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FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

PLANT OPERATING MANUAL

EMERGENCY PLAN IMPLEMENTING PROCEDURE

EM-204B

OFF-SITE DOSE ASSESSMENT DURING RADIOLOGICAL EMERGENCIES (USER INSTRUCTIONS FOR RADDOSE-IV)

TABLE OF CONTENTS

1.0 **PURPOSE**

The RADDOSE-IV Computer model provides a method to evaluate the magnitude of a radiological release from CR-3, to track the plume, and to estimate offsite exposure. This procedure contains operating instructions for RADDOSE-IV and information to be used in developing program inputs.
[NOCS 00387, 00388, 00389, 01029, 01062, 01128, 01582, 01589, 01592, 05647 12210, 13040, 13140, 040188, 040771,]

2.0 **REFERENCES**

2.1 **Developmental References**

2.1.1 RADDOSE-IV Operator's Manual

2.1.2 RADDOSE-IV Detailed Design Manual

2.1.3 RADDOSE-IV Verification & Validation Manual

2.1.4 CR-3 Radiological Emergency Response Plan (RERP)

2.1.5 EM-202, Duties of Emergency Coordinator

2.1.6 Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA-400-R-92-001 Environmental Protection Agency (October, 1991).

2.1.7 Nuclear Regulatory Commission Response Technical Manual.

2.1.8 Final Safety Analysis Report.

2.1.9 Engineering Evaluation EEF-00-009, Rev. 1 – Radiation Monitor Response Factors

3.0 **PERSONNEL INDOCTRINATION**

3.1 **Definitions**

3.1.1 **Advection Step** - ("time step" or "step") The entry of a set of meteorological and source term data into RADDOSE-IV and performance of calculations.

3.1.2 **Core Melt** - deformation of fuel pellet configuration due to excessive core temperature releasing large quantities of gaseous and particulate fission products.

3.1.3 **Delta T** – a measurement of the difference in air temperature between two different elevations above ground level. The value provides a measure of the atmospheric stability.

3.1.4 **Depletion** - reduction of the concentration of the plume (i.e., deposition and dispersion).

3.1.5 **Deposition** - a means of puff depletion that deposits particulate radioactive material on the ground.

3.1.6 **Field** - the space provided on the monitor for one value on the meteorological and source term entry screens.

3.1.7 **Gas Gap Failure** - degradation of the protective cladding around the fuel pellets due to elevated core temperature releasing only radionuclides contained in the space between pellet and the cladding.

3.1.8 **Sea breeze Effect** - a wind circulation system produced when the land temperature is higher than the ocean temperature causing a lower level wind direction from sea to land.

3.1.9 **Sigma-Theta** - The standard deviation of a set of wind range measurements. The Sigma-Theta meter automatically calculates and displays the standard deviation of wind range for the previous 15 minutes.

3.1.10 **Stability Class** - a lettering system from A to G to designate certain atmospheric conditions which affect the dispersion of the plume. Class A indicates rapid dispersion (unstable conditions) and class G indicates slow dispersion (stable conditions).

3.2 Responsibilities

3.2.1 The Emergency Coordinator (EC) is responsible for ensuring the Dose Assessment Team is aware of plant conditions related to offsite dose projections.

3.2.2 The Dose Assessment Team is responsible for the implementation of this procedure.

3.3 Limits & Precautions

3.3.1 Protective Action Guideline doses from the Environmental Protection Agency are 1 REM TEDE and 5 REM Thyroid at the site boundary (0.83 miles) or beyond. EM-202 Enclosure 1 specifies conditions in which site boundary dose or dose rate may require declaration of a Site Area Emergency or General Emergency.

3.3.2 The RADDOSE-IV model has several switches (options) that may be set during program startup which affect the method the model uses to calculate doses. The calculation switches have been pre-set, but further details are available in the Operator's Manual, Section 2.3.1.

3.3.3 Detailed instructions, notes, and cautions are provided on various screens depending on input and parameters.

3.3.4 Doses calculated by RADDOSE-IV are approximately two times the doses calculated by the NRC's RASCAL model. To perform a reasonable comparison, inputs to both models must match as closely as possible (i.e., isotopic distribution, Ci/sec, meteorological data, exposure location, and exposure duration).

3.3.5 In a station blackout, the following instrumentation is available:

- __ RM-A1, RM-A2 meters and detectors powered, but pumps are not available.
- __ RM-Gs 1, 3, 5, 7, 9, 11, 25, 26, 27, 28, 29, 30.
- __ RM-Ls 2, 7.
- __ Primary Meteorological Tower local (at the tower) readouts only.

3.3.6 Recorder AH-32-FIR Channel D indicates total Reactor Building stack flow and is the correct flow to use when using RM-A1 as the RADDOSE-IV release method. AH-294-FT measures Reactor Building purge flow rate only and does not include make up flow.

3.3.7 As of April 2001, RADDOSE-IV has been placed on the Standard Desktop. Running RADDOSE-IV on any standard desktop PC will over-write any other RADDOSE-IV model run in progress. Therefore, two versions of the code have been installed: RADDOSE-IV – TSC and RADDOSE-IV – EOF. These two versions will not over-write each other. Therefore, during an event/drill, it is important that only one computer in each facility log on to their designated version of the code.

4.0 INSTRUCTIONS

4.1 Communications

4.1.1 Using the Dose Assessment Ringdown Telephone, LIFT the receiver and ESTABLISH communications among the TSC and EOF Dose Assessment Teams (DATs) and the Dose Assessment Communicator in the Control Room monitoring radiological and meteorological data. [NOCS 00387]

4.1.2 IF the Dose Assessment Ringdown telephone is inoperable, THEN REFER TO Enclosure 2 for instruction on establishing a conference call on the conventional telephone.

4.1.3 REQUEST the Dose Assessment Communicator in the Control Room SCAN the monitors and provide all abnormal readings (especially effluent monitors).

4.1.4 IF it is suspected that the RM-A1/A2 low range monitor will reach off scale, THEN REQUEST the Accident Assessment Ringdown Communicator in the Control Room to have the Superintendent Shift Operations direct operators to switch the low/medium/high valve controller to the AUTO position.

4.2 Program Startup

NOTE

RADDOSE-IV is available on any computer with the standard desktop. The TSC and EOF dose assessment computers have an icon installed on the desktop. At the TSC, the icon will initiate the RADDOSE-IV – TSC version and in the EOF, the icon will initiate the RADDOSE-IV – EOF version. On other computers, the program is located at Start, Programs, Regulatory Affairs, CR3, RADDOSE-IV, RADDOSE-IV EOF or RADDOSE-IV TSC.

NOTE

RADDOSE-IV will not reboot if closed by using the ‘X’ in the upper-right corner. Always close out of RADDOSE-IV by using the RADDOSE-IV Exit Menu.

4.2.1 IF the dose assessment computer fails, THEN CONSIDER the following alternatives:

- o Use another computer with the standard desktop.
- o OBTAIN dose projection data from the other facility (TSC or EOF) as appropriate.
- o USE EM-204(A) as backup dose assessment.
- o INSTALL (by contacting NIT personnel) RADDOSE-IV on another computer. REFER TO Enclosure 3 for program installation instructions.

4.2.2 LOG ON to computer using your OT number and password. (As of 4/2/01, the generic dose assessment logon ID is no longer valid).

4.2.3 START RADDOSE-IV by double clicking on the RADDOSE-IV icon on the desktop.

4.2.4 ACKNOWLEDGE Current Switch Settings (options for decay and depletion calculations, etc.).

4.2.5 From the Startup Menu, SELECT either:

- o Begin New Incident - This selection erases previously stored data and displays the Accident Definition Screen.

or

- o Continue Previous Incident - This selection recalls all entries and calculations for the previous incident and allows continuation.

4.2.6 IF previous incident data has been stored on a diskette(s),
THEN REFER TO Enclosure 6 for loading instructions.

4.3 Data Input

4.3.1 OBTAIN Meteorological data and radiological data from the Control Room or by using the plant computer. REFER TO Enclosure 4 for plant computer instructions. [NOCS 00387]

4.3.2 RECORD input data on Enclosure 5, Input Data Sheet for RADDOSE-IV if desirable.

4.3.3 Accident Scenario Definition Screen

ENTER the following information:

- o Trip/decay start date
- o Trip/decay start time
- o Release date
- o Release time
- o Time step (normally 30 minute increments)
- o Sea breeze effects (normally "ON")
- o Operator's initials

4.3.4 Meteorological Data Input Screen

4.3.4.1 USE the following priority when collecting wind speed, wind direction and outside air temperature:

1. 33' Primary Tower
2. 175' Primary Tower
3. 33' Alternate Tower (only source for Sigma-Theta, precipitation rate).

4.3.4.2 IF Sigma-Theta is not available,
THEN USE Delta T or the wind range to establish the stability class.
REFER to Enclosure 7, Alternate Methods for Determining Meteorological Data, for use of wind range.

4.3.4.3 IF Control Room instrumentation is used to obtain meteorological data,
THEN ENSURE that values for wind speed, average wind direction, and wind range are determined using the average of the previous 15 minutes as displayed on the appropriate recorder.

4.3.4.4 From the Main Menu, SELECT "Enter/Edit Meteorological Data."

4.3.4.5 ENTER the following data (if not available from the plant computer or the Control Room, REFER TO Enclosure 7):

- o Wind speed (meters/second, 15-minute average)
- o Wind direction from (degrees, 15-minute average)
- o Sigma-Theta **or**
- o Delta T (degrees F) **or**
- o Stability class (entered directly, see Enclosure 7)
- o Outside air temperature (degrees F)
- o Precipitation rate (inches/15 minutes)

4.3.4.6 IF there has not been any recorded rainfall,
THEN ENTER a "0" for "precipitation rate."

NOTE

This feature could be used to enter data for several steps at one time (e.g., from release start time to present time).

4.3.4.7 After all the meteorological data for the current step have been entered, ADD another step by PRESSING the [Insert] key if desirable.

4.3.4.8 PRESS the Down Arrow key and the Up Arrow key to move between the steps.

4.3.4.9 After all the meteorological data have been entered, PRESS the [F9] key to accept and continue.

4.3.5 Source Term Data Entry Screen

NOTE

Enclosure 1 provides reference source terms for dose assessment.

4.3.5.1 From the Main Menu, SELECT "Enter/Edit Source Term Data."

4.3.5.2 DETERMINE the appropriate Accident Type and proceed to the indicated section.

4.3.5.3 - Loss of Coolant Accident (LOCAN, LOCAG, LOCAC)
4.3.5.4 - Fuel Handling Accident (FHA)
4.3.5.5 - Waste Gas Decay Tank Rupture (WGDTR)
4.3.5.6 - Steam Generator Tube Rupture (SGTRN, SGTRG, SGTRC)

4.3.5.3 **Loss of Coolant Accident:**

NOTE
Offsite doses for LOCAN (no fuel damage) are not likely to exceed 1 REM TEDE or 5 REM Thyroid.

1. SELECT and ENTER the appropriate LOCA Accident Type based on the status of the core (REFER TO Enclosure 8):

   LOCAN - no fuel damage, normal RCS
   LOCAG - gas gap failure
   LOCAC - core melt

2. SELECT and ENTER one of the following Release Methods for Noble Gas (NG MTHD) and Iodine (I MTHD) based on the information available. REFER TO Enclosure 9 for more information on Release Methods:

   RMA1 - ENTER RM-A1 cpm (NG and/or I) and Reactor Building vent CFM from recorder AH-32-FIR Channel D. Use for LOCA inside the Reactor Building with a purge in progress.

   RMA2 - ENTER RM-A2 cpm (NG and/or I) and Auxiliary Building vent CFM. Use for LOCA inside the Auxiliary Building (e.g., Letdown leak, Spent Fuel Cooling leak) or LOCA inside the Reactor Building with leak into the Auxiliary Building (e.g., penetration failure).

   CONC - ENTER μCi/cc (NG and/or I) and release point CFM. Reactor Building concentrations may be obtained from RM-A6, PASS, RM-A1 Mid or High Range, grab samples, RM-G29/30.
   Auxiliary Building concentrations may be obtained from RM-A2 Mid or High Range, RM-A3, RM-A4, RM-A7, RM-A8, PASS, grab samples.

   EFFL - ENTER isotopic μCi/cc (NG and I) and release point CFM. Obtain isotopic concentrations from PASS, analysis of grab sample.

   DRECT - ENTER calculated Ci/sec (NG and/or I). Calculated values may be obtained via Enclosure 11 (RM-A1, RM-A2, RM-G29/30 and RM-G25/28), Enclosure 13 (I/NG Ratios), and/or Enclosure 15 (Onsite Plume Measurement).

   DEFLT - Program supplies default Ci/sec.

   RATIO - This method should not be used for the first time step, as that would use default ratios that are likely not the best estimate for actual conditions. Enclosure 13 should be used to determine an I/NG ratio and calculate a Ci/sec release rate for DRECT input. Once an iodine to noble gas ratio has been established, and there is no reason to believe it has changed, then this method may be chosen in subsequent steps. This will enter the iodine release rate based on the same NG/I ratio from the previous step.

3. GO TO Section 4.3.5.7.

4.3.5.4 **Fuel Handling Accident:**

1. ENTER FHA as the Accident Type.

2. SELECT and ENTER one of the following Release Methods for Noble Gas (NG MTHD) and Iodine (I MTHD) based on the information available. REFER TO Enclosure 9 for more information on Release Methods.

   RMA1 - ENTER RM-A1 cpm (NG and/or I) and Reactor Building vent CFM from recorder AH-32-FIR Channel D. Use for FHA inside the Reactor Building with a purge in progress.

   RMA2 - ENTER RM-A2 cpm (NG and/or I) and Auxiliary Building vent CFM. Use for FHA in the Auxiliary Building.

   CONC - ENTER µCi/cc (NG and/or I) and release point CFM. Reactor Building concentrations may be obtained from RM-A6, PASS, RM-A1 Mid or High Range, grab samples, RM-G29/30.
   Auxiliary Building concentrations may be obtained from RM-A2 Mid or High Range, RM-A4, RM-A8, PASS, grab samples.

   EFFL - ENTER isotopic µCi/cc (NG and I) and release point CFM. Obtain isotopic concentrations from PASS, analysis of grab sample.

   DRECT - ENTER calculated Ci/sec (NG and/or I). Calculated values may be obtained via Enclosure 11 (RM-A1, RM-A2, RM-G29/30 and RM-G25/28), Enclosure 13 (I/NG Ratios), and/or Enclosure 15 (Onsite Plume Measurement).

   DEFLT - Program supplies default Ci/sec.

3. GO TO Section 4.3.5.7.

4.3.5.5 **Waste Gas Decay Tank Rupture:**

NOTE
Offsite doses for a WGDTR are not likely to exceed 1 REM TEDE or 5 REM Thyroid.

1. ENTER WGDTR as the Accident Type.

2. SELECT and ENTER one of the following Release Methods for Noble Gas (NG MTHD) and Iodine (I MTHD) based on the information available. REFER TO Enclosure 9 for more information on Release Methods:

   RMA2 - ENTER RM-A2 cpm (NG and/or I) and Auxiliary Building vent CFM.

   CONC - ENTER μCi/cc (NG and/or I) and release point CFM Concentrations may be obtained from RM-A2 Mid or High Range, RM-A8, RM-A11, PASS, grab samples.

   EFFL - ENTER isotopic μCi/cc (NG and I) and release point CFM. Obtain isotopic concentrations from PASS, analysis of grab sample.

   DRECT - ENTER calculated Ci/sec (NG and/or I). Calculated values may be obtained via Enclosure 11 (RM-A2), Enclosure 13 (I/NG Ratios), and/or Enclosure 15 (Onsite Plume Measurement).

   DEFLT - Program supplies default Ci/sec.

3. GO TO Section 4.3.5.7.

4.3.5.6 **Steam Generator Tube Rupture:**

NOTE
Offsite doses for a SGTRN (no fuel damage) are not likely to exceed 1 REM TEDE or 5 REM Thyroid.

1. SELECT and ENTER the appropriate SGTR Accident Type based on the status of the core (REFER TO Enclosure 8):

   SGTRN - no fuel damage, normal RCS
   SGTRG - gas gap failure
   SGTRC - core melt

2. REFER TO Enclosure 10 for information on calculating source terms.

3. SELECT and ENTER one of the following Release Methods for Noble Gas (NG MTHD) and Iodine (I MTHD) based on the information available.

   RMA2 - ENTER RM-A2 Noble Gas cpm, iodine channel cpm and Auxiliary Building vent CFM. Use when the affected generator is steaming to the condenser.

   DRECT - ENTER calculated Ci/sec (NG and/or I) from Enclosure 10 (SGTR), Enclosure 11 (RM-A2 and RM-G25/28), Enclosure 13 (I/NG Ratios), and/or Enclosure 15 (Onsite Plume Measurement).

   CONC - ENTER μCi/cc (NG and/or I) and release point CFM. Concentrations may be obtained from RM-A2 Mid or High Range, RM-A4, RM-A12, RM-G25/28, PASS, and grab samples.

   EFFL - ENTER isotopic μCi/cc (NG and I) and release point CFM. Obtain isotopic concentrations from PASS, analysis of grab sample.

   DEFLT - Program supplies default Ci/sec.

4.3.5.7 IF multiple accidents or multiple release points for the same accident are to be entered, THEN REFER TO Enclosure 12 for specific instructions.

4.3.5.8 After all the source term data for the current step have been entered, ADD another step by PRESSING the [Insert] key and FOLLOWING instructions beginning at Section 4.3.5.2, if desirable.

4.3.5.9 IF more steps are added,
THEN PRESS the [Tab] key to move forward or the [Shift][Tab] keys to move backward.

4.3.5.10 After all source term data have been entered, PRESS the [F9] key to accept and continue.

4.3.5.11 From the Main Menu, SELECT "Perform Calculations" (not required on first step).

4.3.5.12 REVIEW the plume map and dose rates displayed after the calculations are complete and PRESS any key to continue.

4.3.5.13 To view or print results, SELECT "Output Menu" from the Main Menu.

4.3.5.14 To perform a forecast, REFER TO Section 4.4.5.

4.3.5.15 IF more steps have been entered,
AND it is desirable to complete all calculations before printing. THEN SELECT "Continue with Calculations" from the Main Menu.

4.3.5.16 After the plume map for each step is displayed, CONTINUE to SELECT "Continue with Calculations" until all steps have been calculated.

4.3.5.17 From the Main Menu, SELECT "Output Menu."

4.4 Data Output

4.4.1 Dose Rates at User-entered Locations

NOTE

Plume centerline dose rates are automatically calculated at 0.83, 2, 5, and 10 miles. Dose rates can be calculated at user-entered locations. Dose rates at user-enter locations will appear in the printed reports.

4.4.1.1 SELECT "Display PLUME CENTERLINE Dose Rates" from the Output Menu.

4.4.1.2 ENTER the Ring Distance in miles (distance from the plant) and the Direction in degrees (or "M" for plume centerline maximum).

4.4.1.3 PRESS [F9] to calculate.

4.4.1.4 REPEAT as necessary, PRESS [Esc] when finished.

4.4.2 Displayed Reports

4.4.2.1 To display maps or the tabular results of dose, dose rates, and/or deposition calculations, SELECT any of the "Display" options listed on the Output Menu.

4.4.3 Printed Reports

4.4.3.1 From the Output Menu, SELECT "Go to Report Menu."

NOTE

The Dose/Dose Rate Report, the Deposition Report, and the Complete Report contain detailed tabular results of calculations. In most cases, the "Summary Report" will be sufficient.

4.4.3.2 From the Report Menu, SELECT the "Summary Report" which includes the following:

- o Header Page
- o 10 mile Map
- o Maximum dose rates for 0.83, 2, 5, and 10 mile distances, dose rates at any user selected points, and dose rates and accumulated doses at special receptors.
- o A flag to consider Protective Action Recommendations (PARs), if needed.

4.4.3.3 REVIEW the following information on the Header Page:

- o Trip/decay start date and time
- o Release date and time

- Projection number (step)
- List of program switches (e.g., source decay, etc.)
- Meteorological data including mixing height
- Source term data
- Release rates for Noble Gas, Iodine, and particulates
- Cumulative release data
- Isotope % abundance

4.4.3.4 After the printout is complete, SELECT "Output Menu" from the Report Options Menu.

NOTE

If data for one or more steps have been entered but not calculated, the program will automatically begin the next step calculation and display the plume map as in Section 4.3.5.12. If no more data have been entered, the cycle of data entry, calculation, and reporting starts again as in Section 4.3.4.

4.4.4 From the Output Menu, SELECT "Continue With Calculations."

4.4.5 Performing a Forecast

NOTE

After at least one step has been calculated, the Forecast option is available. This option can be used to project dose information and plume position two or more hours into the future based one set of meteorological and source term inputs. Doses will be calculated for the Forecast period only.

4.4.5.1 ENTER meteorological and source term inputs to be used for the forecast period as described in Sections 4.3.4 and 4.3.5.

4.4.5.2 From the Main Menu, SELECT "Performing a Forecast."

4.4.5.3 ENTER the forecast period in multiples of two hours (e.g., 2, 4, 6, 8 hours, etc.).

4.4.5.4 PRESS the [F9] key to accept and continue.

NOTE

On the 10 mile EPZ map displayed after a forecast calculation, the dose units are mREM accumulated during the forecast period NOT mR/hr. However, the printed report is in mR/hr.

4.4.5.5 DISPLAY or PRINT the forecast results just as with a real-time (normal) step if needed.

4.4.6 Before performing the next step after the forecast, REVIEW the meteorological and source term data and CORRECT as necessary as described in Sections 4.3.4 and 4.3.5.

4.4.7 Correcting and Recalculating a Step

4.4.7.1 COMPARE field measurements received from the Offsite Radiation Monitoring Team with calculated values (i.e., Noble Gas/Iodine ratios, dose rates, dose, etc.) obtained from RADDOSE-IV.

4.4.7.2 IF calculated values seem inconsistent with field team data,
THEN REFER TO EM-219 section 4.5.

4.4.7.3 IF incorrect data are discovered for a previous step,
THEN REFER TO Enclosure 14 for correction/recalculation instructions.

4.5 Protective Actions Recommendation

4.5.1 IF dose projections equal or exceed 1 REM TEDE or 5 REM Thyroid at the site boundary (0.83 miles),
THEN NOTIFY the EC to CONSIDER public protective action recommendations.

4.6 Documentation

4.6.1 FORWARD all documentation created in the TSC to the Radiation Controls Coordinator for review as time permits.

4.6.2 TRANSMIT the documentation to Document Services under EM-204(B).

REFERENCE SOURCE TERMS FOR DOSE ASSESSMENT [NOCS 40771]

As a reference for dose assessment calculations, the following source terms are an indication of approximately 1 mR/hr DDE and 1 mR/hr Thyroid at the site boundary.

LOCA/SGTR (Fresh source term)
5E-2 Noble Gas Ci/sec ≈ 1 mR/hr DDE
7E-5 Total Iodine Ci/sec ≈ 1 mR/hr Thyroid

FHA/WGDTR (Decayed source term)
3E-1 Noble Gas Ci/sec ≈ 1 mR/hr DDE
7E-6 Total Iodine Ci/sec ≈ 1 mR/hr Thyroid

Met Data Assumptions:
Wind Speed = 1 m/sec
Wind Direction = 270°
Stability Class = E
Temperature = 80° F
Rain = 0 inches/15 min

RELEASES FROM THE AUXILIARY BUILDING

The following RM-A2 readings yield the above source terms for noble gas and hence correspond to approximately 1 mR/hr:

LOCA/SGTR: Gas Monitor = 4E4 cpm
FHA/WGDTR: Gas Monitor = 2E5 cpm

Assumes vent flow of 156,000 cfm and a monitor conversion factor of 1.7E-8 μCi/cc per cpm (inverse of 5.9E7 cpm per μCi/cc). Use of the iodine monitor to estimate iodine releases is not recommended due to the likelihood of interferences from noble gases. Obtain a grab sample or use Enclosure 13.

RELEASES FROM THE REACTOR BUILDING

The following RM-A1 readings yield the above source terms for noble gas and hence correspond to approximately 1 mR/hr::

LOCA: Gas monitor = 1.2E5 cpm
FHA: Gas monitor = 7E5 cpm

Assumes RB vent flow rate of 50,000 cfm and monitor conversion factor of 1.7E-8 μCi/cc per cpm. Use of the iodine monitor to estimate iodine releases is not recommended due to the likelihood of interferences from noble gases. Obtain a grab sample or use Enclosure 13.

Assuming a Reactor Building Design Basis Leakage flow rate of 3.5 cfm, the following Reactor Building atmosphere concentrations are required to yield the above source terms:

Noble Gas μCi/cc = 3E+1   Iodine μCi/cc = 4E-2

CONFERENCE CALL INSTRUCTIONS

Communications should first be established between the Dose Assessment Communicator in the Control Room (providing met and rad monitor information) and the TSC Dose Assessment Team (DAT). Once the EOF DAT is established, it should be tied into the conference call as soon as possible. (A conference call can be initiated by any of the parties using the appropriate phone numbers.)

Dose assessment phone extensions are posted at the Dose Assessment Ringdown Phones in the Control Room, in the TSC, and EOF dose assessment rooms.

1. The Dose Assessment Communicator to the Control Room should establish communication with the TSC DAT.
2. Hookflash * (receive a stutter dial tone), then dial the EOF DAT extension.
3. Hookflash, and receive the feature dial tone.
4. Dial access code 4 to establish the conference.
5. If the extension at the EOF cannot be reached, hookflash again and communication with the TSC will be re-established.

*A hookflash is quickly depressing and releasing the connection button.

INSTALLING RADDOSE-IV

1.0 The program is contained on one 3 1/2" 1.4 MB diskette marked "FPC RADDOSE-IV, Version 2.0" stored in TSC procedure cabinet with EM-204 (B) or in the EOF Dose Assessment Cabinet.

2.0 If Directory "RD4V2" already exists, go to 2.3.

2.1 Create a directory called "RD4V2" on drive C and make this the current directory. Type the following lines in the DOS Command Prompt window:

```
C:
CD\
MD\RD4V2
CD\RD4V2
```

2.2 If Directory "RD4V2" has just been created, go to 3.0.

2.3 If this directory already exists, delete all files by typing:

```
CD\RD4V2
DEL *.*
Y
```

3.0 Insert the RADDOSE-IV disk into drive A.

4.0 Run the installation program by typing "A:FPCINST."

5.0 Prompts are provided for the type printer to be used.

6.0 When installation is complete, a prompt will confirm the model is correctly installed.

7.0 There are additional data files on disk that must be copied manually. Leave disk inserted and type the following at the prompt:

```
COPY A:\DF\*.*
```

8.0 To start the program, type "FPC" at the DOS prompt.

DATA FROM THE PLANT COMPUTER [NOCS 40188]

This Enclosure contains four methods for obtaining data from the plant computer. Select the most appropriate method. Not all methods may be available. Data can also be obtained directly from the Control Room.

DYNAMIC DATA EXCHANGE SPREADSHEET - Live data from radiation monitors and meteorological instruments displayed in an Excel spreadsheet.

1. Double-click on the PICS icon.
2. Access Control Client box :
   a. In the "Choose a system" box, Select CR3 PPCS.
   b. In the User Name box, type either tsc or eof.
   c. In the Password box, type either tsc or eof.
   d. Click LogOn.
3. Minimize the PICS Access Control Client window.
4. In Windows Explorer, go to the c:\apps\Pics\RtdbDde directory and double- click on RtdbDde.exe file. When the hourglass disappears, go to the next step.
5. Start Excel.
6. Open the file c:\My Documents\Dde\RADMET.xls
7. Click Yes to update all linked information.

SPDS DISPLAYS – Live operational data, graphs, and selected radiation monitors.

1. Double-click on the PICS icon.
2. Access Control Client box :
   a. In the "Choose a system" box, Select CR3 PPCS.
   b. In the User Name box, type either tsc or eof.
   c. In the Password box, type either tsc or eof.
   d. Click LogOn.
3. In the PICS Access Control Client window, double-click on the SPDS Display icon.
4. When the SPDS graphic screen is displayed, press the "A" key to display the Alpha pages. Page 7 of 8 displays RM-G29/30, RM-A6, RM-L1, RM-A1 low-range, RM-A2 low-range, RM-A12, RM-Gs25-28, RM-L2, RM-L7, RM-G1, RM-A5.

PICS ARCHIVE RETRIEVAL – Data from any point recorded in the PICS Real Time Database downloaded per the user specifications of point selection, time selection, and time intervals.

1. Double-click on the PICS icon.

2. Access Control Client box :
   a. In the "Choose a system" box, Select CR3 PPCS.
   b. In the User Name box, type either tsc or eof.
   c. In the Password box, type either tsc or eof.
   d. Click LogOn.

3. In the PICS Access Control Client window, double-click on the Retrieval icon.

4. In the PDRSrtrv box, select File, New Retrieval.

5. On the Simple Retrieval Query Form:
   a. Enter start and stop times of desired data.
   b. Select Fixed Width Text.
   c. Enter file name and path for output file.
   d. Enter Snapshot interval (time between data points).
   e. Highlight point to read and click Select. Repeat as needed.
   f. Add point EVI-1 to the point selection list.
   g. Click Submit.

6. Start Excel.

7. Open the output file from 5.c above.

8. In the Text Import Wizard box:
   a. Select Fixed Width.
   b. Click Finish.

REDAS USE FOR DOSE ASSESSMENT

> **NOTE**
>
> There are tentative plans to eliminate REDAS in the near future.

I. LOGGING ON THE NETWORK

Dose assessment team members log on using your OT number and password.

II. REDAS ACCESS & INITIAL SET-UP

1. From the Desktop menu, double click on the REDAS icon.
2. REDAS Network Accessor box is displayed, click on **OK**.
3. Select **Request**, then **Request Group**.
4. Verify that Standard Group, Sort By Name, and ASCII Tabular File Format have been selected.
5. Specify Start & End Dates & Times. To change parameters, click on the box, then enter dates/times. Specify at least one hour.

III. SELECTING REDAS GROUPS & DOWNLOADING

The order in which groups are selected is not important, however, all four dose assessment groups must be downloaded before importing the data into the Lotus spread sheet.

Group Names:

AA_ENG	Engineering Instruments
AA_MET	Meteorological Instruments
AA_RADAL	Air and Liquid Radiation Monitors
AA_RADG	General Area Radiation Monitors

1. Click on **AA_ENG.**
2. Verify Frequency is 15 minutes and Average box is checked.
3. Click on **OK**. All download parameters will be displayed in a "Group Confirmation" window. If data are correct, click on **Yes**. Otherwise, click on **No** to return to previous screen.
4. Downloading will start, and should take less than 1 minute. While downloading is taking place, the "Data Request Status" window will be active.
5. When downloading is complete, the "REDAS-NIS" window will be displayed.
6. Click on **OK** in the "REDAS-NIS" screen.
7. Select **Request**, then **Request Group**.
8. Click on **AA_MET**.
9. Verify Frequency is 15 minutes and Average box is checked.
10. Click on **OK** to accept download settings.
11. Verify settings in "Group Confirmation" window. Click on **Yes** to accept & begin download.
12. When downloading is complete, the "REDAS-NIS" window will be displayed.
13. Click on **OK** in the "REDAS-NIS" screen.
14. Select **Request**, then **Request Group**.
15. Click on **AA-RADAL**.
16. Verify Frequency is 15 minutes and Average box is checked.
17. Click on **OK** to accept download settings.
18. Verify settings in "Group Confirmation" window. Click on Yes to accept & begin download.
19. When downloading is complete, the "REDAS-NIS" window will be displayed.
20. Click on **OK** in the "REDAS-NIS" screen.
21. Select **Request**, then **Request Group**.
22. Click on **AA_RADG**.
23. Verify Frequency is 15 minutes and Average box is checked.
24. Click on **OK** to accept download settings.
25. Verify settings in "Group Confirmation" window. Click on **Yes** to accept & begin download.
26. When downloading is complete, the "REDAS-NIS" window will be displayed.
27. Click on **OK** in the "REDAS-NIS" screen.

28. Start Excel.

29. Open the output file desired (normally C:\My Documents|data\excel\redas\Aa_eng.txt, etc.).

30. Text Import Wizard Step 1 of 3:
In the Original Data Type, select Delimited then click Next.

31. Text Import Wizard Step 2 of 3:
In the Delimiters, select Comma then click Next.

32. Text Import Wizard Step 3 of 3:
In the Column data format, select General then click Finish.

METEOROLOGICAL INPUT SHEET FOR RADDOSE-IV

DATE/TIME OF TRIP:________________________ DATE/TIME OF RELEASE:________________________

Sources listed by priority – enter number of source data used in each column heading

1. 33ft Primary Tower
2. 175ft Primary Tower
3. 33ft Alternate Tower
4. Other______________

METEOROLOGICAL DATA

ADVECTION STEP	DATE	DATA TIME	WIND SPEED m/sec	WIND DIRECTION DEGREES	Sigma Theta DEGREES or WIND RANGE DEGREES Or Delta T (Deg F)	STABILITY CLASS	AMBIENT TEMPERATURE DEGREES F	RAIN INCHES Per 15 min

RADIOLOGICAL DATA SHEET FOR RADDOSE-IV

ACCIDENT TYPES

LOCAN - Loss of Coolant Accident, Normal RCS
LOCAG - Loss of Coolant Accident, Gas Gap Failure
LOCAC - Loss of Coolant Accident, Core Melt
FHA - Fuel Handling Accident
SGTRN - Steam Generator Tube Rupture, Normal RCS
SGTRG - Steam Generator Tube Rupture, Gas Gap Failure
SGTRC - Steam Generator Tube Rupture, Core Melt
WGDTR - Waste Gas Decay Tank Rupture

RELEASE METHODS

RMA1 - RM-A1 Monitor (cpm)
RMA2 - RM-A2 Monitor (cpm)
CONC - Concentration/Flowrate (µCi/cc)
EFFL - Effluent Isotope Inventory (µCi/cc)
DRECT - Direct Input (Ci/sec)
DEFLT - Default Release Rate (Ci/sec)
RATIO - Iodine based on Noble Gas

SOURCE TERM DATA

ADVECTION STEP	DATE	DATA TIME	ACCIDENT TYPE	SCFM	NOBLE GAS METHOD	GAS MONITOR CPM	*GAS µCi/CC or Ci/sec*	IODINE METHOD	IODINE MONITOR CPM	IODINE µCi/cc or Ci/sec*

* If the Method is DRECT or DEFLT, enter Ci/sec in the Gas µCi/cc and/or the Iodine µCi/cc columns and mark the values with an *.

COPYING RADDOSE-IV DATA FILES

1.0 To copy an incident from the hard disk to formatted floppy diskettes, select "SAVE DATA TO DISK" from the startup menu. This may require several diskettes.

1.1 Insert a diskette in drive A when prompted. Label each diskette with the files it contains (e.g., MET and Source Data), so the files can be restored correctly to the hard disk later. Any files on the diskette will be overwritten.

2.0 To copy an incident from diskettes to the hard disk, type "RETRIEVE" from the C:\RD4V2\> prompt.

2.1 Insert the diskettes into drive A when prompted. Any files on the hard disk with the same name will be overwritten.

ALTERNATE METHODS FOR DETERMINING METEOROLOGICAL DATA

1. Wind direction, wind speed, and wind range can be estimated by observing cooling tower vapor, flags, fossil stack smoke, etc.

2. Stability class can be estimated using wind range if a wind direction recorder is available. Wind range is the difference (in degrees) between the highest and lowest wind direction tracing on the recorder for a 15 minute period. Use this difference and the following table to determine stability class. DO NOT ENTER WIND RANGE INTO THE SIGMA-THETA FIELD.

WIND RANGE DEGREES	STABILITY CLASS
≥ 135	A (disperses rapidly)
134 to 105	B
104 to 75	C
74 to 45	D
44 to 23	E
22 to 13	F
≤ 12	G (disperses slowly)

3. Enter the stability class into the CLS field of the Meteorological Data Input screen

4. Wind direction is determined by estimating the average value of the tracing for a 15 minute period.

5. Meteorological data may also be obtained from the following, however, non-local backup sources may not be representative.

   Primary Backup - FAA Flight Service Station in Gainesville, FL.
   Secondary Backup - Tampa Weather Service in Ruskin, FL.

SELECTION OF ACCIDENT TYPE

This enclosure lists three methods of selecting accident type based on the level of core damage. Each method has advantages and disadvantages. Use the most appropriate method (or combination) to predict the level of core damage.

Based on RM-G29 and RM-G30 readings:	Page 1 of 2
Based on Iodine ratio:	Page 1 of 2
Based on RCS pressure and temperature:	Page 2 of 2

BASED ON RM-G29 AND RM-G30:

This method can be performed quickly but requires a breach of the Reactor Coolant System and that the Reactor Building atmosphere be thoroughly mixed (which may take several hours).

Obtain RM-G29 and RM-G30 readings. Ignore spikes and estimate the sustained monitor reading. Use this value with the following data to determine accident type.

RM-G29/30 R/HR	ACCIDENT TYPE
<100	LOCAN
100 - 25000 WITH RB SPRAY	LOCAG
100 - 75000 WITHOUT RB SPRAY	LOCAG
>25000 WITH RB SPRAY	LOCAC
>75000 WITHOUT RB SPRAY	LOCAC

BASED ON IODINE RATIOS

This method requires a gamma isotopic of a grab sample and hence may take several hours.

Analyze a liquid or gas sample representative of the post-accident source term. Determine the ratio of I-131 to Total Iodine.

I-131/Total Iodine < 0.05 – Assume LOCAN or SGTRN
I-131/Total Iodine ≥ 0.05 – Assume LOCAG or SGTRG

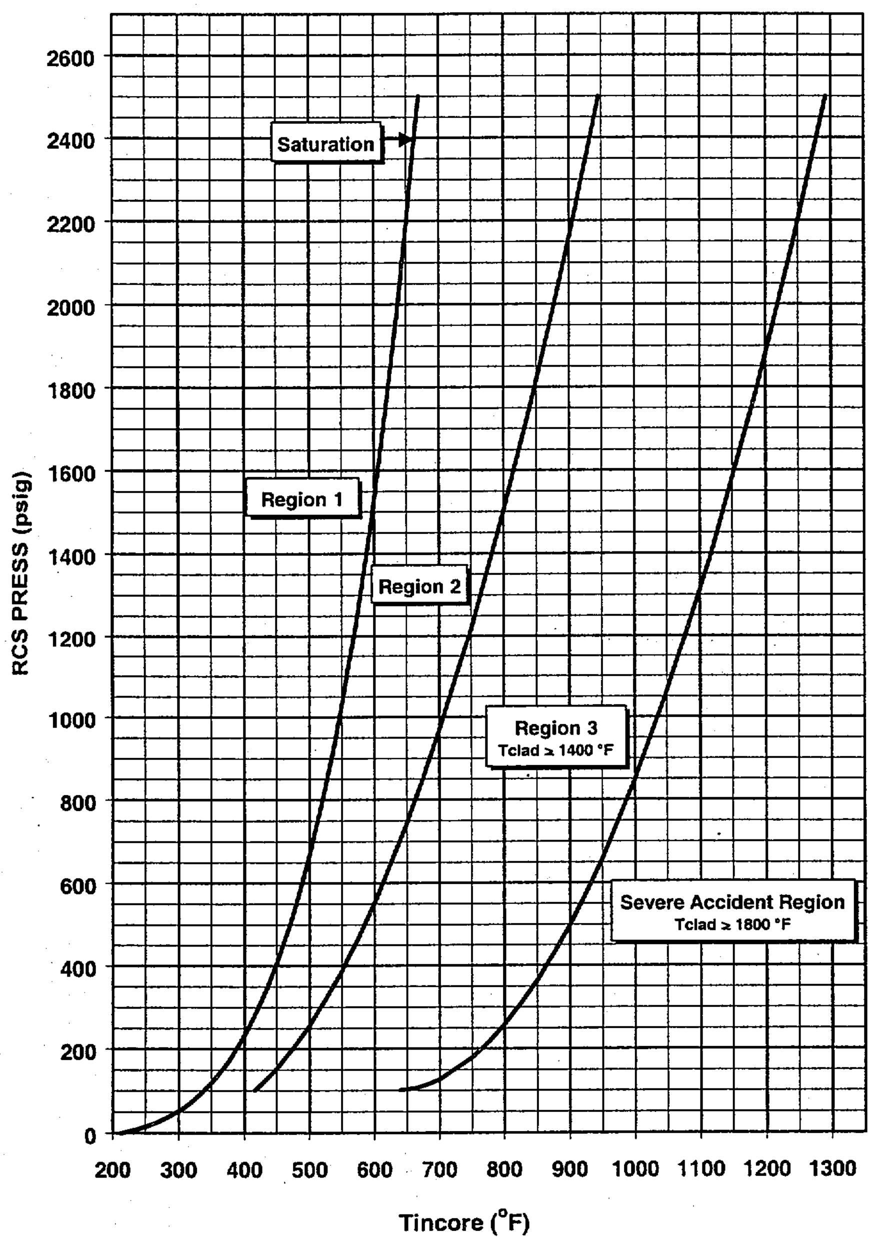
There is no way to distinguish between a gap release and a core melt release using iodine ratios.

SELECTION OF ACCIDENT TYPE

BASED ON RCS PRESSURE AND TEMPERATURE:

This method can be performed quickly but will not indicate mechanically-induced core damage. The intersection of pressure from the Y axis and temperature from the X axis is the level of core damage. (Regions are from the Inadequate Core Cooling procedure used by Operations.)

Regions 1 and 2 indicate no fuel damage (normal RCS activity).
Region 3 indicates possible gas gap failure.
Severe Accident Region indicates possible core melt.



NOBLE GAS AND IODINE - METHODS DESCRIPTIONS

1. RM-A1 or RM-A2 – Low Range Effluent monitor cpm/Flowrate

   The user must enter a specific RM-A1 monitor reading in cpm and a flow rate in SCFM in the Reactor Building vent or a specific RM-A2 monitor reading in cpm and a flow rate in SCFM in the Auxiliary Building vent. The release rate in Ci/sec is then calculated and displayed on the screen. It may be used for Noble Gas and/or Iodine. If the iodine filter has not been changed, the filter μCi for the previous step is subtracted from the current value. On the first step, the model assumes previous filter μCi is zero. Use of the iodine monitor readings is not recommended due to the high potential for inaccuracies.

2. CONC - Concentration/Flowrate

   The user must enter μCi/cc from a grab sample or an estimated μCi/cc and a flowrate measurement or estimate (in SCFM) at the release point. It may be used for Noble Gas and/or Iodne. If this method is used for Iodine, the program asks if the concentration is I-131 only. If I-131 only, the program adds other Iodine isotopes in appropriate ratios. The release rate in Ci/sec is then calculated and displayed on the screen.

3. EFFL - Effluent Isotope Entry

   The Isotope Screen is displayed and the user must enter isotopic concentrations in μCi/cc from a grab sample or from the Post Accident Sampling System. Press the [Enter] key to input the concentration and to move to the next isotope. At least one noble gas and one iodine isotope must be entered. The release rate in Ci/sec is then displayed on the screen. Once a distribution has been entered, the program will retain it until a new distribution is entered or until the accident type is re-entered.

4. DRECT - Direct Input

   The user must enter a calculated release rate in Ci/sec for Noble Gas and/or Iodine. Enclosure 10 includes a method for calculating the noble gas and iodine release rate from the ADV's/MSSV's based on RCS activity for a SGTRN. Enclosure 11 includes worksheets for calculating the noble gas release rate from the following sources:
   a. Low, mid, and high range readings on RM-A1
   b. Low, mid, and high range readings on RM-A2
   c. Containment Releases based on RM-G29/30
   d. ADV/MSSV releases based on RM-G25/28

   Enclosure 15 provides a method for estimating the noble gas release rate based on an onsite plume measurement.

   Enclosure 13 provides a method to determine iodine release rates based on the noble gas release rate and iodine to noble gas ratios and recommended iodine decontamination factors.

5. DEFLT - Default

   The program enters the default value in Ci/sec for a particular accident type. It may be used for Noble Gas and/or Iodine. Default values should be used only as a last resort to calculate an upper limit dose rate. Protective Action Recommendations should not be based on a default calculation.

6. RATIO - Ratio of Noble Gas to Iodine (LOCA ONLY)

   This method is no longer recommended for the first time step as it will enter default ratios that may not be representative of current conditions. There are too many important variables not addressed by this simplistic approach. Enclosure 13 should be used to calculate an iodine release rate if sample or monitor readings are unavailable or unreliable. For subsequent time steps, if there is no reason to believe the NG/I ratio has changed, then this method can be used to have RADDOSE-IV enter the iodine release rate based on the ratio from the previous time step.

STEAM GENERATOR TUBE RUPTURE EVALUATION

Instructions: Determine whether the leaking OTSG is/was steaming to the condenseror to the atmosphereduring the release period. Then refer to the appropriate section below and on the next page to develop source terms.
Background Information: Emergency Operating Procedures direct operators to continue to use both steam generators for RCS cooling until mode 5 is reached unless specific parameters are exceeded. These parameters are part of the Tube Rupture Alternate Control Criteria (TRACC) and involve RCS activity, BWST level, and OTSG level. If the condenser is available (vacuum established), steam will be directed there. Noble gases will be discharged from the condenser through the Auxiliary Building Ventilation and RM-A2. If the condenser is not available, steam will be discharged through the Atmospheric Dump Valves. Periodic steam releases through the Main Steam Safety Valves may occur immediately after a reactor trip. Computer points W354, W355, RECL114, RECL115 track ADVs percent open. Downloading intervals of 1 minute or less over the period of the time step may be useful in determining minutes that the ADVs are open.

I. **LEAKING OTSG STEAMING TO THE CONDENSER** (Use only if no continuous or intermittent releases from ADV's/MSSV's)

NOBLE GAS:

- Use RMA2 Release Method for RM-A2 low-range or Enclosure 11, Page 2 and the DRECT method for the mid or high range.
- Enter RM-A2 low-range monitor cpm or mid or high-range Ci/sec and the Auxiliary Building Vent CFM.

IODINE:

- If there are Iodine channel indications that appear reasonable, use RMA2 Release Method.
- Enter RM-A2 Iodine channel cpm and the Auxiliary Building Vent CFM.
- If the Iodine channel is off-scale, or considered unreliable, use the I/NG ratio in Enclosure 13 to calculate Ci/sec and enter using the DRECT Release Method.

II. **LEAKING OTSG STEAMING TO THE ATMOSPHERE CONTINUOUSLY**

If releases are via the ADV and RM-G25/28 are available, then use Enclosure 11, Page 4 to estimate the release rate of noble gases and Enclosure 13 to determine the iodine release rate – enter using the DRECT method. If there are no releases from the ADV's or the rad monitors are unavailable, use the following:

NOBLE GAS:

- Use DRECT Release Method.
- Ci/sec = (_____μCi/cc NG in RCS) (_____gpm P→S Leak Rate) (6.3E-5) (_____ fraction of time there are releases directly to atmosphere)
- In the above equation, the release rate equals the primary-to-secondary Ci/sec.

IODINE:

- Use DRECT Release Method.
- Ci/sec = (_____μCi/cc Total I in RCS) (_____gpm P→S Leak Rate) (6.3E-5) (_____ fraction of time there are releases directly to atmosphere)
- In the above equation, the release rate equals the primary-to-secondary Ci/sec.

STEAM GENERATOR TUBE RUPTURE EVALUATION

ADDITIONAL INFORMATION

- RM-G26 and RM-G27 are N-16 monitors calibrated to read in gallons per day at 100% power.
- It is assumed that all noble gas activity leaking into the OTSG will be released via the AB stack (RM-A2), MSSVs/ADVs, or EFP-2.
- If core integrity is maintained, activity is based on the most recent RCS activity. RM-L1 may be used to scale this value as transients cause spikes in RCS activity.
- 1 gpm = 63 cc/s
- Maximum Leak Rate = 400 gpm (for one tube)
- Default Flow Rate through stuck open MSSV/ADV = 3E7 cc/sec = 6E4 cfm

DERIVATION OF CONSTANTS USED IN THE SOURCE TERM EQUATIONS

$$6.3E-5 = \left[\frac{1\text{Ci}}{1\text{E}6\mu\text{Ci}} \times \frac{3780\text{ cc}}{1\text{ Gal}} \times \frac{1\text{ min}}{60\text{ sec}}\right]$$

Performed by: ______________________ Date/Time ______________________

Verified by: ______________________ Date/Time ______________________

REFERENCE DOSE RATES FOR A STEAM GENERATOR TUBE RUPTURE [NOCS 40771]

The following dose rates should be used as reference points and can be adjusted based on actual conditions. For example, actual coolant activity levels will likely be less than the assumed value. Offsite doses for a SGTRN should not exceed 1 REM TEDE or 5 REM Thyroid.

DOSE RATES AT 0.83 MILES

1 mR/hr - DDE
30 mR/hr - Thyroid (CDE):
4 mR/hr - TEDE

RELEASE CONDITIONS

Reactor Coolant Activity (Normal)

1.0 µCi/gm Total NG

1.0 µCi/gm Total Iodines

100 GPM primary-to-secondary leak rate (Note -1 tube results in approximately 360 GPM)

Releases directly to atmosphere via ADV

Noble Gas Ci/sec = 4.4E-3

Iodine Ci/sec = 4.4E-3

Meteorological Conditions:

Wind Speed - 1 m/s (2.2 mph)

Stability Class - E (stable)

Rain - 0 inches/15 minutes

Temperature - 80°F

Wind Direction - 270° (from due West)

Noble Gas Release Rate from
RB Purge Exhaust Duct
Based on RM-A1

INPUT DATA			
A. Rx Shutdown: Date:		Time:	
B. Met/Rad Data: Date:		Time:	
C. Advection Step Time Period:	From:	To:	
D. RM-A1 Low Range Gas Reading: or		cpm	
E. RM-A1 Mid Range Gas Reading: or		mR/hr	
F. RM-A1 High Range Gas Reading:		mR/hr	
G. RB Exhaust Flow - from AH-717-FT or 50,000 cfm default:		cfm	
RELEASE RATE ESTIMATE			
H. Time since Rx Shutdown (B-A)		hours	
I. Enter or circle conversion factor:			
Low Range Gas - from Calib. Curve: Slope = Inverse of slope = or 1.7E-8 μCi/cc per cpm default		μCi/cc per cpm	
	μCi/cc per mR/hr		
Mid or High Range Gas	Mid	High	
From 0 to 4 hours post Rx shutdown:	0.03	9.0	
From 4 to 24 hours post Rx shutdown:	0.06	16	
For ≥ 24 hours post Rx shutdown:	0.13	34	

Release Rate = ________ x ________ x ________ x 4.7E-4* = ________
Ci/sec D, E, or F G I Ci/sec

* 4.7E-4 = 472 cc/sec per cfm x 1E-6 Ci/μCi

Completed by: ______________________ Date/Time: ______________

Verified by: ______________________ Date/Time: ______________

Noble Gas Release Rate from AB/FH Exhaust Duct Based on RM-A2

INPUT DATA			
A. Rx Shutdown Date:		Time:	
B. Met/Rad Data: Date:		Time:	
C. Advection Step Time Period:	From:	To:	
D. RM-A2 Low Range Gas Reading: or		cpm	
E. RM-A2 Mid Range Gas Reading: or		mR/hr	
F. RM-A2 High Range Gas Reading:		mR/hr	
G. AB Exhaust Flow - from AH-32-FT or 156,000 cfm default:		cfm	
RELEASE RATE ESTIMATE			
H. Time since Rx shutdown (B-A)		hours	
I. Enter or circle conversion factor:			
Low Range Gas - from Calib. Curve Slope = Inverse of slope = or 1.7E-8 µCi/cc per cpm default		µCi/cc per cpm	
	µCi/cc per mR/hr		
Mid or High Range Gas	Mid	High	
From 0 to 4 hours post Rx shutdown:	0.04	9.0	
From 4 to 24 hours post Rx shutdown:	0.07	16	
For ≥ 24 hours post Rx shutdown:	0.13	34	

Release Rate = ________ x ________ x ________ x 4.7E-4* = __________
Ci/sec D, E, or F G I Ci/sec

* 4.7E-4 = 472 cc/sec per cfm x 1E-6 Ci/µCi

Completed by: ______________________ Date/Time: ________________

Verified by: ______________________ Date/Time: ________________

Noble Gas/Iodine Release Rate from Containment Based on RM-G29/G30

INPUT DATA			
A. Release Time: Date:		Time:	
B. Advection Step Time Period	From:	To:	
C. RM-G29 Reading:		R/hr	
D. RM-G30 Reading:		R/hr	
E. RB Pressure:		psig	
F. Estimated RB hole size:		in^2	
G. RB Sprays: Circle one:	ON OFF		
RELEASE RATE ESTIMATE			
H. Circle Noble Gas Factor:	Sprays On - 0.02 µCi/cc per R/hr Sprays Off - 0.007 µCi/cc per R/hr		
I. Circle Iodine Factor:	Sprays On - 0.0006 µCi/cc per R/hr Sprays Off - 0.005 µCi/cc per R/hr		
J. Flow =	145 x (_____ psig $)^{1/2}$ x _____ in^2 = _____ CFM*** (E) (F) (J)		
K. Noble Gas Release Rate	_____R/hr x _____ µCi/cc / R/hr x _____ CFM x 4.7E-4** = _____ Ci/sec (C or D*) (H) (J)		
L. Iodine Release Rate	_____R/hr x _____ µCi/cc / R/hr x _____ CFM x 4.7E-4** = _____ Ci/sec (C or D*) (I) (J)		

Notes:
* - The lowest of the two RM-G readings is the preferred reading.
** - 4.7E-4 = 472 cc/sec per CFM x 1E-6 Ci/µCi
*** - If for a projected RB purge, directly enter the projected purge CFM
If for a "What if" the RB inventory is all released in 1 hr, enter 3E4 CFM

Completed by: ________________ Date/Time: ________________

Verified by: ________________ Date/Time: ________________

Noble Gas Release Rate from Main Steam Safeties or ADV's Based on RM-G25 or RM-G28

INPUT DATA			
A. Rx Shutdown Date:		Time:	
B. Met/Rad Data: Date:		Time:	
C. Advection Time Period:	From:	To:	
D. RM-G25 Reading: or		mR/hr - monitors A OTSG ADV line	
E. RM-G28 Reading:		mR/hr - monitors B OTSG ADV line	
F. Number of ADV/Safeties open on affected SG (1 - 9):			
G. Fraction of time releases in progress on affected OTSG (0 - 1):			

RELEASE RATE ESTIMATE		
H. Time since RX Shutdown (B - A):		hours
I. Circle conversion factor:		
From 0 to 4 hours post Rx shutdown:	0.03 µCi/cc per mR/hr	
From 4 to 12 hours post Rx shutdown:	0.1 µCi/cc per mR/hr	
For ≥ 12 hours post Rx shutdown:	0.3 µCi/cc per mR/hr	

Release Rate = ______ x ______ x ______ x ______ x 30* = ______ Ci/sec
(D or E) (F) (G) (I)

* 30 = Estimated flow of 3E7 cc/sec per open valve x 1E-6 Ci/µCi

Completed by: ______________________ Date/Time: ______________________

Verified by: ______________________ Date/Time: ______________________

INSTRUCTIONS FOR ENTERING MULTIPLE ACCIDENTS AND RELEASE POINTS

Source terms from three different release points (from one or more accidents) may be entered in each step. Multiple release points could be associated with the same accident (e.g., from RM-A2 and safety relief valves during SGTR) or multiple accidents could cause releases from different points (e.g., LOCA from Containment and WGDTR from RM-A2).

1.0 Entering Multiple Accidents

1.1 After all source term data on line 1 of the current step have been entered, press the down arrow key to move to line 2.

1.2 Press [F2] to access the Accident Menu.

1.3 Select another accident and press [ENTER].

1.4 Enter all source term data for the new accident.

1.5 If a release terminates, enter "NONE" in the Accident Type field.

1.6 Up to three different accidents may be entered in the current step. When all data are correct, press [F9].

2.0 Entering Multiple Release Points for the Same Accident

2.1 After all source term data on line 1 of the current step have been entered, press the down arrow key to move to line 2.

2.2 Press [F2] to access the Accident Menu.

2.3 To enter another release point, select the same accident type again and press [ENTER].

2.4 Enter all source term data for the new release point.

2.5 If a release terminates, enter "NONE" in the Accident Type field.

2.6 Up to three separate release points may be entered in the current step. When all data are correct, press [F9].

Iodine Release Rate
Based on Iodine/Noble Gas Ratio

INPUT DATA		
Advection Time Period:	From:	To:
Assumed Release Path:		
A. Noble Gas Release Rate:		Ci/sec

RELEASE RATE ESTIMATE

B. Base Iodine/Noble Gas Ratio (circle the most appropriate value)

1.	FHA (ratio at pool/cavity water surface)	1E-3
2.	WGDTR (ratio at tank release)	1E-4
3.	LOCAN/SGTRN (0-3 hours post shutdown)	1
4.	LOCAN/SGTRN (>3 hrs post shutdown)	10
5.	LOCAG/SGTRG (released from fuel)	0.5
6.	LOCAC/SGTRC (released from fuel)	0.2

C. Iodine Decontamination Factors (DF) - Enter DF for each removal mechanism that exists and multiply together to obtain Total DF:

Partitioning (LOCA's/SGTR's) – from water flashing - Default DF = 5	______
Plateout (LOCA's/SGTR's) - in containment or OTSG - Default DF = 3	X ______
RB Sprays – Default DF = 10 for 0-2 hrs or 100 for >2 hrs of spray time	X ______
SGTR Release via condenser – Default DF = 1000	X ______
RB/AB Exhaust filters – Default DF = 20	X ______
TOTAL DF:	Total = ______

D. Total Iodine Release Rate:

I Release Rate = ______ X ______ ÷ ______ = ______
NG Rate (A) Base Ratio (B) Total DF (C) Ci/sec

Completed by: ______________________ Date/Time: ______________________

Verified by: ______________________ Date/Time: ______________________

INSTRUCTIONS FOR CORRECTING AND RECALCULATING A TIME STEP

To correct an error in a previous time step, it is necessary to return to both the meteorological data screen and the source term data screen. To recalculate the time step, perform the following:

1. From the Main Menu, select "Enter Meteorological Data," even if all data are correct.
2. If all meteorological data are correct, press [F9]. Go to 6 below.
3. Use the Up Arrow Key to return to the incorrect time step.
4. Use the Right and Left Arrow Keys to return to the incorrect data.
5. Re-enter the data, press [F9].
6. From the Main Menu, select "Enter Source Term Data," even if all source term data are correct.
7. If all source term data are correct, press [F9]. Go to number 11 below.
8. Use the [Shift][Tab] keys to return to the incorrect time step.
9. Use the Right and Left Arrow Keys and/or the Up and Down Arrow Keys to return to the incorrect data. (Use the Up and down Arrow Keys to access multiple accidents within the time step.)
10. Re-enter the data and press [F9].
11. RADDOSE-IV may have added a new time step to both the meteorological and source term data screens by copying the data from the last calculated time step. Ensure this new data are correct then press [F9]. If the data for the new time step are not available yet, it can be corrected when obtained.
12. From the Main Menu, select "Perform Calculations." The program will now recalculate the incorrect time step and display the plume map.
13. It is necessary to recalculate all time steps after the error. Reprint reports as necessary and continue to select "Perform Calculations" or "Continue with calculations" until program returns to the current time step.

Noble Gas Release Rate
Based on Onsite Plume Measurement

NOTE: This method assumes reasonable assurance that measured dose rates represent near maximum plume concentrations.

Date of Measurement: ________________ Time of measurement: _______________

____________ x ___________ x ___________ x ___________ = ______________

Measured Dose Rate (mR/hr)*	x	Conv. Factor	x	Wind Speed (m/sec)	x	Decay Corr.	=	Noble Gas Release Rate (Ci/sec)

Conv. Factor:

0.18 for Elevated ** Release (e.g. - ADV)

0.03 for Ground Release

Decay Corr.:

Time Since Rx Shutdown	Corr. Factor
0 hr	1
1 hr	2
2 hr	4
4 hr	6
≥8 hr	10

* Measured dose rate is the maximum closed window reading found while traversing the plume within 400 meters of the release point.

** Elevated factor based on assumed effective release height of 400 ft. This requires a thermal buoyant plume such as from the ADV's. A release from the RB/AB vent would lie somewhere between the 2 factors and would depend on the ratio of the wind speed to the vent exit velocity. For conservatism use the ground factor for a vent release. Factors are based on RASCAL-3.0.1 runs.

Completed by: ____________________________ Date/Time: ____________________

Verified by: ______________________________ Date/Time: ____________________

Revision Summary for Rev. 31

1. Cover Page – changed type of procedure to R-Reference Use
2. Section 1.0 - Added all NOCS commitments to the list.
3. Section 3.1 – Added definition of Delta T
4. Section 4.1.4 – Added new step to proceduralize existing practice in more than one procedure to help ensure completion.
5. Section 4.2 – Added Note on proper method to close RADDOSE-IV
6. Section 4.2.1 – Corrected Title for NIT.
7. Section 4.3.4.2 – Clarified that Enclosure 7 provides guidance on wind range.
8. Sections 4.3.5.3/4/5/6 to delete reference to radiation monitor sensitivity curves that no longer exist. Also added Enclosure Titles for clarity.
9. Section 4.6.1 - Changed title of Dose Assessment Coordinator to Radiation Controls Coordinator
10. Section 4.6.2 – Changed title of Records Management to Document Services
11. Enclosure 4 – Updated correct selection for logging on to PICS
12. Enclosure 4 – Added note about the potential elimination of REDAS
13. Enclosure 11 – Clarified that an input entry line is the date and time of the data used, not the release time
14. Enclosure 13 – increased the font size of the division sign.
15. Minor editorial changes throughout.

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

PLANT OPERATING MANUAL

EMERGENCY PLAN IMPLEMENTING PROCEDURE

EM-219

DUTIES OF THE DOSE ASSESSMENT TEAM

TABLE OF CONTENTS

1.0 PURPOSE

1.1 The primary purpose of the Dose Assessment Team (DAT) is to provide dose assessment information for the Emergency Coordinator (EC) and the Emergency Operations Facility (EOF) Director.

Dose assessment is a component of determining both emergency classification and protective action recommendations.

This procedure provides guidance to the DAT for setting up operations in the Technical Support Center (TSC) and EOF (in conjunction with EM-204B), interfacing with the TSC Radiation Controls Coordinator and the EC in the TSC and with the EOF Radiation Controls Manager and EOF Director in the EOF, and comparing dose projections with actual data collected by the Off-site Radiation Monitoring Team.
[NOCS 00387, 01582, 01870, 010519, 013040]

2.0 REFERENCES

2.1 Developmental References

2.1.1 Radiological Emergency Response Plan (RERP)

2.1.2 RADDOSE IV Operator's Manual

2.1.3 Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA-400-R-92-001, Environmental Protection Agency (October, 1991)

3.0 PERSONNEL INDOCTRINATION

3.1 Definitions

3.1.1 **Committed Dose Equivalent (CDE)** - Dose to an organ due to the intake of radioactive materials.

3.1.2 **Deep Dose Equivalent (DDE)** - External whole body dose.

3.1.3 **Off-Site RMT** - The portion of the Radiation Monitoring Team (RMT) that performs environmental sampling within the Crystal River Energy Complex and within the 10 mile Emergency Planning Zone (EPZ). The Off-Site RMT is also referred to as the Environmental Survey Team (EST).

3.1.4 **Plume Tracking** - Locating, tracking, and monitoring radiological characteristics of an off-site release.

3.1.5 **Replacement Emergency Dose Assessment System (REDAS)** - System to retrieve and archive the meteorological, radiological, and operational data required for emergency dose assessment purposes.

3.1.6 **Thyroid Dose** - Dose to the thyroid due to intake of radioactive iodine.

3.1.7 **Total Dose (TEDE)** - The sum of external dose (DDE) and the equivalent amount of whole body dose due to individual organ uptakes.

3.2 **Responsibilities** [NOCS 13040]

3.2.1 The TSC DAT assumes primary responsibility for dose assessment from the time the TSC is operational until the Emergency Operations Facility (EOF) is operational and assumes the primary responsibility. However, prior to the EOF being declared operational, the EOF Dose Assessment Team may function as an extension of the TSC team and supply dose assessment information to the TSC. After the EOF team has assumed primary responsibility, the TSC team may function as an extension of the EOF team and supply dose assessment information to the EOF. [NOCS 10519]

3.2.2 The TSC Dose Assessment Status Board Keeper updates the appropriate TSC Dose Assessment Status Boards, plume tracking maps and Release Significance Category. The EOF Field Team Liaison updates the EOF Dose Assessment Status Board and the EOF Radiation Controls Manager ensures the Release Significance Category is updated. [NOCS 10519]

3.2.3 The DAT provides the TSC Radiation Controls Coordinator with the appropriate dose assessment information necessary for the EC to determine emergency classification and/or protective action recommendations (PARs). [NOCS 10519]

3.2.4 When the EOF is operational, responsibility for PARs transfers from the EC to the EOF Director. The EOF Radiation Controls Manager will then ensure the EOF Director is provided with the necessary dose assessment information.

3.2.5 The TSC Radiation Controls Coordinator and EOF Radiation Controls Manager each designate a DAT Leader from the responding DAT members.

3.2.6 The DAT Leaders at both the TSC and EOF assign personnel to the Dose Assessment Computer and REDAS Terminal.

3.2.7 The TSC Environmental Survey Team Dispatcher establishes communications with the Off-Site RMT. The EOF FP Field Team Liaison establishes communications with the TSC dispatcher.

3.2.8 The Environmental Survey Team Dispatcher directs the Off-Site RMT to appropriate locations. The EOF FP Field Team Liaison forwards to the dispatcher recommendations on field team deployment/sampling from the EOF Dose Assessment Team.

3.2.9 The DAT has the authority to carry out all instructions issued by the EC, EOF Director or the Chemistry or Radiation Protection leadership. [NOCS 10519]

3.3 **Limits and Precautions**

3.3.1 The estimated dose rates and measured dose rates will probably not be equal due to the numerous sources of uncertainty. All available data should be analyzed for credibility and considered in making informed decisions.

3.4 **Equipment & Materials**

3.4.1 Hand-held calculator

3.4.2 Equipment identified in EM-204(B), Off-Site Dose Assessment During Radiological Emergencies (Computer Method).

4.0 INSTRUCTIONS

4.1 Formation of the DAT

4.1.1 FORM the DAT at an Alert, Site Area Emergency or General Emergency classification as directed by the TSC Radiation Controls Coordinator and EOF Radiation Controls Manager.

4.1.2 ENSURE a DAT Leader is designated.

4.1.3 ENSURE a Dose Assessment Communicator is available in the Control Room to monitor radiological and meteorological instruments and relay data to the DAT as necessary.

4.1.4 ENSURE personnel are assigned to the Dose Assessment Computer and to access data from the plant computer.

4.2 Obtaining Equipment

NOTE
Procedures, enclosures, and supplies are available in the supply cabinet and procedure files in the Dose Assessment Room.

4.2.1 OBTAIN the following:

a. Hand-held calculator

b. Controlled Copies of EM-204(B) and additional copies of Enclosure 5 (input data sheets for RADDOSE-IV).

c. Controlled Copy of EM-210B and additional copies of Enclosure 4, "Emergency Monitoring Sheet."

4.3 Information from the Control Room

4.3.1 ESTABLISH communications with Dose Assessment Communicator in the Control Room and the DAT in the other facility (TSC or EOF) by use of the Dose Assessment Ringdown phone. REFER TO EM-204(B) Enclosure 2 for conference call instructions if necessary. [NOCS 00387]

4.3.2 ENSURE that the plant data computer operator is aware of any radiation monitors or meteorological instruments that are out of service.

4.3.3 OBTAIN meteorological and radiological data from REDAS and the Control Room (as needed). [NOCS 00387]

4.3.4 IF EM-204(A) dose assessment calculations were performed by Control Room personnel, THEN OBTAIN results.

4.3.5 REVIEW EM-204A data inputs and calculations performed in the Control Room to assist in formulating initial inputs into the computer dose assessment model.

4.3.6 IF it is suspected that the RM-A1/A2 low range monitor will go off scale, THEN REQUEST the Accident Assessment Ringdown Communicator in the Control Room to have the Superintendent Shift Operations direct operators to switch the low/medium/high valve controller to the AUTO position.

4.4 Performing Dose Assessment

4.4.1 PERFORM off-site dose assessment projections using guidance in EM-204(B).

4.4.2 PROVIDE off-site dose projections to the TSC Radiation Controls Coordinator or EOF Radiation Controls Manager.

4.4.3 KEEP the appropriate Dose Assessment status boards and plume tracking maps up-to-date.

4.4.4 CONTINUE to perform dose assessment operations in accordance with this procedure, unless otherwise directed.

4.4.5 KEEP Control Room personnel informed of release calculation results as necessary via the Dose Assessment Communicator in the Control Room or the Accident Assessment Ringdown communicators.

4.5 Field Team Interface

4.5.1 ESTABLISH contact with the Environmental Survey Team (EST) Dispatcher.

4.5.2 PROVIDE information to the EST Dispatcher to aid in plume location and tracking. Enclosure 4 provides guidelines for EST deployment.

4.5.3 OBTAIN local area dose rates, airborne activity levels, and any other pertinent information, such as, unusual weather conditions and wind shifts from the EST as needed.

4.5.4 COMPARE field measurements received from the Off-Site RMT with the calculated values (i.e., Noble Gas/Iodine ratios, doserates, dose, etc.) obtained from the computer model. REFER TO Enclosure 1.

4.5.5 IF the calculated values seem inconsistent with the field data,
THEN INFORM the TSC Radiation Controls Coordinator or EOF Radiation Controls Manager immediately,
AND VERIFY all calculations and Off-Site RMT data. Refer to Enclosure 3 for potential reasons for inconsistencies.

4.5.6 USE Enclosure 2 to record additional field team data a s necessary for review by the TSC Radiation Controls Coordinator, EOF Radiation Controls Manager, or for documentation purposes.

COMPARISON OF ESTIMATED DOSE RATES WITH FIELD MEASUREMENTS

INTRODUCTION:

Comparison of field measurements with RADDOSE-IV estimates of dose rates are made to assess the validity of the calculated dose projections and determine whether the source term being used for the dose rate calculations should be adjusted. This comparison is done to assist in validating dose projections that would be considered when making emergency classifications and/or protective action recommendations.

The results obtained from this enclosure should be considered guidance. Revisions to the calculated source term should be made only after careful consideration of all factors involved with the release. A listing of factors to consider and precautions in making conclusions are given in Enclosure 3.

In the first few hours following the start of a release, the need for rapid information transfer and decision making may have to be performed on a qualitative basis without the benefit of the completed forms provided in this enclosure. The forms are provided as a tool as time permits for a more quantitative assessment.

COMPARISON AND ADJUSTMENT METHODS:

> **NOTE**
>
> **RADDOSE-IV calculates plume centerline dose rates at 0.83, 2, 5, and 10 miles. If estimated dose rates are required at additional distances for comparison purposes, RADDOSE-IV can calculate dose rates at user-defined locations.**

There are three types of comparisons presented below:

Method A may be used for both noble gas and iodine source terms and determines the ratios between the field measurements and RADDOSE-IV dose rates.

Method B is for use on Iodine source term only and determines the ratio of Noble Gas μCi/cc to Iodine μCi/cc measured in the field and compares it to the ratio of Noble Gas Ci/sec and Iodine Ci/sec used in RADDOSE-IV.

Method C compares deposition data measured in the field with the levels calculated by RADDOSE IV.

Section D of this Enclosure provides a discussion on the use of these comparisons by the TSC Radiation Controls Coordinator or EOF Radiation Controls Manager in adjusting estimated source terms or dose consequences.

Method A -Noble Gas and Iodine Source Terms:

A.1.
- a. Record the noble gas gamma dose rate (window closed) measurements from the Off-Site RMT on Table 1. The location (distance and sector) and time are also recorded.
- b. Enter the RADDOSE-IV DDE dose rate estimates for the corresponding location (distance and sector) and time.
- c. Divide the noble gas field measurement value (mRem/hr) by the RADDOSE-IV DDE dose (mRem/hr) and record this ratio in Table 1.
- d. Perform A.1.a through A.1.c for each location.

A.2.
- a. Record the air concentrations for total iodine from the field measurements on Table 2. The location (distance and sector) and time are also recorded.
- b. Convert iodine air concentration to a thyroid dose rate by multiplying the iodine air concentration (μCi/cc) by the appropriate thyroid dose conversion factor (DFI, mRem/hr/μCi/cc) given at the bottom of Table 2(Use the same accident type as used in running RADDOSE IV.) Calculate the thyroid dose for each measured iodine air concentration given and record on Table 2.
- c. Enter the RADDOSE-IV thyroid dose rate estimate (mRem/hr) for the corresponding location (distance and sector) and time.
- d. Divide the thyroid dose rate based on field measurement air concentrations by the RADDOSE-IV thyroid dose rate estimates and record on Table 2.
- e. Perform A.2.a through A.2.d for each location.

A.3 Determine the median of the ratios of measured to calculated DDE dose rates. Enter the median of the ratios in the box provided below Table 1.

A.4. Repeat A.3 above for the Thyroid dose rate ratios in Table 2. Enter the ratio median in the box below Table 2.

A.5. All data should be provided to the TSC Radiation Controls Coordinator or EOF Radiation Controls Manager, who will review the data in accordance with Section D of this Enclosure.

Method B - Noble Gas to Iodine Ratio Comparison:

B.1. The noble gas to iodine ratio should be fairly consistent throughout the plume. However, at the edges of the plume, or to the side or below the plume, there can be measurable gamma dose rates from shine, but no measured iodine concentration. Comparisons should only be done if it is known the team was in the plume (Window open > 2 times window closed dose rates.)
Record on Table 3:
- time of field measurements
- the location (distance/sector)
- the Noble Gas (gamma) dose rate (DDE) measured in the field
- the Iodine µCi/cc measured in the field (total iodine).

B.2. Convert the DDE to Noble Gas µCi/cc by dividing by the Noble Gas Dose Conversion Factor (DFNG) given at the bottom of Table 3. (Use the same accident type as used in running RADDOSE IV.)

B.3. Calculate the field measurement (Noble Gas to Iodine) ratio by dividing the Noble Gas µCi/cc by the Iodine µCi/cc and record in the right hand column of Table 3.

B.4. Perform steps B.1, B.2, and B.3 for each location.

B.5. Calculate the average of the ratios by summing the ratios and dividing by the number of ratios. Enter into the appropriate formula below the Table 3.

B.6. Determine the RADDOSE-IV ratio by dividing the Noble Gas Ci/sec by the Iodine Ci/sec from the time step corresponding to the field measurement time. Enter into the appropriate formula below Table 3.

B.7. The Noble Gas to Iodine ratio in the field can now be compared to the Noble Gas to Iodine ratio used in RADDOSE-IV. All data should be provided to the TSC Radiation Controls Coordinator or EOF Radiation Controls Manager, who will review the data in accordance with Section D of this Enclosure.

Method C – Deposition Comparisons

C.1 Deposition modeling is extremely uncertain. The source term for particulate releases will likely not be known, especially as a function of time. The nuclide mix can be highly variable from the mix assumed. Deposition levels within the first few hours of an event will likely be dominated by the noble gas particulate daughters Rb-88 and Cs-138, which are not modeled by RADDOSE IV. Meteorological deposition models, particularly the deposition rate factor assumed, are highly variable and uncertain. Deposition levels can be highly variable within a short distance due to factors such as surface roughness, overhead tree covers, washout of activity to lower lying areas, etc. Models cannot predict this local variability. Therefore, once field team deposition data is available, it is recommended that any information or decisions based on deposition be based solely on the field measurements and not the model predictions. Therefore, there is no need for detailed forms for performance of comparisons between field team results and model results.

C.2 However, if it is desired to make a comparison of the measured field team deposition results to the RADDOSE IV predictions, the following conversion factor should be applied to the RADDOSE IV results:

RADDOSE IV $\mu Ci/m^2 \times 2.22E4 = dpm/100\ cm^2$

D. Review of Data Comparisons

D.1 It is recommended that if results compare within a factor of 3, the agreement should be considered good, and no adjustments should be made. If the results do not agree within a factor of 3, then adjustments to model inputs are recommended if the field team results are considered credible.

D.2 The TSC Radiation Controls Coordinator or EOF Radiation Controls Manager should review the comparison data. It is not expected that the model and field results will be consistent. Enclosure 3 provides a discussion of some of the more likely reasons there will be differences and uncertainties in the various results. The uncertainties in Enclosure 3 should be considered in trying to confirm the validity of any of the results and in making conclusions concerning offsite radiological conditions.

D.3 After review of the applicable data, the TSC Radiation Controls Coordinator or EOF Radiation Controls Manager will determine if adjustments should be made to the assumed model inputs to RADDOSE IV. Instructions will be provided to the Dose Assessment Team members running RADDOSE IV. These instructions should include a decision on whether past time periods run in RADDOSE IV should be corrected, or if the revised inputs should be used from that point forward.

TABLE 1

COMPARISON OF NOBLE GAS (GAMMA) FIELD MEASUREMENTS AND CALCULATED DEEP DOSE EQUIVALENT (DDE) DOSE RATE ESTIMATES

	TIME	LOCATION DISTANCE/ SECTOR	NOBLE GAS (GAMMA) FIELD MEASUREMENT mRem/hr.	RADDOSE-IV CALCULATED DDE mRem/hr.	FIELD / RADDOSE-IV
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Median*of Ratios = [ ]

*- To determine the median of the ratios, rank the ratios in ascending order. If there is an odd number of values, the middle value will be the median. If there is an even number of values, the median will be the average of the two values around the middle point.

Performed by: ______________________ Verified by: ______________________

TABLE 2

COMPARISON OF FIELD MEASUREMENTS AND CALCULATED THYROID DOSE RATE ESTIMATES

	TIME	LOCATION DISTANCE/ SECTOR	FIELD MEASUREMENT		RADDOSE IV THYROID DOSE RATE mRem/hr.	FIELD / RADDOSE-IV
			IODINE µCi/cc	THYROID DOSE RATE* mRem/hr		
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

* THYROID mRem/HR = (IODINE µCi/CC) X (DFI**)

Accident Type	**DFI (mRem/HR PER µCi/CC)
FHA	1.3E9
WGDTR	1.3E9
LOCAN	5E8
LOCAG	1E9
LOCAC	1E9
SGTRN	5E8
SGTRG	1E9
SGTRC	1E9

**DFI (DOSE FACTORS FOR IODINE) The DFI is a weighted average for total Iodine based on the distribution of Iodine isotopes in each accident type (The individual nuclide dose factors are based on Table 5.2 of EPA 400. DFI I-131 = 1.3E+9).

Median* of Ratios = [ ]

*- To determine the median of the ratios, rank the ratios in ascending order. If there is an odd number of values, the middle value will be the median. If there is an even number of values, the median will be the average of the two values around the middle point.

Performed by: ______________________ Verified by: ______________________

TABLE 3

COMPARISON OF NOBLE GAS TO IODINE RATIOS
FIELD AND RADDOSE-IV

	TIME	LOCATION DISTANCE/ SECTOR	FIELD MEASUREMENT			
			DDE mRem/HR	NG µCi/CC*	I µCi/CC	NG TO I RATIO
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

AVERAGE FIELD TEAM RATIO = ________________ ÷ ________________ = ______________
sum of the ratios | number of ratios | avg. field ratio

RADDOSE-IV RATIO = ______ NG CI/SEC ÷______ I CI/SEC = ____________
RADDOSE -IV RATIO

Accident Type	DFNG** (mRem/HR PER µCi/CC)
FHA	2E4
WGDTR	5E4
LOCAN	7E5
LOCAG	1E6
LOCAC	1E6
SGTRN	7E5
SGTRG	1E6
SGTRC	1E6

*NG µCi/CC = (DDE mRem/HR) ÷ (DFNG**)
**DFNG (DOSE FACTORS FOR NOBLE GAS) CALCULATED FROM EPA-400 TABLE 5.3

Performed by: ______________________________ Verified by: ___________________________________

Date:

FIELD TEAM DATA
mR/hr

Miles	Sector	Time:		Time:		Time:		Time:		Time:	
		DDE	THY	DDE	THY	DDE	THY	DDE	THY	DDE	THY

Uncertainties in Offsite Dose Assessment

A. General

A dose model is made up of 3 primary parts: an estimate of the source term, an estimate of the meteorological dispersion, and an estimate of the dose given a calculated concentration. All 3 of these parts are subject to many uncertainties, as listed below.

A field team measurement eliminates the first two parts of the dose model and hence all the associated uncertainties. However, it adds other uncertainties such as the use of an instantaneous reading as being representative of a time averaged dose.

The importance of the various uncertainties is very dependent on the exact conditions of the event in progress. There are no fixed rules that can be applied. Decisions based on radiological conditions will not be an exact science, but will be a subjective decision based on all available information and judgment.

Given the numerous significant uncertainties involved, it is not recommended that valuable time be spent trying to resolve differences between results (model vs. field team, utility compared to State or NRC, etc.) that are within the same order of magnitude. In most cases, such agreement should be considered good enough for decision-making.

B. Model – Source Term Uncertainties

The following are some of the uncertainties associated with estimating the source term for model input:

1. Unmonitored releases – it is very likely that for the more significant release events (when dose model results are more important) that the release will be unmonitored. This could result from a loss of all power to the radiation monitors or release paths that bypass the monitored pathways. In such cases there will be no measure of the magnitude of the radioactivity concentration, nor of the flow rates from the release pathway. Estimates based on default assumptions as to what the release might be for a given accident can be many orders of magnitude high or low as they are based on one set of conditions (e.g. – assumed amount of fuel failure or RCS concentration, assumed containment leak rate or tube rupture leak rate, etc.).

2. Radiation Monitor Uncertainties – if the release path is monitored, there are many uncertainties associated with the use of the radiation monitor results. These include:
   - High background from direct sources resulting from the accident giving unknown detector response to the general area dose rates.
   - Particulate daughter interference – the noble gas particulate daughters Rb-88 and Cs-138 will be 2 significant contributors to dose rates during the first few hours post trip, assuming some core damage. These particulates will plate out in the gas sample chamber or on the charcoal filter and mask any contribution from the noble gases or iodines the monitor is attempting to quantify.
   - Degraded conditions – degraded conditions during an accident could include loss of power or degraded voltage, high temperature and humidity, or monitor saturation. These conditions can significantly affect the monitor response.
   - Conversion factor dependence on mix – the monitor conversion factor is based on an assumed mix of nuclides, or even a single nuclide calibration. The mix of nuclides in an accident can be significantly different than that assumed resulting in an inappropriate conversion factor for that event.
   - Noble gas interference on iodine channels – for monitored pathways, the noble gas activity should be much higher than the iodine activity. Therefore, any response on the iodine monitor is likely due to noble gases being delayed in the charcoal cartridge (plus particulate daughter buildup). Iodine monitor results would likely significantly overestimate the iodine releases.

3. Highly Variable Release Rates – an accident will usually be associated with many transient conditions – more fuel will fail over time, radionuclide concentrations will build up in a building, flows from the source_volume will change as pressures change, or fans are brought back into service. Hence, the release rate is expected to be highly variable over short periods of time. One release rate must be chosen to represent the entire 15 or 30 minute model step. Should that be the peak release rate, the current release rate, or some estimated average, which may be difficult to make.

4. Iodine and particulate removal mechanisms -there are numerous mechanisms for the removal of iodines and particulates. These include partitioning, water scrubbing, washout, deposition, and filters. Each of these is highly dependent on the release path and conditions. For example, an OTSG tube rupture at a location below the secondary side water level will result in an iodine removal factor in the OTSG of approximately 100, compared to a DF of approximately 3 if the break is above the water level. Although default removal factors for iodine are incorporated into the dose procedures/models, they can be orders of magnitude off from actual conditions. Iodine levels will spike following a reactor trip, but noble gases will not. Hence, a constantly changing iodine to noble gas ratio with time can be expected.

5. Nuclide mix – the model has assumed mixes of nuclides for the various accident types. The accident mix could be significantly different, which will affect the dose per curie. For example, the normal coolant mix (LOCAN, SGTRN) of iodine has I-131 at 1% based on the past few cycles of actual RCS coolant sample results. However, what if the accident doesn't cause gross fuel clad damage, but causes 12 pins to start leaking. I-131 may now increase to 20% of the RCS mix. This would result in a 10 factor higher dose per Ci/sec, but would be uncompensated for in the model unless we entered grab sample isotopic results. If an isotopic analysis was obtained, that isotopic represents one isolated period of time in an ever changing nuclide mix period.

6. Sample representativeness – accident conditions could cause normal sample uncertainty issues to be amplified. For example, if the flow rate from the vent is not the normal flow rate the sample will not be isokinetic. If there is more water vapor in the sample due to leakage into the Auxiliary Building, it could affect sample line losses.

C. Model – Dispersion Uncertainties

1. Single Point Measurement/Straight Line Model – the model assumes that the plume goes in a straight line for the entire advection period based on a single location meteorological measurement. A wind field model, based on multiple meteorological data location inputs would in many cases predict a much different plume location, more representative of actual conditions. Hence the current simplified model may predict high doses where there is no dose, and no doses where there are high doses. This would include phenomenon such as the sea-breeze effect, where, for example, the indicated wind direction is from the West, but 3 miles inland, the westerly sea-breeze ends and the plume takes the direction of the prevailing local winds, even back to the east where there could be some reconcentration.

2. Release elevation – the CR3 RADDOSE IV model assumes all releases are at ground level. The recommended meteorological data to be used is the 33' data, representative of ground dispersion conditions. In most cases, the releases will be partially elevated. For AB/RB vent releases, the fraction that is ground and the fraction elevated depends on the ratio of the wind speed to the vent exit velocity. For containment failure events, even though the release point may be near ground, the containment air leaking out may be near 200 degrees and hence have thermal buoyancy. Releases from the ADV's and MSSV's will have both momentum and thermal plume rise and be essentially totally elevated. The wind direction for the elevated portion of the plume may be significantly different than the ground wind direction. Wind speeds could be a factor of 2 or 3 different. The plume touchdown point would be important as discussed below.

3. Plume touchdown point – since the CR3 RADDOSE IV model assumes all releases are at ground level, it always predicts a concentration at ground level. For elevated releases, plume touchdown may not be for several miles. For the DDE, this would only result in a difference of a factor of approximately 5 between an assumed ground release and a plume that is still 400 feet above the ground, as there will still be a gamma ray flux (shine) from the overhead cloud. However, for iodine, the code would predict ground level iodine concentrations resulting in a calculated thyroid dose when there would be no thyroid inhalation dose until the plume touched down.

4. Complicating factors – there are a number of real-life factors that affect the plume such that it does not behave as a straight-line gaussian function. These factors include building wake effects, low-wind speed plume meander, terrain effects, fumigation effects, lid reflection with variable lid height, buoyant gases or heavier than air gases, plume depletion due to decay and deposition, rainfall. Corrections are made from some of these factors, but each correction is a simplification that does not match reality and each adds more uncertainty.

D. Model – Dose Estimation

Compared to the significant uncertainties in the source term and dispersion estimates, the dose estimation part is more accurate. However, it is still prone to a number of uncertainties, including:

1. Time of exposure – since the EPA PAG's are in integrated dose, the calculated dose rate must be multiplied by an exposure time. That could be 1 hour or 5 hours before the release stops or the wind direction changes significantly.

2. Receptor – the dose could be calculated to the adult, or another age group such as the child or infant, who may not be the limiting individual depending on the dose pathways and mix of nuclides.

3. Standard man assumptions – built into the dose factors are many assumptions such as breathing rates and organ sizes. These factors vary for each individual. A jogger who is breathing heavy is going to receive a higher dose than that based on a standard man assumed breathing rate.

4. Finite cloud corrections – the model may assume that the plume is semi-infinite. This would overestimate the DDE, particularly for very stable conditions at the site boundary, where the actual plume may be very narrow. Finite cloud correction factors can be applied, but again this adds uncertainty and they are typically based on a fix nuclide mix.

E. Field Team Uncertainties

1. Finding the plume – as noted above, the plume may not be in the down wind sector as indicated by the single point meteorological tower. Hence, the field team may not be in the right location to monitor the plume. (Note however that a zero dose rate reading does provide important information – it provides the actual radiological conditions at that location, indicates that the model is not accurately predicting the plume if it had shown measurable dose rates at that location (at least as far as plume location), and combined with zero readings from other locations is part of a demonstration of a lack of a significant release.) If the field team is detecting activity, then it can be uncertain as to whether the team has found the maximum dose rates or is on the fringe of the plume.

2. Instantaneous Readings – the model provides time averaged dose rates over a 15 or 30 minute period. Field team readings are instantaneous. The plume will meander. It will not always be over the averaged plume centerline. Dose rates at what will be the time averaged plume centerline at any one instant could be close to zero. Dose rates 15 degrees off plume centerline could be higher than the calculated plume centerline dose rate for any one instant (For example - if the time averaged centerline dose rate is 1 R/hr, then for the periods of time that the plume is over the centerline, the dose rate right at the plume centerline must be greater than 1 R/hr to compensate for the times when the plume is off centerline and the dose rate at that location is close to 0. Hence, at a particular instance the plume centerline may be 15 degrees off of the time-averaged centerline and the dose there may be 3 R/hr.) Uncertainties associated with instantaneous data can be reduced by having the field team determine a time averaged dose rate over 5-15 minutes at the same location. However, this adds the uncertainty of trying to eyeball an average without a recorder on a varying dose rate meter.

3. Contamination – with the deposition of noble gas particulate daughters, there is a good possibility that once in the plume, the field team's survey meter, as well as their clothing and vehicle may become contaminated to the point that subsequent surveys are detecting dose rates from the contamination and not the plume. It could also become difficult to distinguish plume dose rates from shine dose rates from the contaminated ground.

4. Plume arrival time – the model, which is a 15 or 30-minute projection, may predict a dose rate at some distance downwind, yet the actual plume may not have traveled that far yet. Hence a field team may detect no dose rate, when there will be one in a few minutes. Likewise the field team may never catch up with a short -term puff release, where the release has stopped, but there is still a plume within the Emergency Planning Zone.

RADIOLOGICAL MONITORING TEAM DEPLOYMENT STRATEGY

NOTE

Every situation is different. No set of rules on monitoring team deployment will work for all situations. However, the following provides some general principles that could be employed in most cases. The guidance is limited to priorities within the first few hours of an event.

1. A dose rate survey taken close to the plant in all compass directions (or at least a 180 degree sweep centered on the perceived downwind direction) will provide a rapid indication of the order of magnitude plume dose rates. Therefore, as long as direct shine dose rates from sources such as the containment do not interfere with accurate plume readings, a walk around the berm would confirm the lack of a measurable plume or would readily find a plume maximum instantaneous dose rate. If sources onsite result in high direct dose rates, then this close-in dose rate survey could be performed at a distance of approximately 1000 ft. There is a system of roads to the fossil plants at this approximate distance that would make it possible to perform a 360 degree survey within a short time period. Note that this survey does not require a team with their full kit of air samplers, etc.

2. Once a plume is located and the general downwind location is known, two teams with survey meters should be located in the general downwind direction, close to the plant, approximately 2 or 3 sectors apart. They should continuously observe the plume dose rate. This will help distinguish whether changes in the measured dose rate are due to changes in the wind direction or changes in the release rate.

3. In most cases it will be important to get at least one air sample in the plume immediately. This is to confirm whether iodine is a significant contributor to the dose compared to the noble gases and establish a more credible iodine to noble gas ratio to be used in future calculations. Therefore, the Environmental Survey Team should find a location that they know is in the plume, by ensuring the window open dose rate reading is at least two times the window closed reading. Once the air sample is obtained, it is recommended that it be immediately transported for a gamma spectrum analysis. This is due to the high potential for noble gas and particulate interference on a gross count rate meter. If a ground release, this sample can likely be obtained on site (within the owner controlled area). If a vent release, the team may have to search at the approximate site boundary distance to ensure they are in the plume. If an effectively elevated release, such as from the ADV's, the plume may not touch down for many miles. Before an Environmental Survey team is dispatched a far distance to look for plume touchdown, it should be confirmed that the plume will have traveled that far by that time and that a second survey team is available to continue to survey close to the plant/site to ensure changing conditions are rapidly identified.

Revision Summary for Rev.16

1. Changed the title of the Dose Assessment Coordinator to TSC Radiation Controls Coordinator throughout the procedure.
2. Changed the title of the Corporate Health Physicist to EOF Radiation Controls Manager throughout the procedure.
3. Listed all NOCS commitments in Section 1.1
4. Expanded Section 3.2 - Responsibilities to include responsibilities being performed by the Dose Assessment Team in the EOF. These are not new responsibilities, but are being added to EM-219 to allow for the deletion of REP-04, Offsite Radiological Dose Assessment Methods for the Emergency Operations Facility
5. Deleted 3.3.2 as step was no longer required.
6. Added Step 4.3.6 to proceduralize an existing practice in more than one procedure to help ensure completion.
7. Enclosure 1, Page 2 – Deleted reference to incorrect step numbers.
8. Minor editorial changes throughout procedure.