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IMPORTANT TO SAFETY
NON-ENVIRONMENTAL IMPACT RELATED

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THREE MILE ISLAND NUCLEAR STATION
UNIT NO. 1 EMERGENCY PLAN IMPLEMENTING PROCEDURE 1004.7
OFFSITE/ONSITE DOSE PROJECTIONS

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THREE MILE ISLAND NUCLEAR STATION
UNIT NO. 1 EMERGENCY PLAN IMPLEMENTING PROCEDURE 1004.7
OFFSITE/ONSITE DOSE PROJECTIONS

1.0 PURPOSE

The purpose of the procedure is to provide:

a. Techniques and methods for calculating projected doses (whole body, and thyroid dose equivalent which might result from monitored releases of radioactive materials from TMI Unit 1.

b. Techniques and methods for predicting the downstream concentrations of radioactive liquids resulting from a major accidental release of radioactive liquids to the Susquehanna Valley.

c. Contingency methods for estimating projected doses if monitors are out of service or off-scale high.

The Radiological Assessment Coordinator is responsible for implementing this procedure.

2.0 ATTACHMENTS

2.1	Attachment I	Dose Assessment Sheet
2.2	Attachment II	Meteorological Data
2.3	Attachment III	Calculation of the Source Term and Onsite/Offsite Dose Projections
2.4	Attachment IV	Contingency Calculations
2.5	Attachment V	Liquid Release Calculation
2.6	Attachment VI	Protective Action Guides
2.7	Attachment VII	Field Monitoring Nomograph
2.8	Attachment VIII	Computerized Dose Calculations
2.9	Attachment IX	High Range RMS Dose Calculations
2.10	Attachment X	Dose Conversion Factor Calculation

2.11 Attachment XI Hydrogen Purge Calculation

2.12 Attachment XII Thumbrules

3.0 EMERGENCY ACTION LEVELS

3.1 As required by an Emergency Plan Implementing Procedure.

3.2 As directed by the Emergency Director or his designee.

4.0 EMERGENCY ACTIONS

INITIALS

> NOTE: The minicomputer may be used in lieu of written hand calculations to determine dose projections. Utilize Attachment VIII "Computerized Dose Calculations" to operate the minicomputer.

> NOTE: Perform steps in order.
> If the release is radioactive materials to the atmosphere, perform Steps 4.1 - 4.5.
> If release is of radioactive liquids to the Susquehanna River perform Steps 4.6 - 4.8.

> NOTE: Refer to EPIP 1004.6, Additional Assistance and Notification, Attachment III (pg. 10.0) for back-up sources of meteorological information.

_____ 4.1 Complete the Meteorological section of the Dose Assessment Sheet by completing Attachment II.

_____ 4.2 Complete the Release section, Source Term and Dose Projection section of the Dose Assessment Sheet by completing forms on Attachment III. If High Range RMS is to be utilized then refer to Attachment IX. Use Attachment X if a DCF is to be calculated. Use Attachment XI for a Hydrogen Purge calculation. Use Attachment XII for a Thumbrule calculation.

_____4.3 Utilize Attachments VI and VII to evaluate Field Monitoring data and recommend Protective Action.

_____4.4 Utilize Attachment IV to project dose based upon contingency calculations.

_____4.5 Always report dose rate, dose, time used, and basis for the time estimate to the Emergency Director, or his designee.

_____4.6 Compile the expected downstream concentrations by performing the steps and completing the forms in Attachment V.

_____4.7 Compile the time for the flume to reach downstream users and a 24 hour average concentration by completing the remaining steps in Attachment V.

_____4.8 Report results to the Emergency Director or his designee.

ATTACHMENT I

DOSE ASSESSMENT SHEET

1.0 Meteorological Section

1.1 Time______________
1.2 Date______________
1.3 Wind Direction______________
1.4 Pasquil Stability Class______________

2.0 Release Section

2.1 Release Pathway______________
2.2 Monitor Designation______________

3.0 Source Term Calculation

10^{-6}	x	Meter Reading	x	Meter Conversion Factor	x	Ventilation Flowrate	=	Source Term
		(cpm or $\frac{cpm}{min}$)		$\left(\frac{uci/cc}{cpm\ or\ \frac{cpm}{min}}\right)$		$\left(\frac{cc}{sec}\right)$		$\left(\frac{Ci}{sec}\right)$
Noble Gas Channel		________	x	________	x	________	=	________
Radioiodine Channel		________	x	________	x	________	=	________

4.0 Onsite/Offsite Dose Projections

	Source Term	x	Dispersion Factor	x	$\frac{1}{\text{Wind Speed}}$ mph	x	Dose Conversion Factor	x	Estimated Duration	=	Dose
	$\left(\frac{Ci}{sec}\right)$	:	$\left(\frac{Sec}{m^3}\right)$	:	$\left(\frac{mph}{mph}\right)$	:	$\left(\frac{\frac{mrem}{hour}}{\frac{Ci}{m^3}}\right)$	:	(hours)	: =	mrem
Noble Gas Channel		x		x		x	4E5	x		=	
Radioiodine Channel		x		x		x	3E9	x		=	

Dose	Distance					
(mrem)	200m	400m	EA	2LPZ	5EPZ	10EPZ
Whole Body						
Thyroid						

ATTACHMENT II

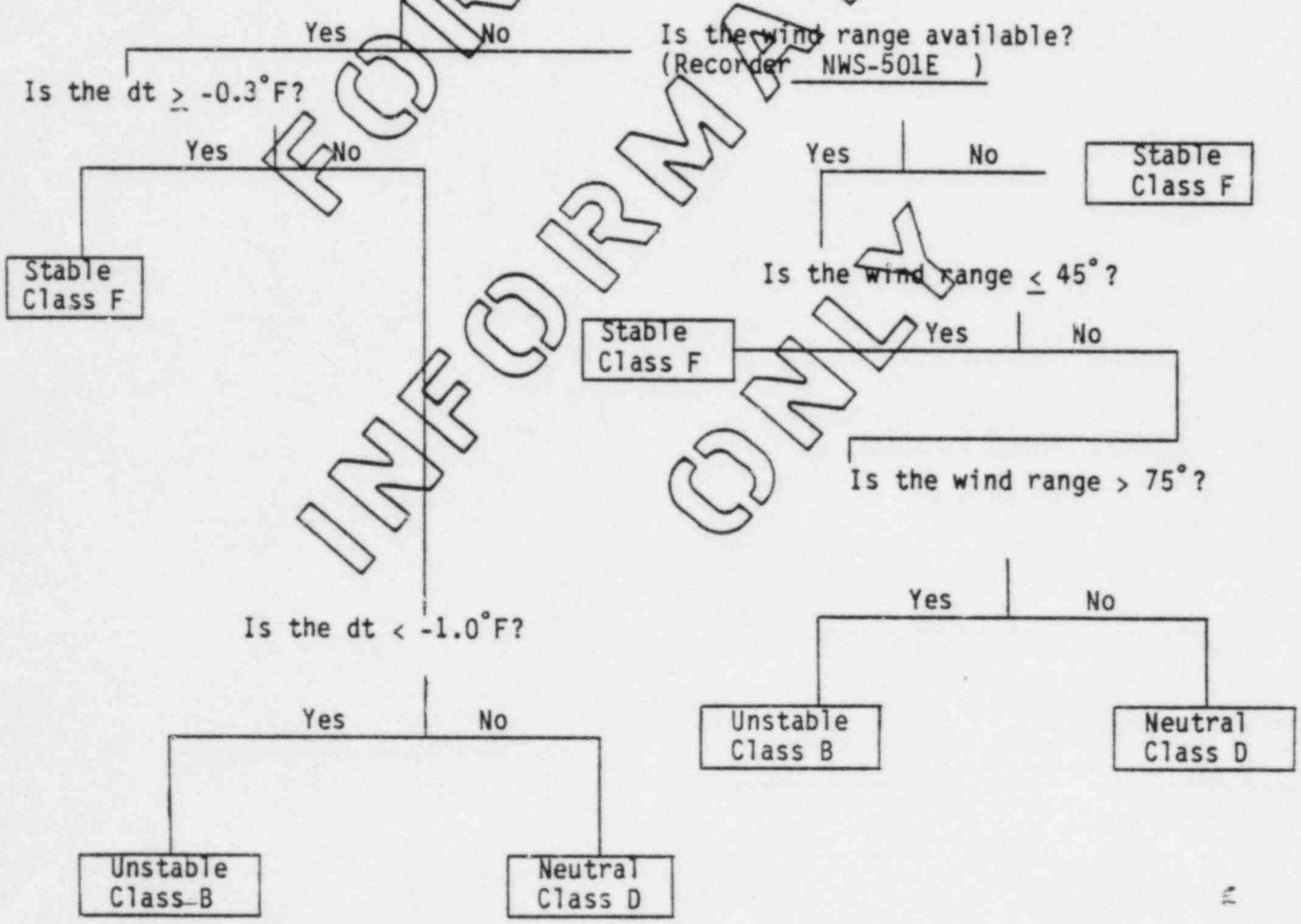
METEOROLOGICAL DATA

1. Record the following information on the Dose Assessment Sheet in the Meteorological section.

   1.1 Time of Day
   1.2 Date

   1.3 Wind Direction (per Recorder NWS-501E in degrees radian)
   1.4 Pasquil Stability Class (per the algorithm described below)

   Is the differential temperature (dt) available?
   (Recorder NWS-501E)



2. Determine the dispersion factors that correspond to the correct stability class from Table 1, Dispersion Factors. Record the dispersion factors on the Dose Assessment Sheet, in the Onsite/Offsite Dose Projection section.

Table 1, Dispersion Factors

Pasquil Stability Class	Distance					
	200m	400m	EA	2EPZ	5EPZ	10EPZ
B	7.7 E-4	2.75 E-4	1.1 E-4	2.2 E-6	7.4 E-7	4.7 E-9
D	3.8 E-3	1.35 E-3	5.4 E-4	5.1 E-5	1.3 E-5	5.2 E-6
F	9.1 E-3	3.25 E-3	1.3 E-3	2.0 E-4	7.0 E-5	3.2 E-5

Record the Wind Speed (per recorder NWS-501-E in mph) on the Dose Assessment Sheet in the Onsite/Offsite Dose Projection section.

ATTACHMENT III

Calculation of the Source Term and Onsite/Offsite Dose Projections

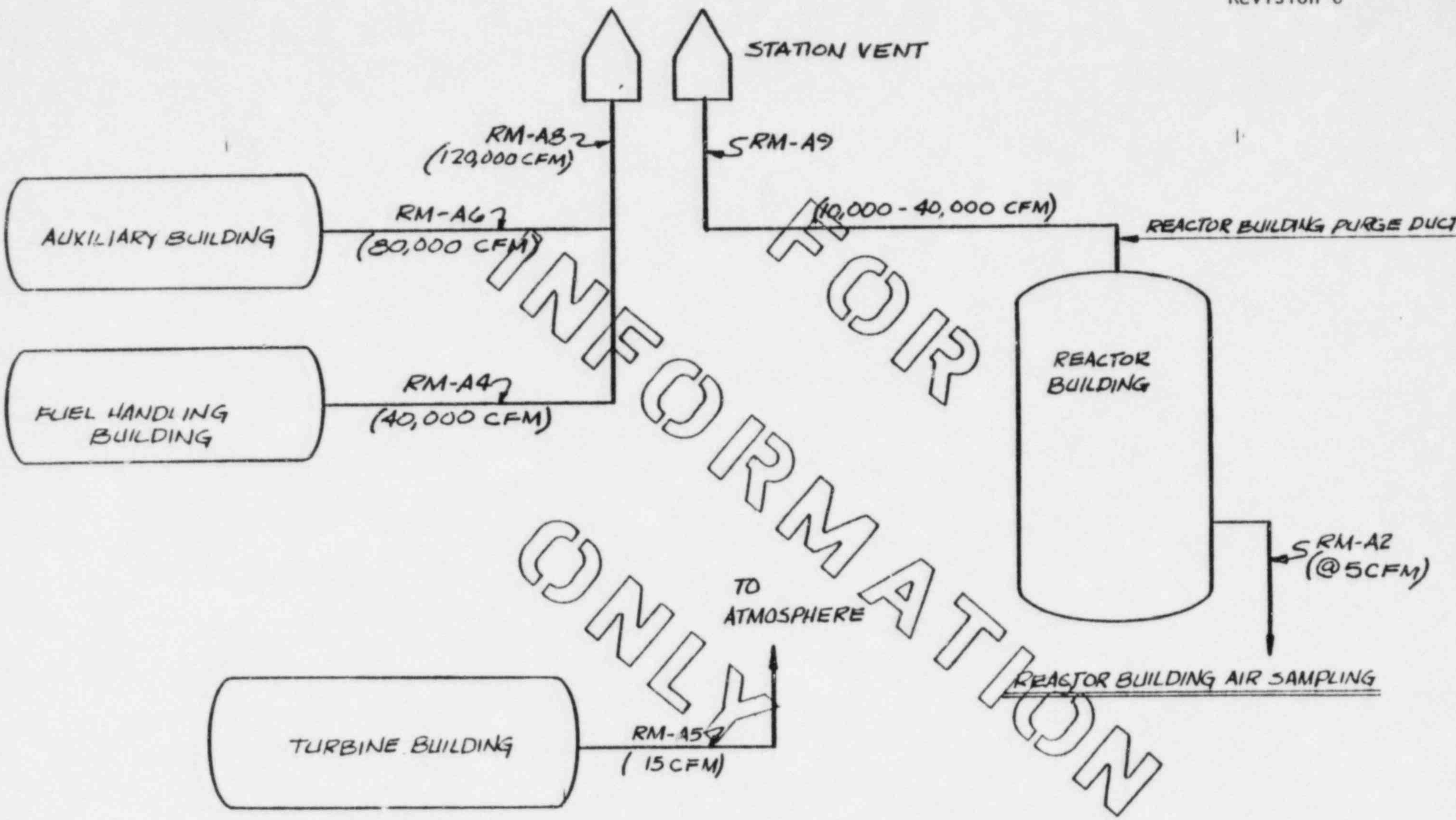
1. Identify the affected atmospheric radiation monitor(s) per the Radiation Monitoring System (RMS) Schematic by comparing the "actual" indicated concentration of radionuclide to the "normal observed" level. If more than one monitor on a Release Pathway is affected then choose the monitor furthest downstream of the release source. If all monitors in a Release Pathway are out-of-service or off-scale then proceed to the Contingency Calculations, Attachment IV.
   Record the monitor designation and Release Pathway on the Dose Assessment Sheet, in the Release section.

2. Record the Noble Gas Channel and Radioiodine Channel readings for the affected monitor on the Dose Assessment Sheet in the Source Term Calculation section.

3. Record on the Dose Assessment Sheet in the Source Term Calculation section, the Meter Conversion Factors that correspond to the affected monitor. The Meter Conversion Factors are listed on Table presented below:

Table 2 Meter Conversion Factors

Monitor Designation	Meter Conversion Factors	
	Noble Gas $\left(\frac{uci/cc}{cpm}\right)$	Radioiodine $\left(\frac{uci/cc}{cpm/min}\right)$
RM-A2	2.52 E-08	8.33 E-10
RM-A4	" "	" "
RM-A5	" "	N/A
RM-A6	" "	8.33 E-10
RM-A8	2.7 E-08	7.7 E-10
RM-A9	2.56 E-08	7.2 E-10


STATION VENT
RM-A8
(120,000 CFM)
RM-A9
AUXILIARY BUILDING
RM-A6
(80,000 CFM)
(10,000 - 40,000 CFM)
REACTOR BUILDING PURGE DUCT
FUEL HANDLING BUILDING
RM-A4
(40,000 CFM)
REACTOR BUILDING
RM-A2
(@5CFM)
TO ATMOSPHERE
REACTOR BUILDING AIR SAMPLING
TURBINE BUILDING
RM-A5
(15CFM)
FOR INFORMATION ONLY

4. Determine the Ventilation Flowrate for the affected Release Pathway.

TABLE 3 VENTILATION FLOWRATE

Release Pathway	Ventilation Flowrate Recorder
1. Station Vent (RM-A8)	1. FR-151 (CFM)
2. Auxiliary Building (RM-A6)	2. FR-150 " "
3. Fuel Handling Building (RM-A4)	3. FR-149 " "
4. Reactor Building Purge (RM-A9)	4. FR-148 " "

Multiply the Ventilation Flowrate in (CFM) by 472 to obtain the ventilation Flowrate in ($\frac{cc}{sec}$).

Record on the Dose Assessment Sheet in the Source Term Calculation section the ventilation flowrate.

5. Calculate the Source Term ($\frac{Ci}{sec}$) as indicated by the Dose Assessment Sheet, Attachment I.

6. Calculate the Onsite/Offsite Dose Projections as indicated by the Dose Assessment Sheet, Attachment I.

7. Determine the Emergency Action Level (EAL) utilizing Table 3 and the Exclusion Area Dose Projection.

TABLE 3 EMERGENCY ACTION LEVELS (EAL)

EAL	Fraction of Lower Limit Protective Action Guide	Whole Body Gamma Exposure at Site Boundary(EA)
Alert	.01	$\geq$ 10 $\frac{mrem}{hour}$ < 50 $\frac{mrem}{hour}$
Site Emergency	.05	$\geq$ 50 $\frac{mrem}{hour}$ < 1 $\frac{Rem}{hr}$
General Emergency	1	$\geq$ 1 Rem/hr

ATTACHMENT IV. CONTINGENCY SOURCE TERM CALCULATION

------------------------- Instructions for Using Attachment Four -------------------------

1. Select a release pathway from the posted menu:

   A. Case I Secondary Side Release

   Includes: OTSG tube rupture
   Loss of electric load
   Loss of power
   Direct steam release

   -- GO TO CASE I --

   B. Case II Reactor Building Release

   Includes: Loss of coolant accident (LOCA)
   Maximum hypothetical accident (MHA)
   Rod ejection accident
   Spent fuel accident in the RB

   -- GO TO CASE II --

   C. Case III Auxiliary and Fuel Handling Building Release

   Includes: Spent fuel handling accident in the FHB
   Fuel cask drop during transfer Op
   Waste decay tank rupture

   -- GO TO CASE III --

2. For the selected release pathway follow the logic diagram and calculate the noble gas and radioiodine source terms (S1 and S2 respectively).

3. Enter the following items on the dose assessment worksheet (Attachment I Section 4.0)

   S1 = Noble gas source term (CI/sec)

   S2 = Radioiodine source term (CI/sec)

   S3 = Whole body DCF (MREM/HR/uci/cc)

   S4 = Thyroid DCF (MREM/HR/uci/cc)

4. Attach to the dose assessment worksheet (Attachment I) a completed Worksheet A.

CASE I: SECONDARY SIDE RELEASE

Section A - Determine the Reactor Coolant Activity by following the flow diagram starting in the upper left hand corner then continue to Section B.

Section B - Determine the OTSG tube rupture leak Rate by following the flow diagram starting in the upper left hand corner. Then continue to Section C.

Section C - Determine the transport fractions by following the flow diagram starting in the upper left-hand corner. Then continue to Section D.

Section D - to do the dose assessment dacIculation use the answers from Sections A, B and C. Fill in the appropriate blanks and calculate S1 and S2, then proceed to Section E.

Section E - Follow directions as indicated at top of page.

CASE I: SECONDARY SIDE RELEASE

A. Reacto olant Activity

| Is the RML1 (RC Letdown Monitor) High Channel Reading in cpm available? (Y/N) |

-- YES -- Enter the RML1 High Reading = A1 = ____ CPM

Calculate the RCS Activity

in $\frac{uc}{ml}$ = (A1 ÷ 22) = ____ D1 (Enter Item D1 in Section D)

Fill in the blank and check the appropriate item in Section E

C1 = "RML1 High Channel Reading of ____ (A1) CPM indicating ____ (D1) $\frac{uc}{ml}$"

NO

------------- GO TO SECTION B -------------

| Is the RML1 (RC Letdown Monitor) Low Channel Reading in cpm available? (Y/N) |

-- YES -- Enter the RML1 Low Reading = A1 = ____ CPM

Calculate the RCS Activity

in $\frac{uc}{ml}$ = (A1 ÷ 1220) = D1 (Enter Item D1 in Section D)

Fill in the blank and check the appropriate item in Section E

C1 = "RML1 Low Channel Reading of ____ (A1) CPM indicating ____ (D1) $\frac{uc}{ml}$"

NO

------------- GO TO SECTION B -------------

| Is the most Recent RCS Sample Gross Beta Gamma Activity in uc/ml available? (Y/N) |

-- YES -- RCS Activity in $\frac{uc}{ml}$ = ____ D1 (Enter Item D1 in Section D)

Fill in the blank and check the appropriate item in Section E

C1 = "Most Recent RCS Sample of ____ (D1) $\frac{uc}{ml}$"

NO

------------- GO TO SECTION B -------------

RCS Activity

in $\frac{uc}{ml}$ = 360 = D1 (Enter Item D1 in Section D)

C1 = FSAR Assumption of 1% FF and 360 $\frac{uc}{ml}$ Gross Beta Gamma activity. (Fill in the blank and check the appropriate item in Section E.)

GO TO SECTION B

CASE I: SECONDARY SIDE RELEASE

B. OTSG Tube Rupture Leakrate

| Is the Identified RCS Leakrate in GPM available? (Y/N) | -- YES -- Enter the identified Leakrate = ____ GPM (D2) (Enter Item D2 in Section D)

C2 = "Identified RCS Leakrate of ____ GPM" (D2)

(Fill in the blank and check the appropriate item in Section E.)

---------- GO TO SECTION C ----------

NO

| Is the Unidentified RCS Leakrate in GPM available? (Y/N) | -- YES -- Enter the unidentified Leakrate = ____ GPM (D2) (Enter Item D2 in Section D)

C2 = "Unidentified RCS Leakrate of ____ GPM" (D2)

(Fill in the blank and check the appropriate item in Section E.)

-- GO TO SECTION C --

NO

Leakrate = 400 GPM = D2 (Enter item D2 in Section D)
C2 = FSAR Assumption of 400 GPM leakrate
(Check the appropriate item in Section E)

-------- GO TO SECTION C -----------

CASE I: SECONDARY SIDE RELEASE

C. Transport Fractions

Is there a direct release of steam to the atmosphere (Y/N)

- NO - Radioiodine Transport Fraction = .0075 = D3
(Enter Item D3 in Section D)
(Check the appropriate item in Section E)

C3 = Condenser Off-Gas Release

---------- GO TO SECTION D ----------

YES

Is A fraction of total steam flow through the condenser hotwells? (Y/N)

- NO - Radioiodine Transport Fraction = 1 = D3
(Enter Item D3 in Section D)
(Check the appropriate item in Section E)

C3 = Direct Release of Steam to the Atmosphere

---------- GO TO SECTION D ----------

YES

Enter the fraction of steam flow directed to the condenser hotwell as (A)
(See Table 1 "Steam Discharge Flowrates" Attachment IX)

Radioiodine Transport Fraction = (______ (A) * .0075) + ((1 - ______ (A)) * 1) = ______ + ______

= ______ = ___D3___ (Enter Item D3 in Section D)

C3 = Combined Release of Steam to the Condenser and Directly to Atmosphere (Check the appropriate item in Section E)

-- GO TO SECTION D --

CASE I: SECONDARY SIDE RELEASE

--------------------------------- WORKSHEET A ---------------------------------

D. Dose Assessment Calculation

D1 = Reactor Coolant Activity in (uc/ml) from Section A

D2 = Primary to Secondary Leakrate in (GPM) from Section B

D3 = Radioiodine Transport Fraction from Section C

Noble Gas
Source Term

in $\left(\frac{CI}{sec}\right)$ = ______ (D1) . ______ (D2) . 5E-5

= ______ (S1)

Radioiodine
Source Term

in $\left(\frac{CI}{sec}\right)$ = ______ (D1) . ______ (D2) . ______ (D3) . 2.5E-6

= ______ (S2)

-- GO TO SECTION E --

S3 = 4E5 $\frac{\frac{MREM}{HR}}{\frac{uci}{cc}}$

S4 = 1.6E9 $\frac{\frac{MREM}{HR}}{\frac{uci}{cc}}$

Enter S1, S2, S3 and S4 onto the
Dose Assessment Sheet, Attachment 1.

FOR INFORMATION ONLY

WORKSHEET A

E. Dose Assessment Assumptions (check appropriate entry and fill in the blank)

C1 = |_| "RML1 High Channel Reading of ____ (A1) CPM indicating ____ (D1) uc/ml"

|_| "RML1 Low Channel Reading of ____ (A1) CPM indicating ____ (D1) uc/ml"

|_| "Most Recent RCS Sample of ____ (D1) uc/ml"

|_| FSAR Assumption of 1% FF and 360 uc/ml

C2 = |_| "Identified RCS Leakrate of ____ (D2) GPM"

|_| "Unidentified RCS Leakrate of ____ (D2) GPM"

|_| C2 = FSAR Assumption of 400 GPM Leakrate

C3 = |_| C3 = Condenser Off-Gas Release

|_| C3 = Direct Release of Steam to the Atmosphere

|_| C3 = Combined Release of Steam to the Condenser Off-Gas and Directly to Atmosphere

CASE II: REACTOR BUILDING RELEASE

Section A - Determine Accident selection by following flow diagram starting at the upper left hand corner. Then continue to Section B.

Section B - Determine the Reactor Coolant Activity by following the flow diagram starting in the upper left hand corner (2 pages). Then continue to Section C.

Section C - To make the calculation of Reactor Building Radionuclide concentrations, answer the question in the box then do the necessary calculation, then proceed to section D.

Section D - To do the calculation of Reactor Building Leakrate follow the flow diagram starting in the upper left hand corner. Then continue to Section E.

Section E - To do the calculation of Reactor Building source terms use the answers from Sections B, C and D then continue to Section F.

Section F - Follow directions given in prerequisites.

A. Accid[illegible] Selection

Is the release associated with a spent fuel handling accident? (Y/N) -- NO ---------------------- Go to Section B

YES

C1 = Spent Fuel Handling Accident in the RB (Check the appropriate item in Section F

Is the number of damaged fuel rods available? (Y/N) -- NO ---------------------- C2 = Number of damaged fuel rods is FSAR postulated 208

(Check the appropriate item in Section F)

Noble Gas Concentration

$(\frac{uci}{cc}) = 1.7$ = E1 (Enter Item E1 in Section E)

Radioiodine Concentration

$(\frac{uci}{cc}) = 1.5E-3$ = E2 (Enter Item E2 in Section E)

-- GO TO SECTION D --

YES

Enter the number of damaged fuel rods = A1 = ______
C2 = Actual number of damaged fuel rods
(Check the appropriate item in Section F)

Reactor Building

Noble gas concentration $(\frac{uci}{cc}) = (1.7 \cdot \frac{\_\_\_\_}{A1}) \div 208$

$= \_\_\_\_ \frac{uci}{cc}$ = E1 (Enter Item E1 in Section E)

Reactor Building

Radioiodine Concentration $(\frac{uci}{cc}) = (1.5E-3 \cdot \frac{\_\_\_\_}{A1}) \div 208$

$= \_\_\_\_ \frac{uci}{cc}$ = E2 (Enter Item E2 in Section E) -- GO TO SECTION D --

CASE II: REACTOR BUILDING RELEASE

B. Reactor Coolant Activity, Cont'd

Is the RML1 (RC Letdown Monitor) High Channel Reading in cpm Available? (Y/N)

-- YES --

Enter the RML1 high reading = A1 = ____ CPM

Calculate the RCS Activity

in $\frac{uc}{ml}$ = (A1 ÷ 22) = ______ = A2 (Enter item A2 in Section C)

C1 = "RML1 High Channel Reading of ____ CPM"
A1

(Check appropriate item in Section F)

-- GO TO SECTION C --

NO

Is the RML1 (RC Letdown Monitor) Low Channel Reading in cpm Available? (Y/N)

-- YES --

Enter the RML1 low reading = A1 = ____ CPM

Calculate the RCS Activity

in $\frac{uc}{ml}$ = (A1 1220) = ______ = A2 (Enter item A2 in Section C)

C1 = "RML1 Low Channel Reading of ____ CPM"
A1

(Check appropriate item in Section F)

-- GO TO SECTION C --

NO

B. R[illegible] [illegible]or Coolant Activity, Cont'd

| Based upon in-core instrumentation does the ED suspect fuel melting? | -- YES --

Reactor Building noble gas concentration

(uc/cc) = 5.7E3 (uci/cc) = E1 (Enter item E1 in Section E)

Reactor Building radioiodine concentration

(uc/cc) = 5E2 (uci/cc) = E2 (Enter item E2 in Section E)

C1 = Fuel melting as indicated by in-core instrumentation
(Check appropriate item in Section F)

-- GO TO SECTION D --

NO

| Based upon in-core instrumentation does the ED suspect fuel cladding damage? | -- YES --

Reactor Building noble gas concentration

(uci/cc) = 160 (uci/cc) = E1

Reactor Building radioiodine concentration

(uci/cc) = 13 (uci/cc) = E2

C1 = Fuel cladding damage as indicated by in-core instrumentation
(Check appropriate item in Section F)

-- GO TO SECTION D --

NO

| Most Recent RCS Sample Gross Beta Gamma Activity in uc/ml | - YES --

Enter RCS Activity in uc/ml = ______ = A2 (Enter item A2 in Section C)

C1 = "Most Recent RCS Sample"
(Circle appropriate item in Section F)

-- GO TO SECTION C --

NO --

Reactor Building noble gas concentration

(uc/ml) = 160 = E1 (Enter item E1 in Section E)

Radioiodine concentration

(uc/ml) = 13 = E2 (Enter item E2 in Section E)

C1 = "FSAR assumed fuel cladding damage"
(Check appropriate item in Section F

-- GO TO SECTION D --

CASE II: REACTOR BUILDING RELEASE

C. Calculation of Reactor Building Radionuclide Concentrations

Is the total number of gallons of RCS leakage into the Reactor Building available? (Y/N)	-- NO --	C1 - FSAR assumed fuel cladding damage (Check the appropriate item in Section F) Reactor Building noble gas concentration (uci/cc) = 160 = E1 (Enter item E1 in Section E) Radioiodine concentration (uci/cc) = 13 = E2 (Enter item E2 in Section E) -- GO TO SECTION D --
YES		Enter the total number of gallons = ______ = A3 (Enter item A3 below) C2 = Actual number of gallons of RCS leakage into the Reactor Building (Check the appropriate item in Section F)

Calculate the Reactor Building Noble Gas Concentration (uci/cc) =

(A2 . A3 . 2950) ÷ 5.6E10 = ______ = E1 (Enter item E1 in Section E)

Reactor Building Radioiodine Concentration (uci/cc) =

(A2 . A3 . 56) ÷ 5.6E10 = ______ = E2 (Enter item E2 in Section E)

-- GO TO SECTION D --

CASE II: REACTOR BUILDING RELEASE

D. Calculation of Reactor Building Leakrate

Is the actual Reactor Building internal pressure indicated on PT-291? (Y/N)	-- NO --

NO:

A4 = 50.6 psig

C3 = FSAR postulated RB pressure of 50.6 psig

(Check the appropriate item in Section F)

Enter item A4 below and perform the calculation

YES:

Enter the actual pressure = ____ = A4

C3 = Actual RB internal pressure

(Check the appropriate item in Section F)

Calculate the actual RB leakrate $\left(\frac{cc}{sec}\right)$

$= (656 * \left(\frac{A4}{50.6}\right)^{\frac{1}{2}}) = \_\_\_\_ \left(\frac{cc}{sec}\right) = E3$ (Enter item E3 in Section E)

-- GO TO SECTION E --

CASE II: REACTOR BUILDING RELEASE

E. Calculation of Reactor Building Source Terms

Noble gas source term $\left(\frac{CI}{sec}\right)$

= (E1 . E3) ÷ 1E6 = ______ S1

S3 = 4E5 $\frac{MREM/HR}{uci/cc}$

Radioiodine source term $\left(\frac{CI}{sec}\right)$

= (E2 . E3) ÷ 1E6 = ______ S2

S4 = 1.6E9 $\frac{MREM/HR}{uci/cc}$

Enter Items S1, S2, S3 and S4 onto the dose assessment sheet, Attachment 1.

F. Dose Assessment Assumptions (Check the box and fill in the blank items if applicable)

| | C1 = Spent fuel handling accident in the Reactor Building

| | C2 = Number of damaged fuel rods is FSAR assumed 208

| | C2 = Actual number of damaged fuel rods is ______ (A1)

| | C1 = RML1 high channel reading of ______ (A1) CPM

| | C1 = RML1 low channel reading of ______ (A1) CPM

| | C1 = Fuel melting as indicated by in-core instrumentation

| | C1 = Fuel cladding damage as indicated by in-core instrumentation

| | C1 = Most recent RCS sample

| | C1 = FSAR assumed fuel cladding damage

| | C2 = Actual number of gallons of RCS leakage into the Reactor Building

| | C3 = FSAR postulated RB pressure of 50.6 psig

| | C3 = Actual RB pressure of ______ (A4) psig

CASE III: AUXILIARY AND FUEL HANDLING BUILDING RELEASE

Section A - Follow the accident selection flow diagram and then continue to the section indicated by the answer, (yes or no).

Sections B, C, D, and E
In these sections do the necessary calculations to get the answers S1, S2, and C1, then continue to Section F.

Section F - Fill out sheet completely.

CASE III: AUXILIARY AND FUEL HANDLING BUILDING RELEASE

A. Accident Selection

Has a grab sample been obtained of the affected area and analyzed on a geli spectrophotometer? (Y/N) -- YES -- GO TO SECTION B

NO

Does the accident involve fuel assembly damage in the spent fuel pool? (Y/N) -- YES -- GO TO SECTION C

NO

Does the accident involve fuel cask drop during transfer operation? (Y/N) -- YES -- GO TO SECTION D

NO

Does the accident involve a waste gas release? (Y/N) -- YES -- GO TO SECTION E

NO -------- GO TO SECTION F --

CASE III: AUXILIARY AND FUEL HANDLING BUILDING RELEASE

B. Source Term Generation Based Upon a Grab Sample

Calculate the noble gas source term in $(\frac{CI}{sec})$ where

B1 = total $\frac{uc}{cc}$ of noble gas isotopes as indicated in sample

B2 = ventilation flowrate from affected building in CFM

Noble gas source term = $\underset{B1}{\_\_\_\_\_\_\_\_} \times \underset{B2}{\_\_\_\_\_\_\_\_} \times 4.7E\text{-}4 = \underset{S1}{\_\_\_\_\_\_\_\_}\ \frac{CI}{sec}$

Calculate the radioiodine source term in $(\frac{CI}{sec})$ where

B3 = total $\frac{uc}{cc}$ of radioiodine isotopes as indicated in sample

B2 = ventilation flowrate from affected building in CFM

Radioiodine source term = $\underset{B3}{\_\_\_\_\_\_\_\_} \times \underset{B2}{\_\_\_\_\_\_\_\_} \times 4.7E\text{-}4 = \underset{S2}{\_\_\_\_\_\_\_\_}\ (\frac{CI}{sec})$

Enter B2, S1, and S2 in Section F

Enter the Time/Date of the sample in the blank below

C1 - Grab sample analyzed on a geli spectrophotometer at ________________
Time/Date

(Check the appropriate item in Section F and fill in the blanks)

-- GO TO SECTION F --

CASE III: AUXILIARY AND FUEL HANDLING BUILDING RELEASE

C. Fuel Assembly Damage in the Spent Fuel Pool

Noble gas source term $\left(\frac{CI}{sec}\right) = \frac{4.2}{S1}$ (Enter S1 and S2 in Section F)

Radioiodine source term $\left(\frac{CI}{sec}\right) = \frac{7.5E-4}{S2}$

C1 = FSAR postulated fuel assembly damage in the spent fuel pool

(Check the appropriate item in Section F)

-- GO TO SECTION F --

D. Fuel Cask Drop During Transfer Operation (Enter S1 and S2 in Section F)

Noble gas source term $\left(\frac{CI}{sec}\right) = \frac{1.2E-3}{S1}$

Radioiodine source term $\left(\frac{CI}{sec}\right) = \frac{4.5E-4}{S2}$

C1 = FSAR postulated fuel cask drop during transfer operation

(Check the appropriate item in Section F)

-- GO TO SECTION F --

CASE III: AUXILIARY AND FUEL HANDLING BUILDING RELEASE

E. Waste Gas Decay Tank Rupture

Noble gas source term $(\frac{CI}{sec}) = \frac{26}{S1}$ (Enter S1 and S2 in Section F)

Radioiodine source term $(\frac{CI}{sec}) = \frac{.004}{S2}$

Cl = FSAR postulated waste gas decay tank rupture

(Check appropriate item in Section F)

-- GO TO SECTION F --

CASE III: AUXILIARY AND FUEL HANDLING BUILDING RELEASE

F. Dose assessment assumptions

(Check the box and fill in applicable items)

|__| C1 = Grab sample analyzed on a geli spectrophotometer at ______ Time/Date

|__| C2 = Ventilation flowrate of ______ CFM
B2

|__| C1 = FSAR postulated fuel assembly damage in the spent fuel pool

|__| C1 = FSAR postulated fuel cask drop during transfer operation

|__| C1 = FSAR postulated waste gas decay tank rupture

S1 = ______ (CI/sec)

S2 = ______ (CI/sec)

S3 = 4E5 (MREM/HR/uci/cc)

S4 = 1.6E9 (MREM/HR/uci/cc)

Enter Items S1, S2, S3, and S4 onto the Dose Assessment Sheet, Attachment 1.

ATTACHMENT V

LIQUID RELEASE CALCULATION

1. Estimate quantity of radioactive liquid released or the release rate of the liquid being released _______ (1a) gallons or _______ (1b) gpm.

2. From recorded information or sample analysis determine the activity level (in uCi/ml) of the released liquid: _______ (2) ?Ci/ml.

3. Obtain the river level by calling the River Forecast Center in Harrisburg at phone number 782-2256 or 782-3488 and record the reading: _______ (3) ft.

4. Find the river flow corresponding to the river level No. 3 above, in Table I, and record: _______ (4) CFS.

5. Calculate the average and maximum downstream concentrations of radioactive material as follows:

Maximum

$$\underset{(2)}{\_\_\_\_} \frac{?Ci}{ml} \times \underset{(1b)}{\_\_\_\_} gpm \times 2.33 \times 10^{-3} \frac{cfs}{gpm} \div \underset{(4)}{\_\_\_\_} cfs = \underset{(5)}{\_\_\_\_} \frac{?Ci}{ml}^{**}$$

NOTE: ** If the average or maximum downstream concentration is $\geq 1 \times 10^{-6}$?Ci/ml, notify downstream users to curtail intake.

ATTACHMENT V (Cont'd)

Time for Flume to Reach Downstream Users

6. Downstream Points (Table II) ____ ____ ____ ____ ____

7. Distance to Point in miles (Table II) ____(9) ____(9) ____(9) ____(9) ____(9)

8. River velocity in mph corresponding to river flow from (4) above (Table 1) ____(10) ____(10) ____(10) ____(10) ____(10)

9. Calculate a time in hours for the flume to reach selected point: Step 7 / Step 8 ____ ____ ____ ____ ____

24 Hour Average Concentration in Unrestricted Areas

10. Record the duration of the release in minutes: ____ min.

11. Calculate a 24 hour average concentration in unrestricted areas:

$$\underset{(5a)}{\underline{\quad\quad}} \frac{?Ci}{ml} \times \underset{(1)}{\underline{\quad\quad}} min \times 6.95 \times 10^{-4} = \underset{(1)}{\underline{\quad\quad}} \frac{?Ci}{ml}$$

ATTACHMENT V (Cont'd)

12. Determine the estimated fraction of MPC:*

$$\frac{\text{?Ci}}{\text{ml}} \text{ \_\_\_\_\_ (13)} + MPC_w^{**} = \text{\_\_\_\_\_ (12) Fraction of MPC}$$

NOTE: * If the ratio obtained in (14) of Attachment is >500, notification of NRC is required within 24 hours per 10CFR20.403. If the ratio obtained in >5,000, immediate notification is required per 10CFR20.403.

NOTE: ** MPC_w is the weighted MPC for the isotopes released. If unknown, use 3×10^{-8} ?Ci/ml.

ATTACHMENT V (Cont'd)

TABLE I

RIVER FLOW VS. RIVER LEVEL

A	B	C	D
Gauge Reading Market Street Bridge, Hbg. (Feet)	River Elevation at TMI (Feet Above Sea Level)	River Flow (Cubic Feet per Second)	River Velocity (MPH)
4.3	278.7	20,000	.9
5.3	279.5	40,000	1.4
6.2	280.1	60,000	.7
7.1	280.7	80,000	2.0
8.1	281.3	100,000	2.3
10.4	282.5	150,000	2.6
12.5	283.6	200,000	3.1
14.3	284.9	250,000	3.3
16.1	285.8	300,000	3.5
17.9	287.0	350,000	3.7
19.5	288.1	400,000	3.9
21.2	289.7	450,000	4.1
22.7	291.0	500,000	4.3
24.3	292.6	550,000	4.5
25.6	294.0	600,000	4.7
26.9	295.2	650,000	4.9
28.1	296.[illegible]	700,000	5.1
29.3	297.1	750,000	5.3
30.4	298.1	800,000	5.5
31.3	299.2	850,000	5.7
32.0	300.1	900,000	5.9
32.6	301.1	950,000	6.1
33.1	302.0	1,000,000	6.3

NOTE: River elevations 302.0 feet at water intake structure TMI requires initiation of EPIP 1004.2 ALERT.

ATTACHMENT V (Cont'd)

TABLE II

DOWNSTREAM POINTS

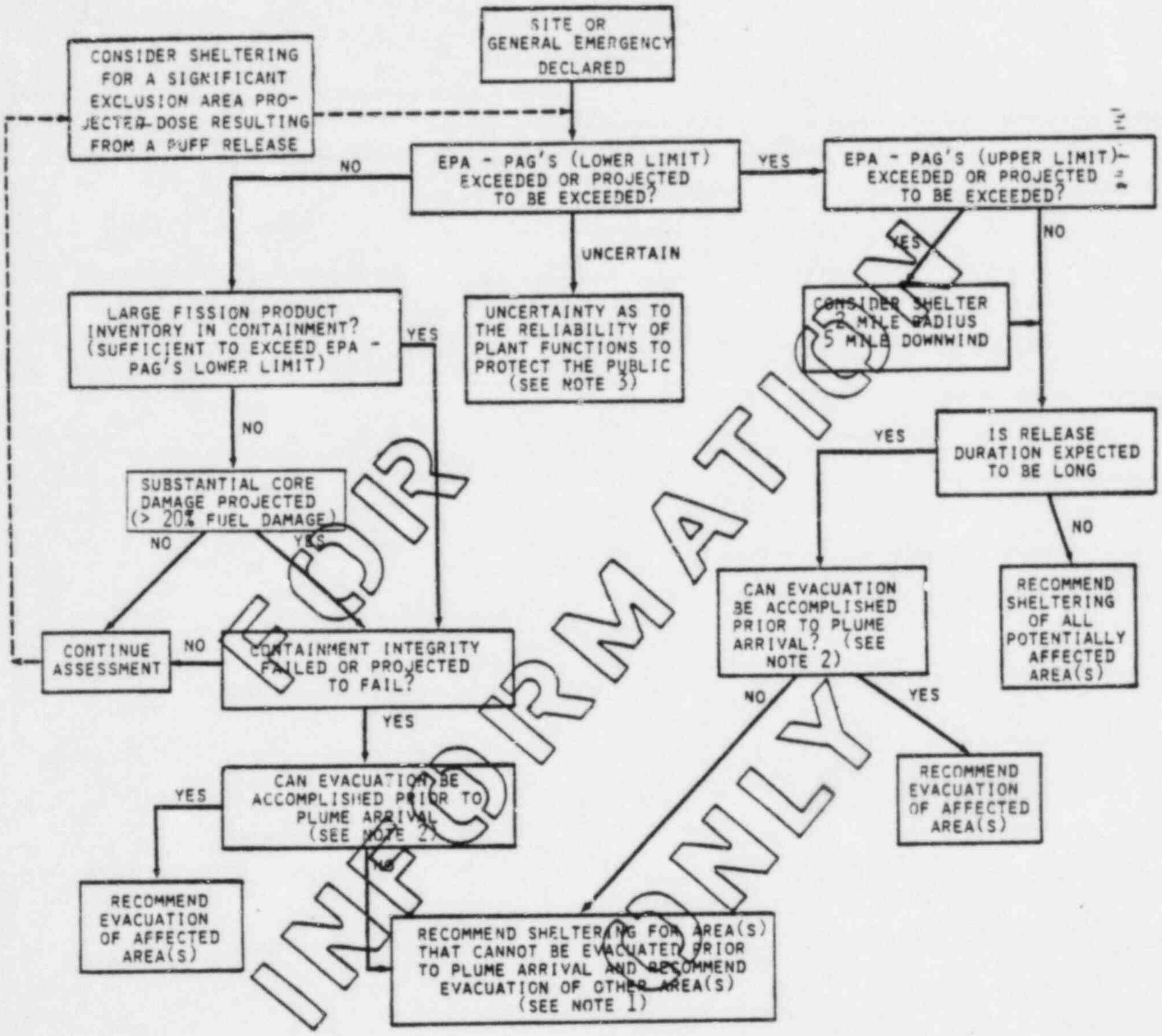
Downstream Water Users (6)	Distance To User (miles) (7)
Brunner Island Steam Electric Station	5.0
Wrightsville Water Supply Company	16.25
Borough of Columbia	16.75
City of Lancaster	16.75
Safe Harbor Water and Power Corp.	27.25
Holtwood Reservoir	34.75
Chester Water Authority	43
City of Baltimore	49

ATTACHMENT VI

Protective Action Guides/Protective Action Recommendation

Protective Action Guide (PAG'S)	Actual or Projected Exclusion Area Dose (rem)	
	Whole Body	Thyroid
Lower Limit (PAG)	1	5
Upper Limit (PAG)	5	25

LOGIC DIAGRAM
DEVELOPMENT OF PROTECTIVE ACTION RECOMMENDATIONS (PAR)



NOTE 1: CONSIDERATION SHOULD BE GIVEN TO THE PROJECTED EXPOSURE TO BE RECEIVED TO A PERSON IF HE SHELTERS VICE EVACUATES. IN SO DOING, YOU MUST FACTOR RELEASE DURATION, RELEASE MAGNITUDE AND ASSUME A PROTECTION FACTOR OF 2 FOR UP TO THE FIRST 2 HOURS OF RELEASE DURATION AND A PF OF 1 FOR > 2 HOURS RELEASE DURATION. THE PATHWAY OF LEAST EXPOSURE SHOULD BE CHOSEN.

NOTE 2: TMI EVACUATION TIME ESTIMATES

	LOWER (HOURS)	UPPER (HOURS)
BEST ESTIMATE (NIGHT)	5.25	8.50
TYPICAL WEEKDAY (NORMAL)	5.75	8.50
ADVERSE WEATHER	8.00	11.50

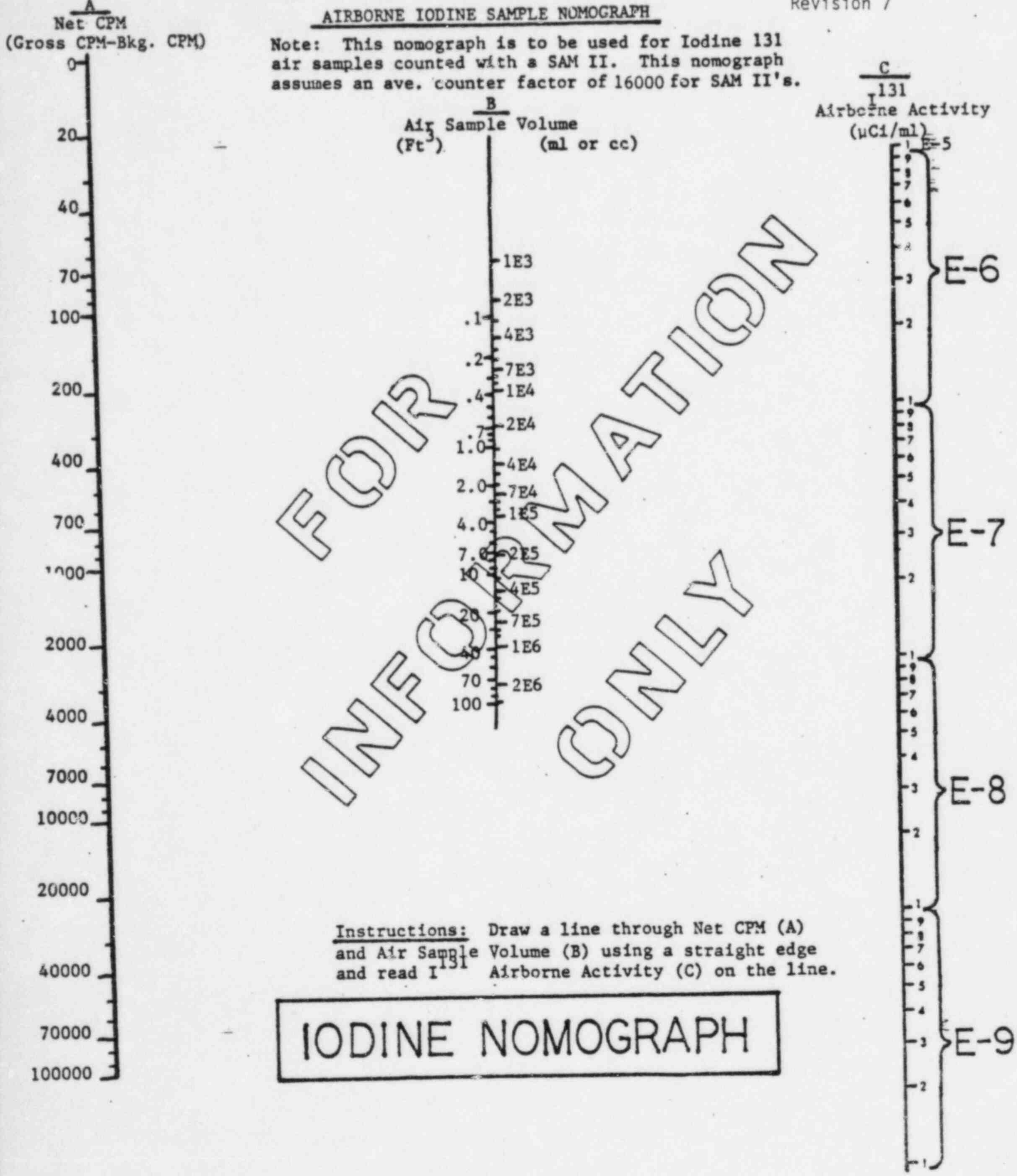
LOWER - GOOD STATE OF EMERGENCY READINESS (SLOW SCENARIO)
UPPER - LACK OF ADEQUATE PREPARATION TIME (FAST SCENARIO)

NOTE 3: IN EXERCISING THE JUDGMENT AS TO THE NEED FOR PROTECTIVE ACTION RECOMMENDATIONS, ANY UNCERTAINTY CONCERNING THE STATUS OF PLANT FUNCTIONS NEEDED FOR PROTECTION OF THE PUBLIC, THE LENGTH OF TIME THE UNCERTAINTY EXISTS, THE PROSPECTS FOR EARLY RESOLUTION OF AMBIGUITIES, AND THE POTENTIAL DEGRADATION OF THE PLANT FUNCTIONS NEEDED FOR PROTECTION OF PUBLIC SHOULD BE CONSIDERED; I.E., SIGNIFICANT UNCERTAINTY AS TO THE RELIABILITY OF PLANT FUNCTIONS TO PROTECT THE PUBLIC EXTENDING BEYOND A REASONABLE TIME PERIOD IS A SUFFICIENT BASIS FOR MAKING A PROTECTIVE ACTION RECOMMENDATION TO SHELTER WITHIN A 2 MILE RADIUS OF THE PLANT AND 5 MILES DOWNWIND. CONTINUE PLANT ASSESSMENT.

ATTACHMENT VII

AIRBORNE IODINE SAMPLE NOMOGRAPH

Note: This nomograph is to be used for Iodine 131 air samples counted with a SAM II. This nomograph assumes an ave. counter factor of 16000 for SAM II's.



Instructions: Draw a line through Net CPM (A) and Air Sample Volume (B) using a straight edge and read I^{131} Airborne Activity (C) on the line.

IODINE NOMOGRAPH

ATTACHMENT VIII

COMPUTERIZED DOSE CALCULATIONS

1. Ensure computer components are connected as pictured in Attachment 1A.

2. Energize the system components in the following order:

   a. Quick Printer II

   b. Video Display

   c. Keyboard Terminal

   d. Expansion Interface

3. Computer will respond with the following message:

   MEMORY SIZE -

   Strike the 'ENTER' Key

4. Computer will respond with:

   RADIO SHACK LEVEL II BASIC

   READY

   >

> NOTE: For loading Unit II programs go to Step 7.

5. For airborne release:

   Place cassette labeled 'Program "D" Airborne Dose Calculations' in recorder and ensure cassette is rewound. Depress the PLAY button, set volume level to '4'.

6. For liquid release:

   Place cassette labeled 'Program "L" Liquid Release Calculations' in recorder and ensure cassette is rewound. Depress the PLAY button, set volume level to '4'.

ATTACHMENT VIII (Cont'd)

7. For Unit II airborne release with RMS system in-service and on-scale: Place cassette labeled "EMERG2" Unit II Emergency Dose Calculations' in recorder and ensure cassette is rewound. Depress the PLAY button, set volume level to "4".

8. For Unit II airborne release with RMS system out-of-service and/or off-scale:
Place cassette labeled "Emergency Contingency Calculations" in recorder and ensure cassette is rewound. Depress the PLAY button, set volume level to "4".

9. Enter the following command from the keyboard:
CLOAD "D" for Unit I airborne; CLOAD "L" for Unit I liquid; CLOAD "EMERG2" for Unit II Emergency Dose Calculations; CLOAD "CONT2" for Unit II Emergency Contingency Calculations and strike the 'ENTER' key. At this time the cassette will begin loading the program into the computer memory. Program loading will take approximately 2-1/2 or 3 minutes. One steady and one blinking star will appear in the upper right corner of the video display to signify program loading is in progress.

> NOTE: If both stars appear, with neither blinking; i.e. both steady replace cassette with new copy and start over at step 5.

10. When program loading is completed, the computer will respond with:
READY
>_
Depress stop button, rewind the cassette and remove it from the recorder.

ATTACHMENT VIII (Cont'd)

11. To begin program execution, enter the following command from the keyboard:

    RUN

    and strike the 'ENTER' key.

12. General notes on program operation:

    a. All responses must be followed by striking the 'ENTER' key.

    b. Numbers in scientific notation should be entered using the following formats:

       9.2×10^{3} = 9.2E3

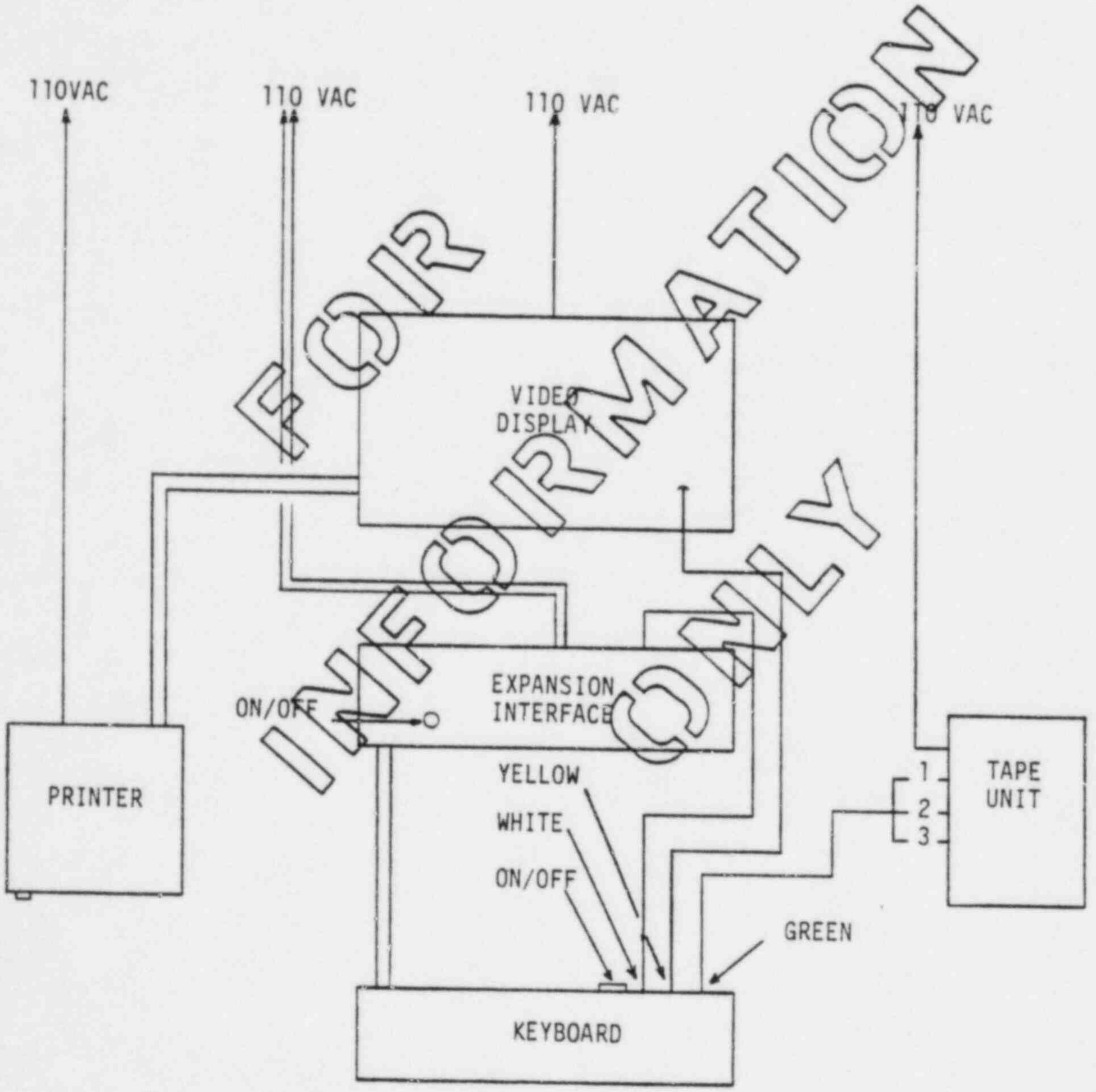
       4.0×10^{-4} = 4E-4

    c. All responses requiring a yes or no, are to be answered with a Y or N.

ATTACHMENT VIII

COMPUTER CONNECTIONS

AND COLOR CODES



TAPE UNIT

1. Black Plug - Ear
2. Lg. Grey Plug - Aux.
3. Sm. Grey Plug - Mic.

ATTACHMENT IX

HIGH RANGE RMS DOSE CALCULATIONS

Section A - System Description

The High Range RMS is categorized into three distinct subsystems (See Schematic):

1. Radioiodine Processor Stations
2. Containment Air Sampling
3. High Range Noble Gas Channels

Subsystem (1):

Radioiodine Processor Stations

Three stations allow samples to be obtained independent of radiation monitors RM-A5, A8 and A9. The stations are controlled by solenoid valves which actuate flow through one or more of the (3) parallel filter cartridges per station. The sampling times for each filter cartridge are adjustable on each local control panel. The filter cartridges must be manually removed for analysis.

Subsystem (2):

Containment Air Sampling

The post accident RB atmospheric sampling station is located at the 322' level of the intermediate building, one floor above radiation monitor RM-A2. Three-way ball valves are installed in the RM-A2 sampling lines downstream of containment isolation valves. The sampling lines are connected downstream of CM-V1, CM-V2, CM-V3 and CM-V4 at P-108.

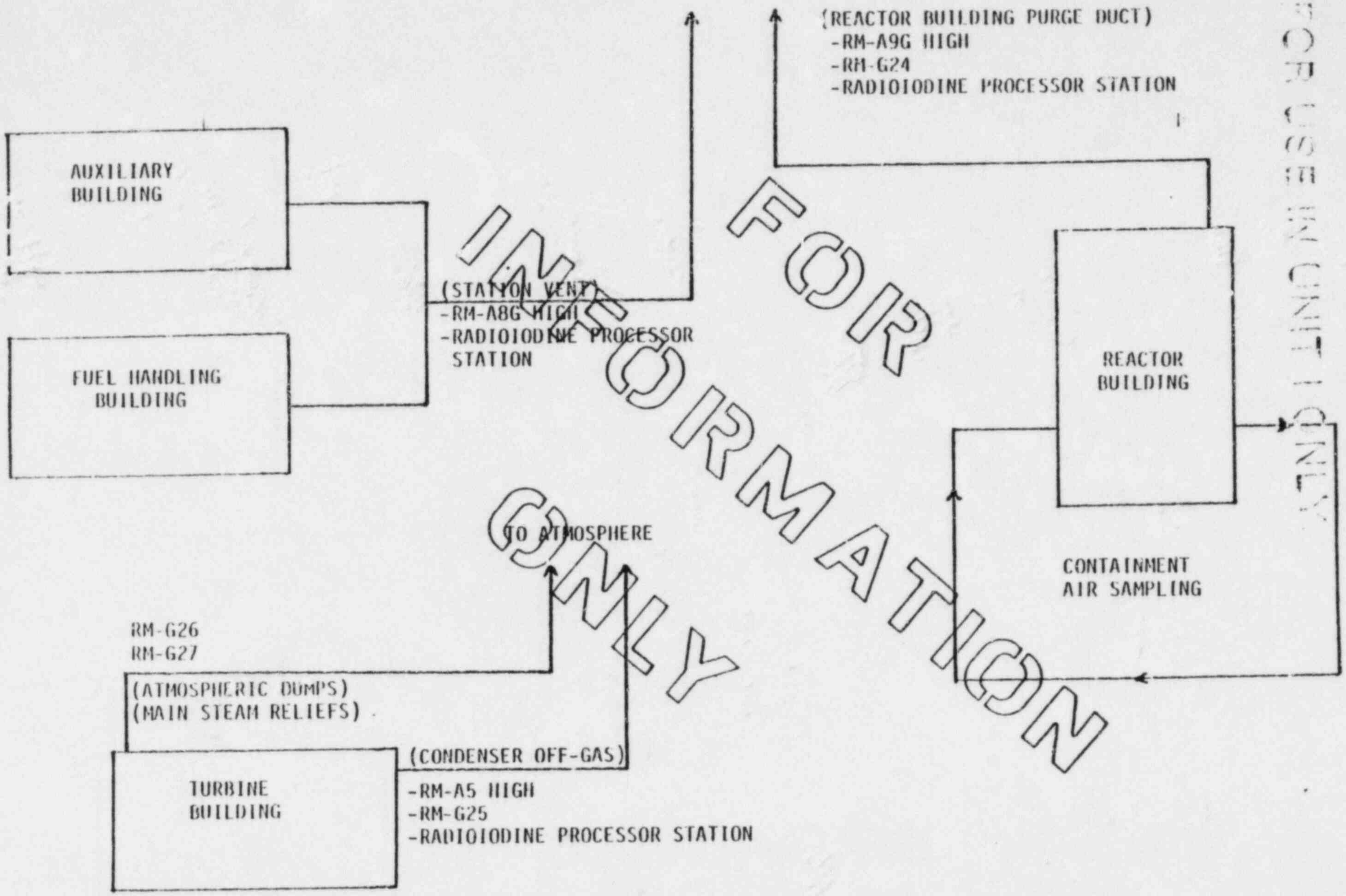
ATTACHMENT IX

HIGH RANGE RMS DOSE CALCULATIONS

SUBSYSTEM 3: HIGH RANGE NOBLE GAS CHANNELS

MONITOR DESIGNATION	EFFLUENT PATHWAY	DETECTOR TYPE	RANGE ?Ci/cc	CONVERSION FACTOR CPM/?ci/cc	FLOWRATE CFM RECORDER
RM-A8G High	Aux and FHB	GM Tube	1E-2/1E-3	1E3	FR-151
RM-A9G High	RB Purge	GM Tube	1E-3/1E2	2.6E3	FR-148
RM-G24	RB Purge	Ion Chamber	1E1-1E5	* 9.5	FR-148
RM-A5 High	Condenser Off-Gas	GM Tube	1E-3/1E2	5E3	See Table 1
RM-G25	Condenser Off-Gas	Ion Chamber	1E1/1E5	1.5	See Table 1
RM-G26	A, B Main Steam Lines	Scintillation	1E-2/1E3	1020	See Table 1
RM-G27	C, D Main Steam Lines	Scintillation	1E-2/1E3	1056	See Table 1

*MR/HR/?ci/cc


(REACTOR BUILDING PURGE DUCT)
-RM-A9G HIGH
-RM-G24
-RADIOIODINE PROCESSOR STATION
AUXILIARY BUILDING
FUEL HANDLING BUILDING
(STATION VENT)
-RM-A8G HIGH
-RADIOIODINE PROCESSOR STATION
REACTOR BUILDING
CONTAINMENT AIR SAMPLING
TO ATMOSPHERE
RM-G26
RM-G27
(ATMOSPHERIC DUMPS)
(MAIN STEAM RELIEFS)
TURBINE BUILDING
(CONDENSER OFF-GAS)
-RM-A5 HIGH
-RM-G25
-RADIOIODINE PROCESSOR STATION

ATTACHMENT IX

HIGH RANGE RMS DOSE CALCULATIONS

Section B - Source Term Calculations

1.0 Calculation of the Radioiodine Source Term utilizing the Radioiodine Processor Station.

1.1 Enter the radioiodine concentration in microcuries/cc as determined per EPIP 1004.31 from the silver zeolite cartridge:

I131	______	μci/cc
I132	______	μci/cc
I133	______	μci/cc
I134	______	μci/cc
I135	______	μci/cc
Total	______ (A)	μci/cc

1.3 Enter the release flowrate in cubic feet per minute (CFM) as determined from the Table below:

Release Pathway	Release Flowrate (CFM)
Station Vent	FR-151
RB Purge Duct	FR-148
Condenser Off-Gas	See Table 1

Release Flowrate ______ (B) (CFM)

1.4 Calculate the Radioiodine Release Source Term utilizing the following equation:

Radioiodine concentration ______ (A) (μCi/cc) x Release Flowrate ______ (B) (CFM)

x Curie Conversion Factor 1E-6 $\frac{CI}{\mu ci}$ x Flowrate Conversion Factor 472 $\frac{cc/sec}{CFM}$ = Radioiodine Source Term ______ $\frac{CI}{sec}$

1.5 Go to Attachment 1, Section 4.0 "Dose Assessment Sheet"

TABLE 1

Steam Discharge Flow Rates

(1) Steam Generator "A", "B"

Valve Tag No.	Steam Flow #/hr.	Press. PSIG
MS-V17A, MS-V17B, C and D	792,610	1050
MS-V18A, MS-V18B, C and D	799,990	1060
MS-V19A, MS-V19B, C and D	814,955	1080
MS-V20A, MS-V20B, C and D	824,265	1092
MS-V21A, MS-V21B	[illegible]4,900	1040
MS-V22A	70,212	200
MS-V22B	76,793	200

(2) Steam discharged from steam Generator B similar for Valve MS-V17C, D MS-V18C, D MS-V19C, D, MS-V20C, D, MS-V21B. (MS-V22B is 76,793 #/hr at 200 PSIG)

(3) Steam Dump to Atmosphere MS-V4A and B

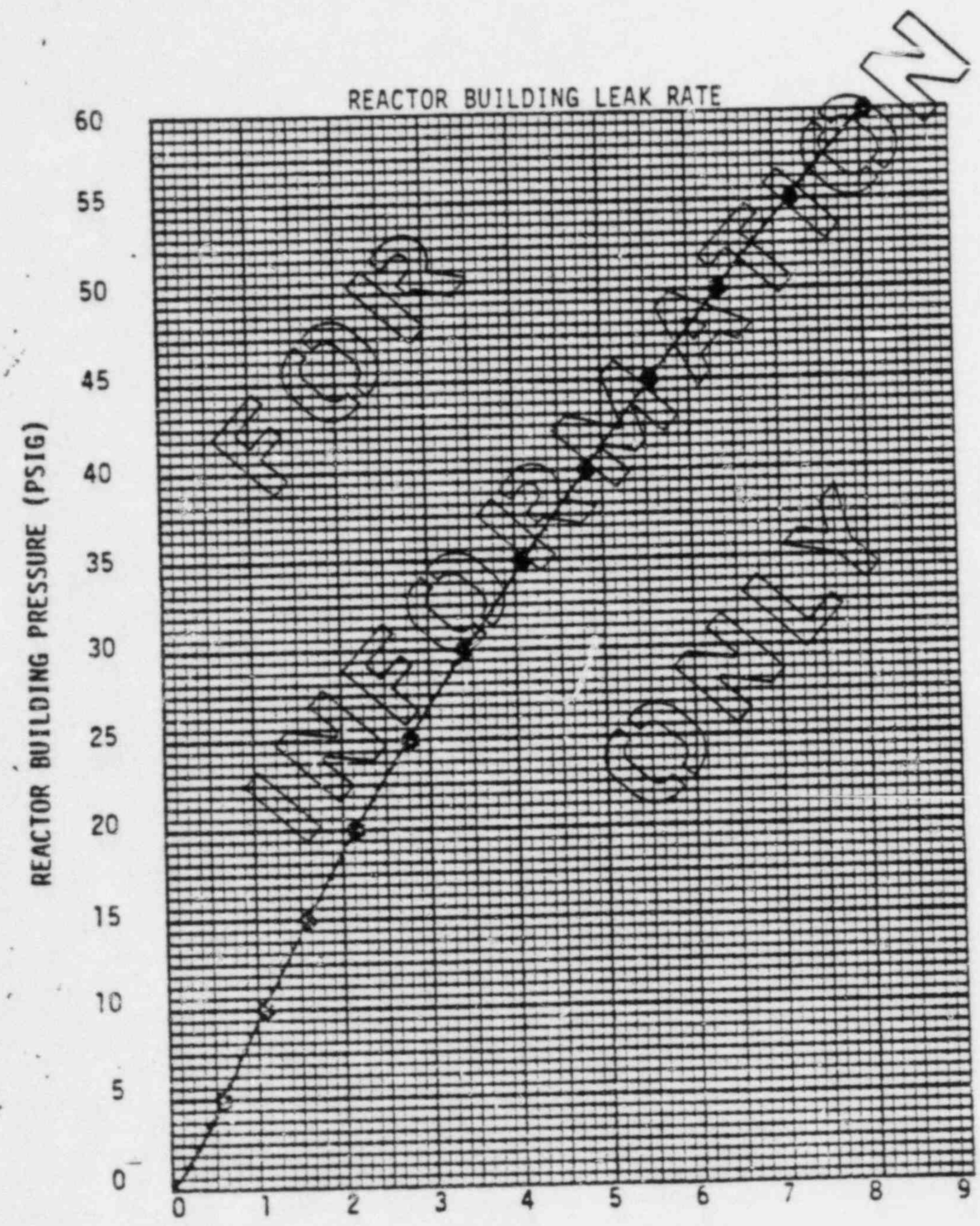
% Valve opening demand	Steam flow #/hr.
20	1.77×10^5
40	3.6×10^5
60	5.09×10^5
80	5.61×10^5
100	5.767×10^5

(4) Condenser Vacuum Pump Discharge Path

To be read from flowmeter on the pumps, or if unknown, use 20 SCFM.

(5) In the event of a direct release of steam to the atmosphere utilizing RMG-26 or MRG-27 to monitor the source term; the following term shall be included with the release flowrate:

$$\frac{\text{Total Steam Flowrate}}{\text{Steam Flow Past}} \quad \text{RMG-26 or RMG-27}$$



REACTOR BUILDING LEAK RATE
(CFM)

ATTACHMENT IX (Cont'd)

2.0 Calculation of the Radioiodine and Noble Gas Source Terms utilizing the Containment Air Sampling Station.

2.1 Enter the Containment Air Sampling Bomb Radionuclide Concentrations in microcuries per cubic centimeter (µci/cc) as determined per EPIP 1004.31:

Noble Gas Nuclides			Radioiodine Nuclides		
KR85	________	µci/cc	I131	________	µci/cc
KR85m	________	µci/cc	I132	________	µci/cc
KR87	________	µci/cc	I133	________	µci/cc
KR88	________	µci/cc	I134	________	µci/cc
XE133	________	µci/cc	I135	________	µci/cc
XE133m	________	µci/cc	Total Radioiodine	________ (A_2)	µci/cc
XE135	________	µci/cc			
XE135m	________	µci/cc			
Total Noble Gas	________ (A_1)	µci/cc			

2.2 Enter the Reactor Building release flowrate as determined from the Table below: Release Flowrate ________ CFM
(B)

Purge Valves Open	FR-148
Purge Valves Closed	See Table 2

2.3 Calculate the Noble Gas Release Source Term utilizing the following equation:

Total Noble Gas Concentration ____ (A1) $\frac{\mu ci}{cc}$ x Release Flow Rate ____ (B) CFM x Flowrate Conversion Factor 472 $\frac{cc/sec}{CFM}$

Curie Conversion x Factor 1E-6 $\frac{Ci}{\mu ci}$ = Noble Gas Source Term ____ $\frac{Ci}{Sec}$

ATTACHMENT IX (Cont'd)

2.4 Calculate the Radioiodine Release Source Term utilzing the following equation:

Total Radioiodine Concentration $\underset{(A2)}{\_\_\_\_}\ \frac{\mu ci}{cc}$ x Release Flow Rate $\underset{(B)}{\_\_\_\_}$ CFM x Flowrate Conversion Factor $\underline{472}\ \frac{cc/Sec}{CFM}$

Curie Conversion x Factor $\underline{1E\text{-}6}\ \frac{Ci}{\mu ci}$ = Radioiodine Source Term $\_\_\_\_\ \frac{Ci}{Sec}$

2.5 Go to Attachment 1, Section 4.0 "Dose Assessment Sheet"

3.0 Calculation of the Noble Gas and Radioiodine Source Term utilizing the High Range Noble Gas Channels.

3.1 Enter the Noble Gas Channel reading in CPM: $\underset{(A)}{\_\_\_\_}$ CPM

3.2 Enter the meter conversion factor as identified in Section A:

$$\underset{(B)}{\_\_\_\_}\ \frac{\text{CPM or } \frac{MR}{HR}}{\frac{\mu ci}{cc}}$$

Enter the postulated mixture conversion factor as identified in Table 3:

$$\underset{(B1)}{\_\_\_\_}\ \frac{\frac{\mu ci}{cc}\ \text{Pos. Mix}}{\frac{\mu ci}{cc}\ \text{Cal. Isotope}}$$

Enter the nuclide class fraction as identified in Table 4:

$$\underset{(B2)}{\_\_\_\_}\ \frac{\frac{\mu ci}{cc}\ \text{Noble Gas}}{\frac{\mu ci}{cc}\ \text{Pos. Mix}}$$

3.3 Enter the Release Flowrate in CFM as identified in Section A:

$\underset{(C)}{\_\_\_\_}$ CFM

3.4 Calculate the Noble Gas Source Term in curies per second (CI/SEC) utilizing the equation below:

Noble Gas Channel Reading $\underset{(A)}{\_\_\_\_}$ (CPM) ÷ Meter Conversion Factor $\underset{(B)}{\_\_\_\_}$ $\dfrac{\text{CPM or } \frac{MR}{HR}}{\frac{\mu ci}{cc} \text{ Cal. Isotope}}$ X $\underset{(B1)}{\_\_\_\_}$ $\dfrac{\frac{\mu ci}{cc} \text{ Pos. Mix}}{\frac{\mu ci}{cc} \text{ Cal. Isotope}}$

x $\underset{(B2)}{\_\_\_\_}$ $\dfrac{\frac{\mu ci}{cc} \text{ Noble Gas}}{\frac{\mu ci}{cc} \text{ Pos. Mix}}$ x Release Flow Rate $\underset{(C)}{\_\_\_\_}$ CFM x Release Flowrate Conversion $\underline{472}$ $\dfrac{\frac{cc}{sec}}{CFM}$

X Curie Conversion $\underline{1E\text{-}6}\ \dfrac{CI}{\mu c}$ = Noble Gas Source Term $\underset{(D)}{\_\_\_\_}$ $\dfrac{CI}{sec}$

3.5 Calculate the Radioiodine Source term in curies per second (CI/SEC) as follows:

3.5.1 Enter the Noble Gas Source term as calculated in Step 3.4: $\underset{(D)}{\_\_\_\_}$ $\dfrac{CI}{sec}$

3.5.2 Enter the fraction of Radioiodine as determined from Table 4: $\underset{(E)}{\_\_\_\_}$ Radioiodine Fraction

3.5.3 Enter the fraction of Noble Gas as determined from Table 4: $\underset{(F)}{\_\_\_\_}$ Noble Gas Fraction

3.5.4 Determine the Radioiodine source term utilizing the equation below:

$\underset{(D)}{\_\_\_\_}$ $\dfrac{CI}{sec}$ Noble Gas X $\underset{(E)}{\_\_\_\_}$ Radioiodine Fraction ÷ $\underset{(F)}{\_\_\_\_}$ Noble Gas Fraction

= Radioiodine Source Term $\underset{(G)}{\_\_\_\_}$ $\dfrac{CI}{sec}$

3.6 Go to Attachment 1, Section 4.0 "Dose Assessment Sheet"

ATTACHMENT IX (Cont'd)

TABLE 3

Postulated Mixture Conversion Factor
($\frac{\mu ci}{cc}$ Calibration Isotope to $\frac{\mu ci}{cc}$ Pos. Mixture)

MONITOR DESIGNATION	EFFLUENT PATHWAY	CALIBRATION ISOTOPE	CONVERSION FACTOR CPM/µci/cc
RM-A8G High	Aux and FHB	XE133	0.7
RM-A9G High	RB Purge	XE133	0.7
RM-G24	RB Purge	KR85	0.01
RM-A5 High	Condenser Off-Gas	XE133	0.6
RM-G25	Condenser Off-Gas	XE133	0.6
RM-G26	A, B Main Steam Lines	KR85	0.007 * 0.005
RM-G27	C, D Main Steam Lines	KR85	0.007 * 0.005

* Iodine spike assumption based upon plant transient.

ATTACHMENT IX (Cont'd)

TABLE 4

Nuclide Class Fraction Of Postulated Mixture
($\frac{\mu ci}{cc}$ Pos. Mixture to $\frac{\mu ci}{cc}$ Nuclide Class)

MONITOR DESIGNATION	NOBLE GAS FRACTION	RADIOIODINE FRACTION
RM-A8G High	0.94	0.07
RM-A9G High	0.94	0.07
RM-G24	0.94	0.07
RM-A5 High	1.00	0.0008
RM-G25	1.00	0.0008
RM-G26	0.80 * 0.67	* 0.06 * 0.24
RM-G27	0.80 * 0.67	0.06 * 0.24

* Iodine spike assumption based upon plant transient.

ATTACHMENT X. DOSE CONVERSION FACTOR CALCULATION

------------------------ Instructions for Using Attachment X ----------------------------

1. Select a DCF calculation from the posted menu:

   A. Whole body DCF calculation based upon gamma spectrum analysis.

   -- GO TO SECTION A --

   B. Thyroid DCF calculation based upon a gamma spectrum analysis.

   -- GO TO SECTION B --

   C. Whole body DCF decay correction (assumes 1 hr elapsed time from original sample analysis).

   -- GO TO SECTION C --

   D. Thyroid DCF decay correction (assumes 1 hr elapsed time from original sample analysis).

   -- GO TO SECTION D --

   E. Default DCF (DDCF) calculations

   -- GO TO SECTION E --

2. For the selected DCF calculation determine the whole body or thyroid DCF, S3 and S4 respectively.

3. Enter the following items on the dose assessment worksheet (Attachment I, Section 4.0).

   S3 = Whole body DCF (MREM/HR/uci/cc)

   S4 = Radioiodine DCF (MREM/HR/uci/cc)

4. Attach to the dose assessment worksheet (Attachment I) a completed Worksheet B.

A. WHOLE BODY DOSE CONVERSION FACTOR (WBDCF) CALCULATION

------------------------------Utilizing the Attached Worksheet------------------------------

1. Enter the Date/Time of the sample analysis.

2. Enter Concentrations in $(\frac{\mu C}{cc})$ for the listed nuclides in column 2.

3. Multiply the concentration of the listed nuclides (column 2) by the photon energy (column 3) to obtain the photon contribution (column 4). Enter the Photon Contribution in column 4.

4. Determine the total concentration of the listed nuclides by adding items a.-m. of column 2. Enter the Total 1Concentration as item A1.

5. Determine the total photon contribution of the listed nuclides by adding items a.-m. of column 4. Enter the Total Photon Contribution as item A2.

6. Enter items A1 and A2 in equation A-1. Calculate the WBDCF on the worksheet as item S3.

WORKSHEET B

WBDCF Calculation

Sample ______________
Date/Time

COL 1	COL 2	COL 3	COL 4
Nuclide	Concentration	Photon Energy	Photon Contribution
a.) KR 85M	______	X .18	= ______
b.) KR 85	______	X .0022	= ______
c.) KR 87	______	X .79	= ______
d.) KR 88	______	X 2.2	= ______
e.) XE 133M	______	X .02	= ______
f.) XE 133	______	X .03	= ______
g.) XE 135M	______	X .53	= ______
h.) XE 135	______	X .26	= ______
i.) I 131	______	X .39	= ______
j.) I 132	______	X 2.2	= ______
k.) I 133	______	X .6	= ______
l.) I 134	______	X 2.6	= ______
m.) I 135	______	X 1.5	= ______

Total Conc. = ______ A1   Total Photon Cont. = ______ A2

Equation A-1   WBDCF Calculation:

WBDCF in $\frac{\frac{MREM}{HR}}{\frac{uci}{cc}}$

____
Sample Date/Time

$$= \left(\frac{\_\_\_\_}{A2} \div \frac{\_\_\_\_}{A1} \right) . 9E5 = \frac{2.1 \times 10^5}{S3}$$

B. THYROID DOSE CONVERSION FACTOR (TDCF) CALCULATION

------------------------------ Utilizing the Attached Worksheet ------------------------------

1. Enter the Date/Time of the sample analysis.

2. Enter the Sample Concentrations in µci/cc for the listed nuclides in column 2.

3. Multiply the nuclide concentrations in column 2 by the isotope DCF in column 3 to obtain the isotope contributions (column 4). Enter the Isotope Contributions in column 4.

4. Determine the total concentration for the listed nuclides by adding items a.-e. of column 2. Enter the Total Concentration as item A1.

5. Determine the total isotope contribution for the listed nuclides by adding items a.-e. of column 4. Enter the Total Isotope Contribution as item A2.

6. Enter items A1 and A2 in equation B-1.

7. Calculate the TDCF utilizing equation B-1. Enter the TDCF as item S4 on the worksheet.

------------------------------------ WORKSHEET B ------------------------------------

Thyroid DCF Calculation

Sample ____________________
Date/Time

COL 1	COL 2	COL 3	COL 4
Nuclides	Concentration	Isotope DCF	Isotope Contributions
a. I 131		1.6E9	
b. I 132		7.9E7	
c. I 133		5.4E8	
d. I 134		4E7	
e. I 135		1.6E8	

:al Concentration = __________ A1 Total Isotope Contributions = __________ A2

Equation B-1 TDCF Calculation:

TDCF in $\frac{\frac{MREM}{HR}}{\frac{uci}{cc}}$

= (______ A2 ÷ ______ A1) . = ______ S4

C. WHOLE BODY DOSE CONVERSION FACTOR (WBDCF) DECAY CORRECTION

------------------------------ Utilizing the Attached Worksheet ------------------------------

1. Enter the Date/Time of the original sample.

2. Enter the Original Concentraticns in µci/cc for the listed nuclides in column 2.

3. Multiply the original nuclide concentrations (column 2) by the remaining fraction (column 3) to obtain the present concentration (column 4). Enter the Present Concentrations in column 4. Factors in column 3 account for 1 hour decay.

4. Multiply the Present Concentration (column 4) by the photon energy (column 5) for the listed nuclides to obtain the photon contribution (column 6). Enter the Photon Contributions in column 6.

5. Determine the total concentrations for the listed nuclides by adding items a.-m. of column 4. Enter the Total Present Concentration as item A1.

6. Determine the total photon contribution for the listed nuclides by adding items a.-m. of column 6. Enter the Total Photon Contribution as item A2.

7. Enter items A1 and A2 in equation C-1.

8. Calculate the WBDCF utilizing equation C-1. Enter the WBDCF on the worksheet as item S3.

9. The elapsed time between the original concentrations and calculated WBDCF is 60 minutes. Determine the date/time of the calculated WBDCF by adding 60 minutes to the original sample time. Enter the date/time on the worksheet.

WORKSHEET B

(WBDCF Decay Correction)

Original Concentration ____________
Date/Time

COL. 1 Nuclides	COL. 2 Original Concentrations	COL. 3 Remaining Fraction	COL. 4 Present Concentrations	COL. 5 Photon Energy	COL. 6 Photon Contributions
a. KR 85M		0.86		.18	
b. KR 85		1.00		.0022	
c. KR 87		0.58		.79	
d. KR 88		0.78		2.2	
e. XE 133M		0.987		.02	
f. XE 133		0.995		.03	
XE 135M		0.08		.53	
h. XE 135		0.93		.26	
i. I 131		0.996		.39	
j. I 132		0.74		2.2	
k. I 133		0.97		.6	
l. I 134		0.45		2.6	
m. I 135		0.90		1.5	

Total Present Concentration = ________ A1

Total Photon Contribution = ________ A2

Equation C-1 WBDCF Calculation:

WBDCF in $\frac{\frac{MREM}{HR}}{\frac{uci}{cc}}$

____
Date/Time
of decay corrected DCF

= (____ A2 ÷ ____ A1) . 9E5 = ____ S3

D. THYROID DOSE CONVERSION FACTOR (TDCF) DECAY CORRECTION

------------------------------ Utilizing the Attached Worksheet ------------------------------

1. Enter the Date/Time of the original concentrations.

2. Enter the Original Concentrations in μci/cc for the listed nuclides in column 2.

3. Multiply the original nuclide concentrations (column 2) by the remaining fraction (column 3) to obtain the present concentration (column 4). Enter the Present Concentrations in column 4. Factors in column 3 account for 1 hour decay.

4. Multiply the present concentration (column 4) by the isotope DCF (column 5) for the listed nuclides to obtain the isotope contributions (column 6). Enter the Isotope Contributions in column 6.

5. Determine the total concentrations for the listed nuclides by adding items a.-e. of column 4. Enter the total concentration as item A1.

6. Determine the total isotope contribution for the listed nuclides by adding items a.-e. of column 6. Enter the total isotope contribution as item A2.

7. Enter items A1 and A2 in equation D-1.

8. Calculate the TDCF utilizing equation D-1. Enter the TDCF as item S4 on the worksheet.

9. The elapsed time between the original concentrations and calculated TDCF is 60 minutes. Determine the date/time of the calculated TDCF by adding 60 minutes to the time of the original sample. Enter the date/time on the worksheet.

----------------------------------- WORKSHEET B -----------------------------------

THYROID DCF DECAY CORRECTION

Original Concentration ____________
Date/Time

COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6
Nuclides	Original Concentrations	Remaining Fraction	Present Concentrations	Isotope TDCF	Isotope Contributions
a. I 131		0.996		1.6E9	
b. I 132		0.74		7.9E7	
c. I 133		0.97		5.4E8	
d. I 134		0.45		4E7	
e. I 135		0.90		1.6E8	

Total Concentration = ____________ A1

Total Isotope Contribution = ____________ A2

Equation D-1 TDCF Calculation:

TDCF in $\frac{MREM/HR}{uci/cc}$

= (______ A2 ÷ ______ A1) = ______ S4

____
Date/Time

E. DEFAULT DOSE CONVERSION FACTOR (DDCF) CALCULATION

------------------------------ Utilizing the Attached Worksheet ------------------------------

1. Enter the Date/Time of reactor shutdown.
2. Enter the Date/Time of the requested (DDCF) calculation.
3. Determine the time since reactor shutdown by substracting the time (Item 2) from the time (Item 1).
4. Select the proper accident classification from column 1. Circle this item.
5. Select the proper "time after Rx S/D" from column 2-10. Circle this item.
6. Enter the whole body dose conversion factor (WBDCF) and thyroid dose conversion factor (TDCF) as items S3 and S4 on the worksheet.

WORKSHEET B

DDCF Calculation

1. Reactor shutdown Date ______ Time ______
2. DDCF calculation Date ______ Time ______
3. Time (hrs.) from Rx SD ______ Hrs.

Column 1 Accident Classification	Col 2	Col 3	Col 4	Col 5	Col 6	Col 7	Col 8	Col 9	Col 10
	TIME FROM REACTOR SHUT DOWN IN HOURS								
	0	1	2	4	6	8	10	12	24
OTSG Tube Rupture									
WBDCF	2.1E5	1.8E5	1.5E5	1.0E5	8.0E4	6.4E4	5.5E4	4.8E4	3.3E4
TDCF	5.8E8	6.1E8	6.4E8	7.1E8	7.7E8	8.4E8	9.1E8	9.8E8	1.3E9
Fuel Handling (RB)									
WBDCF	2.7E4	2.7E4	2.7E4	2.7E4	2.7E4	2.7E4	2.7E4	2.7E4	2.7E4
TDCF	1.2E9	1.3E9	1.3E9	1.4E9	1.4E9	1.4E9	1.4E9	1.4E9	1.5E9
Fuel Handling (FHB)									
WBDCF	2.4E4	2.4E4	2.4E4	2.4E4	2.4E4	2.4E4	2.4E4	2.4E4	2.4E4
TDCF	1.6E9	1.6E9	1.6E9	1.6E9	1.6E9	1.6E9	1.6E9	1.6E9	1.6E9
Rod Ejection									
WBDCF	1.4E5	1.2E5	1.1E5	9.9E4	9.0E4	8.5E4	8.1E4	7.8E4	7.2E4
TDCF	1.2E9	1.2E9	1.3E9	1.3E9	1.4E9	1.4E9	1.4E9	1.4E9	1.5E9
e Gas									
WBDCF	5.5E4	4.9E4	4.5E4	3.9E4	3.5E4	3.2E4	3.1E4	2.9E4	2.7E4
TDCF	5.4E8	6.1E8	6.6E8	7.7E8	8.5E8	9.2E8	9.7E8	1.0E9	1.2E9
Others									
WBDCF	8.2E5	7.0E5	6.0E5	4.6E5	3.7E5	3.0E5	2.6E5	2.2E5	1.3E5
TDCF	3.8E8	4.6E8	5.3E8	6.2E8	6.9E8	7.4E8	7.9E8	8.3E8	1.0E9

WBDCF = S3 = ________

TDCF = S4 = ________

ATTACHMENT XI. HYDROGEN PURGE CALCULATION

The RAC shall complete this attachment should the Emergency Director (ED) decide that a hydrogen purge of the reactor building (RB) is necessary in compliance with EPIP 1004.4 Item 3.1.2.b. The purpose of this procedure is to provide the (ED) with guidelines for the reactor building ventillation flowrate.

1. Date ______ Time ______

2. Obtain and analyze a reactor building post-accident sample in accordance with EPIP 1004.31 Item 4.8. Determine the noble gas and radioiodine airborne concentrations in accordance with EPIP 1004-7 Attachment IX Item 2.1. List the noble gas airborne concentration (Item A1) and the radioiodine airborne concentration (Item A2) below.

   ____________ (A1) Noble gas airborne concentration $\left(\frac{uCi}{cc}\right)$

   ____________ (A2) Radioiodine airborne concentration $\left(\frac{uCi}{cc}\right)$

3. Determine the dispersion factor (X/Q) at the exclusion area (EA) in accordance with Attachment II. List the (EA) dispersion factor (as Item A3) below.

   ____________ (A3) Exclusion area (EA) dispersion factor $\left(\frac{sec}{meter^3}\right)$

4. Determine the whole body and thyroid dose conversion factors (DCF) in accordance with Attachment X. List the whole body DCF (WBDCF) as item A4 below. List the thyroid DCF (TDCF) as item A5 below.

   ____________ (A4) Whole body DCF $\frac{\frac{MREM}{HR}}{\frac{uCi}{cc}}$

   ____________ (A5) Thyroid DCF $\frac{\frac{MREM}{HR}}{\frac{uCi}{cc}}$

5. Calculate the (RB) ventillation flowrate that corresponds to 1000 $\frac{MREM}{HR}$ whole body dose rate as shown below.

   $2.2 \times 10^6 \div (\overline{\quad(A1)\quad} \times \overline{\quad(A3)\quad} \times \overline{\quad(A4)\quad}) = \overline{\quad(A6)\quad}$ CFM

6. Calculate the (RB) ventillation flowrate that corresponds to 5000 $\frac{MREM}{Hr}$ thyroid dose committment as shown below.

   $1.1 \times 10^7 \div (\overline{\quad(A2)\quad} \times \overline{\quad(A3)\quad} \times \overline{\quad(A5)\quad}) = \overline{\quad(A7)\quad}$ CFM

7. Compare calculated (RB) venitllation flowrates (items A6 and A7). Choose the most limiting of items A6 and A7. Explain to the ED that this flowrate would yield exclusion area dose rates consistent with EPIP 1004.4 criteria. Also, that continuation of the purge for one hour would yield dose rates consistent with the EPA lower limit PAG's.

ATTACHMENT XII THUMBRULES

-------------------------- Instructions for Utilizing Annex I --------------------------

1. Identify the release pathway. Select an effluent monitor.

2. Select the appropriate thumbrule form Table 1 or 2.

3. Complete the worksheet by calculating the ratio of actual to assumed conditions for the listed parameters. As an example;

   RM-A5 is reading 1E5 CPM (Enter in Col. B)
   Condenser off-gas flowrate is 10 SCFM (Enter in Col. C)
   The dispersion factor at the exclusion are ia 1E-5 $\frac{sec}{M3}$ (Enter in Col. D)

   Thumbrule No. 1 from Table 1 should be utilized. The worksheet should completed as follows:

Affected Monitor	Ratio Col. B	Ratio Col. C	Ratio D	Correction Factor	Uncorrected Dose Rate	Corrected Dose Rate
RM-A5	$\frac{1E5}{1E6}$ = .1	$\frac{10}{20}$ = .5	$\frac{1E-5}{1E-4}$ = .1	.1x.5x.1 = .005	.01 $\frac{MR}{HR}$	.01 x .005 = 5E-5 $\frac{MR}{HR}$

   The correction factor is the product of the individual parameter ratios. The corrected dose rate is the product of the correction factor and the uncorrected dose rate.

4. Enter the corrected dose rate on the dose assessment worksheet (Attachment VI). Attach to the dose assessment worksheet a completed <u>Worksheet D</u>. Enter "thumbrule" in items S1, S2, S3, S4 and S5.

ATTACHMENT XII - TABLE 1

Low Range RMS Thumbrules for Dose Protection
G = Gaseous Channel
RI = Radioiodine Channel

Column A	Column B	Column C	Column D	Column E
Monitor	Reading	Ventilation Flowrate	Dispersion Factor	Dose Rate
	CPM	CFM	sec/M3	MREM/HR WB
1. RM-A5G	1E6	20	1E-4	.01
2. RM-A8G	1E6	1E5	1E-4	50
3. RM-A8RI	1E4 *	1E5	1E-4	100 **
4. RM-A9G	1E6	5E4	1E-4	25
5. RM-A9RI	1E4 *	5E4	1E-4	50 **

* CPM/MIN

** MREM/HR Thyroid Dose Commitment

WORKSHEET D

Affected Monitor	Ratio Col. B	Ratio Col. C	Ratio Col. D	Correction Factor	Uncorrected Dose Rate	Corrected Dose Rate

ATTACHMENT XII - TABLE 2

High Range RMS Thumbrules for Dose Protection
G = Gaseous Channel

Column A	Column B	Column C	Column D	Column E
Monitor	Reading (CPM)	Ventilation Flowrate (CFM)	Dispersion Factor (sec/M3)	Dose Rate MREM/HR (WB)
1. RM-A5 High (G)	1E6	20	1E-4	25
2. RM-G25 (G)	3E3 *	20	1E-4	1
3. RM-G26 and 27***	1E3	5.6E6 **	1E-4	5
4. RM-A8 High (G)	1E2	1E5	1E-4	450
5. RM-A9 High (G)	1E3	1E4	1E-4	20
6. RM-G24 (G)	1E2 *	1E4	1E-4	10

* MR/HR

** lb/hr

*** Release via the condenser off-gas

WORKSHEET D

Affected Monitor	Ratio Col. B	Ratio Col. C	Ratio Col. D	Correction Factor	Uncorrected Dose Rate	Corrected Dose Rate