATION

Kewaunee Nuclear Power Plant

EMERGENCY PLAN IMPLEMENTING PROCEDURE

NO. EP-ENV-3G

REV. D

TITLE: Manual Dose Projection  
Calculation

DATE: JUN 21 1983

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REVIEWED BY

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APPROVED BY

*[Signature]*

## 1.0 APPLICABILITY

This procedure will be utilized by the Environmental Protection Director during any incident that involves a significant release of radioactive materials to the environment, for the purpose of projecting a radiological dose impact.

## 2.0 PRECAUTIONS

- 2.1 Ensure all data on the forms of this procedure is accurately recorded.
- 2.2 Check all calculations for accuracy.

## 3.0 REFERENCES

- 3.1 U.S. NRC Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I, Revision 1, October 1977.
- 3.2 U.S. EPA, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA-520/1-75-001, September 1975. Appendix D Technical Bases for Methods the Estimate the Projected Thyroid Dose and Projected Whole Body Gamma Dose from Exposure to Airborne Radioiodines and Radioactive Noble Gases.

## 4.0 INSTRUCTIONS

### 4.1 Whole Body Dose Projection Estimate

If the source term is identified by sample results which quantifies specific nuclide content, then a conservative whole body dose estimate may be calculated using form ENV-3G.1, Estimated Whole Body Dose Calculation Worksheet.

- 4.1.1 Acquire the data needed for Section I of Form ENV-3G.1 from the RAF or TSC.

NOTE: Data Needed: Release rate of Noble gas in (Ci/sec), actual or estimated release duration, and X/Q from EP-ENV-3E or 3F.

- 4.1.2 Calculate the Whole Body Dose Projection Estimate using Section II of Form ENV-3G.1 and the following equation:

$$D(\text{REM}) = X/Q(\text{Sec}/\text{m}^3) \times Q(\text{Ci}/\text{Sec}) \times T(\text{hrs}) \times \frac{DF(\text{REM} - \text{m}^3)}{Ci - \text{hrs}}$$

where:

D = projected whole body dose estimate (REM)

X/Q = Atmospheric dispersion coefficient determined on Form ENV-3E.2 or ENV-3F.2 (Sec/m<sup>3</sup>)

Q = Nuclide equivalent release rate (Ci/Sec) from EP-RET-5  
(Flow rate (cc/sec) x conc. (uCi/cc) x 10E-06)

DF = Whole body dose conversion factor  $\frac{(\text{REM} - \text{m}^3)}{(Ci - \text{hrs})}$

NOTE: The whole body dose conversion factor is calculated from NRC Regulatory Guide 1.109, Rev 1, dated October 1977.

- 4.1.3 Field Sample Analysis Method (Marinelli Beaker of a Field Drawn RAP Sample).

Complete Sections I & II of Form ENV-3G.2 and the following equation:

$$D(\text{REM}) = FC \times DF \times T$$

where:

D = Is Dose in REM

DF = Whole body dose conversion factor  $\frac{(\text{REM} - \text{M}^3)}{(Ci - \text{hrs})}$

T = Release duration in hours

FC = Field Concentration of specific nuclide in uC/cc as per Gamma Scan result

NOTE: A separate Calculation Form is required for each point of interest.

#### 4.2 Thyroid Dose Projection Estimate

If an Iodine Source Term is identified, calculate the projected or estimated dose for each point of interest by using a separate Form ENV-3G.2 and one of the following methods.

##### 4.2.1 Inplant Sample Method

Complete Section I of Form ENV-3G.2 for each point of interest if the release rate of Iodine-131 (Ci/sec) is available for a thyroid dose projection estimate.

##### 4.2.2 Field Sample Analysis Method

Complete Section II of Form ENV-3G.3 for each point of interest if the actual measured Iodine-131 airborne concentration (uCi/cc) is available for a thyroid dose projection estimate. This method is also to be used as a backup for the Inplant Sample Method.

NOTE: This method assumes only Iodine-131 exposure, so it will only be an approximation of the total Iodine dose.

- 4.3 Record all results of Dose Projections by the method used on Form ENV-3A and the field map. Also, report this data to the Radiological Protection Director, Emergency Response Manager, and Technical Support Center Communicator.
- 4.4 Proceed to procedure EP-ENV-3H, Protective Action Recommendation Determination, to determine the appropriate Protective Action Recommendations.

FORM ENV-3G.1

ESTIMATED WHOLE BODY DOSE CALCULATION WORKSHEET  
FOR  
SPECIFIC NOBLE GAS RELEASE

LOCATION: Sector/Point # \_\_\_\_\_

DATE \_\_\_\_\_ TIME \_\_\_\_\_

I. Enter data available below:

A. (Record in Column 1 of section II below) Noble Gas Nuclides release rates  
(Data is available from the RPD or TSCD)

B. X/Q as determined and recorded on Form ENV-3E.2 or 3F.2 \_\_\_\_\_ (Sec/m<sup>3</sup>)

C. (Data available from RPD or TSCD) Release Duration \_\_\_\_\_ (hrs)

II. Calculate dose for each nuclide and sum all doses to get total exposure dose by using the formula below:

Nuclide	Release Rate (Ci/Sec)	x	X/Q(Sec/m <sup>3</sup> )	x	Release Duration(hrs)	x	Dose Factor (REM-m <sup>3</sup> ) (Ci-hr)	=	Dose (REM)
Kr-85		x		x		x	1.84	=	_____
Kr-85m		x		x		x	1.34 x 10 <sup>2</sup>	=	_____
Kr-87		x		x		x	6.76 x 10 <sup>2</sup>	=	_____
Kr-88		x		x		x	1.68 x 10 <sup>3</sup>	=	_____
Xe-133		x		x		x	3.36 x 10 <sup>1</sup>	=	_____
Xe-133m		x		x		x	2.87 x 10 <sup>1</sup>	=	_____
Xe-135		x		x		x	2.06 x 10 <sup>2</sup>	=	_____
Xe-135m		x		x		x	3.56 x 10 <sup>2</sup>	=	_____

Signature of Completing  
Authority and Title

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Title)

TOTAL WHOLE BODY  
EXPOSURE DOSE

= \_\_\_\_\_

FORM ENV-3G.2

FIELD SAMPLE ANALYSIS METHOD OF WHOLE BODY DOSE CALCULATION

LOCATION: Sector/Point # \_\_\_\_\_

DATE \_\_\_\_\_ TIME \_\_\_\_\_

Section I (Enter data available below)

A. Record the Field Concentrations of Gamma Scan Identified Noble Gases in Section II, Column I. (Data is available from RPO/RAF or TSCD)

B. Release Duration (actual or estimated) \_\_\_\_\_

Section II - Calculate doses for each nuclide and sum all doses to get total exposure dose by using the formula below.

<u>Nuclide</u>	<u>Field Concentration</u> (uCi/cc)	<u>Dose Factor</u> (REM-m <sup>3</sup> ) (Ci-hr)	<u>Release Duration</u> (hrs)	<u>Dose</u> (REM)
Kr-85	x	1.84	x	= _____
Kr-85m	x	$1.34 \times 10^2$	x	= _____
Kr-87	x	$6.76 \times 10^2$	x	= _____
Kr-88	x	$1.68 \times 10^3$	x	= _____
Xe-133	x	$3.36 \times 10^1$	x	= _____
Xe-133m	x	$2.87 \times 10^1$	x	= _____
Xe-135	x	$2.06 \times 10^2$	x	= _____
Xe-135m	x	$3.56 \times 10^2$	x	= _____

Signature of Completing  
Authority and Title

\_\_\_\_\_  
(Signature)

\_\_\_\_\_  
(Title)

TOTAL WHOLE  
BODY DOSE = \_\_\_\_\_

FORM ENV-3G.3  
ESTIMATED THYROID DOSE PROJECTION CALCULATION

LOCATION: Sector/Point # \_\_\_\_\_ DATE \_\_\_\_\_ TIME \_\_\_\_\_

I. INPLANT SAMPLE METHOD

- A. Iodine-131 Release Rates \_\_\_\_\_ (Ci/sec)  
B. X/Q at the point of interest from Form ENV-3E.2 or 3F.2 \_\_\_\_\_ (Sec/m<sup>3</sup>)  
C. Release Duration (Data available from RPD or TSCD) \_\_\_\_\_ (hrs)  
D. Calculated Iodine-131 Concentration at the point of interest.

Release Rate(Ci/Sec) x X/Q(Sec/m<sup>3</sup>) = uC/cc of I-131

\_\_\_\_\_ X \_\_\_\_\_ = \_\_\_\_\_ uC/cc of I-131

- E. Determine Estimated Total Thyroid Dose from Figure ENV-3G. Use the Calculated Iodine-131 Concentration on the X-axis and go vertically up the graph to intersect the appropriate Release Duration line, then read off the Y-axis the Estimated Total Thyroid Dose.

Calculated I-131 Concentration vs. Release Duration => Total Thyroid Dose

\_\_\_\_\_ uC/cc vs. \_\_\_\_\_ hrs => \_\_\_\_\_ REM

- F. Multiply Thyroid Dose (in REM) by 2 and make recommendation based on corrected thyroid dose.

Thyroid Dose (from step "E") x 2 = Corrected Thyroid Dose in REM.

\_\_\_\_\_ REM x 2 = \_\_\_\_\_ REM

NOTE: EPA Guidelines state that protective action recommendations based on thyroid dose should use the dose calculated for children in the affected population.



FORM ENV-3G.3  
ESTIMATED THYROID DOSE PROJECTION CALCULATION

II. FIELD SAMPLE ANALYSIS METHOD

- A. Field Sample Analysis I-131 Concentration at the point of interest \_\_\_\_\_ uC/cc
- B. Release Duration (Data available from the RPD or TSCD) \_\_\_\_\_ (hrs)
- C. Determine Estimated Total Thyroid Dose from Figure ENV-3G. Use the field sample analysis I-131 concentration on the X-axis and go vertically up the graph to intersect the appropriate Release Duration line, then read off the Y-axis the Estimated Total Thyroid Dose.

Field Sample Analysis

Iodine-131 Concentration vs. Release Duration => Total Thyroid Dose

\_\_\_\_\_ uC/cc vs. \_\_\_\_\_ hrs => \_\_\_\_\_ REM

- D. Multiply Thyroid Dose (in REM) by 2 and make recommendation based on corrected thyroid dose.

Thyroid Dose (from step "E") x 2 = Corrected Thyroid Dose in REM.

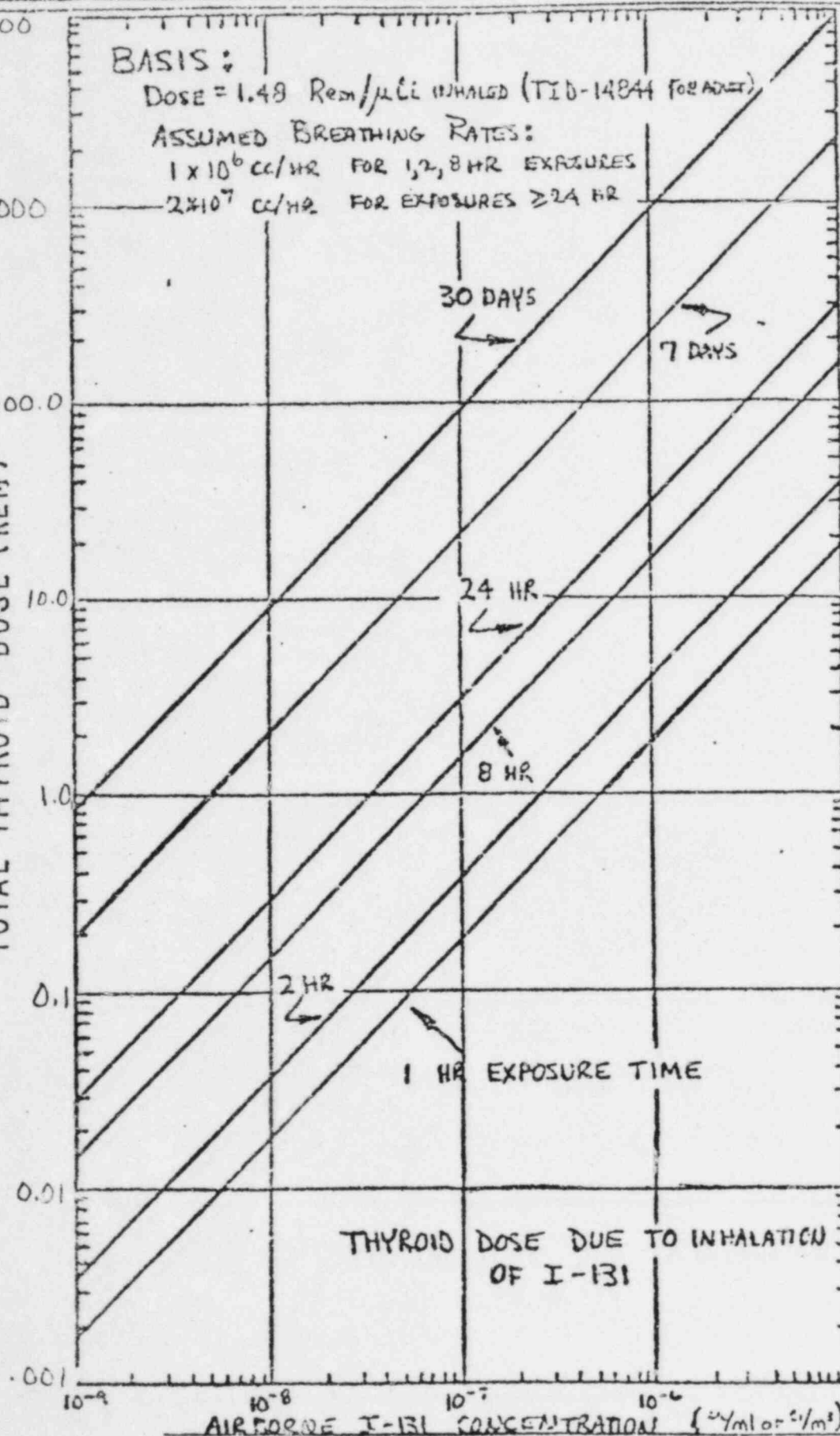
\_\_\_\_\_ REM x 2 = \_\_\_\_\_ REM

NOTE: EPA Guidelines state that protective action recommendations based on thyroid dose should use the dose calculated for children in the affected population.

COMPLETED BY \_\_\_\_\_

\_\_\_\_\_  
(Title)

FIGURE 3E  
TOTAL THYROID DOSE (REM)



- (1) Values are calculated using the old dose conversion for I-131. The new constant in the reference is  $1.5 \times 10^6$ . However, the old conversion,  $1.8 \times 10^6$ , is used for conservation
- (2) To approximate the child (6 months to one year worst case) thyroid dose from the