BSEP PLANT OPERATING MANUAL

VOLUME XIII, BOOK 2

PLANT EMERGENCY PROCEDURES (PEP)

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PLANT OPERATING MANUAL
VOLUME 13, BOOK 2
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CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT NOS. 1 & 2

PLANT EMERGENCY PROCEDURES INTRODUCTION

PLANT EMERGENCY PROCEDURE PEP-1.0

VOLUME XIII

Rev. 3

... INFORMATION ONLY

Recommended By: [signature] Date: 4/9/82

Approved By: [signature] for C R Dietz Date: 4/9/82
Plant General Manager

PEP-1.0 PLANT EMERGENCY PROCEDURES INTRODUCTION

1.1 Manual Purpose and Use

The purpose of this manual is to implement the emergency actions described in the Radiological Emergency Plan for the Brunswick Steam Electric Plant (BSEP) and provide the BSEP staff and supporting agencies with specific instructions, forms and data to ensure prompt actions, proper notifications, and effective communications during potential and actual emergency conditions. It also denotes the means by which emergency preparedness is maintained by periodic training, exercises, and equipment inventories and checks. During and subsequent to an emergency, this manual will provide a record of the actions completed in fulfillment of established emergency response requirements.

The Plant Emergency Procedures Manual is organized to facilitate immediate use by both on-site and off-site emergency response personnel. The basic contents of sections are shown on EXHIBIT 1.1-1, USE OF THE PEP MANUAL.

Section 1 is the Introduction and Emergency Organization. This section describes the proper use of the manual and the organization of the key emergency response personnel.

Sections 2 and 3 are the action sections to be implemented during the emergency or potential emergency. Section 2 consists of step-by-step immediate action procedures, and the classification scheme used by plant personnel in reporting potential emergency events, evaluating their extent, classifying them as an Unusual Event, Alert, Site Emergency, General Emergency or as an event of lesser safety significance, and controlling the situation. Also included are management guides for key personnel.

Section 3 contains the specific procedures required to monitor, control and mitigate the consequences of classified emergencies. This section provides step-by-step instructions to direct specific personnel activities during an emergency.

Section 4 of this manual includes the supplemental procedures required to assure the appropriate emergency personnel and equipment are prepared for the onset of emergency conditions.

Appendix A lists emergency response resources and their suggested channels for access in emergency communications. Appendix B contains reference materials and forms anticipated to be required to fulfill requirements of the specific procedures.

The controlled copies of this manual are indexed with color-coded tabs to facilitate use in emergencies.

Red Tabs — precede portions of the manual which may be required for immediate action, or approximately within the first hour after an event is reported to the Control Room.

Yellow Tabs	denote the Key Personnel Emergency Management Guides. These guides are used to assure that appropriate actions are addressed by responsible, qualified personnel and that the status of actions may be properly maintained.
Blue Tabs	precede those PEPs normally used by emergency response members subsequent to the initial classification of an emergency.
White Tabs	preface those sections which provide reference information or emergency preparedness data.

EXHIBITS are numbered according to the procedure in which they are located. The EXHIBIT number uses the PEP number followed by an assigned integer. EXHIBITS are located at the end of the respective PEPs in numerical order according to the assigned integer.

Example: The first three EXHIBITS of PEP 3.4.4 are located at the end of that PEP and are numbered as follows: 3.4.4-1, 3.4.4-2, 3.4.4-3.

For informational blanks and checkoffs, the use of "N.A." for items not available or not applicable is permitted.

EXHIBIT 1.1-1

USE OF THE PEP MANUAL

SECTION 1.0	MANUAL PURPOSE AND USE; EMERGENCY ORGANIZATION
SECTION 2.0	EMERGENCY CONTROL AND MANAGEMENT; IMMEDIATE ACTIONS TO EVALUATE EVENT AND CLASSIFY
SECTION 3.0	EMERGENCY ACTIONS TO CONTROL, MITIGATE AND TERMINATE AN EMERGENCY
SECTION 4.0	ACTIVITIES TO ASSURE EMERGENCY PREPAREDNESS
APPENDIX A	EMERGENCY RESPONSE RESOURCES
APPENDIX B	EXTRA MAPS, EXHIBITS AND FORMS

1.2 Emergency Response Organization

The Emergency Response Organization has been defined to quickly and effectively bring an emergency condition under control. The organization is compatible with and integrated into the normal mode of operation. The position of Site Emergency Coordinator will be activated upon declaration of any emergency level from an Unusual Event to General Emergency. Dependent upon the level of the emergency, other members of the emergency organization will be activated as needed.

EXHIBIT 1.2-1 shows the Emergency Response Organization for BSEP. Each position in the Emergency Response Organization has been assigned primary, alternate, and interim personnel to function in that position, as indicated in EXHIBIT 1.2-2. The organization consists of the Site Emergency Coordinator with the Technical Support Group reporting to him. This Group consists of a Plant Operations Director, an Emergency Repair Director, a Logistics Support Director and a Radiological Control Director. Each of these positions directs one or more teams. The Site Emergency Coordinator is the primary interface with the Emergency Response Manager, who interfaces with off-site organizations and individuals, including the Corporate Emergency Operations Center, the Site Public Information Coordinator, the Corporate Spokesman, the State Emergency Response Team (SERT) Headquarters, and other state and federal agencies. Upon activation of the Emergency Operations Facility (EOF), off-site dose assessment and off-site environmental monitoring responsibilities shift from the Site Emergency Coordinator to the Emergency Response Manager. The EOF organization under the direction of the Emergency Response Manager consists of the Technical Analysis Manager, the Radiological Control Manager, Administration & Logistics Manager, and their supporting staff.

Current phone numbers are maintained in controlled copies of this Manual in the Technical Support Center, Operational Support Center, and the Control Room.

Outside support agencies, and the means of contacting each, are also listed in PEP-Appendix A.

EXHIBIT 1.2-1
EMERGENCY RESPONSE ORGANIZATION

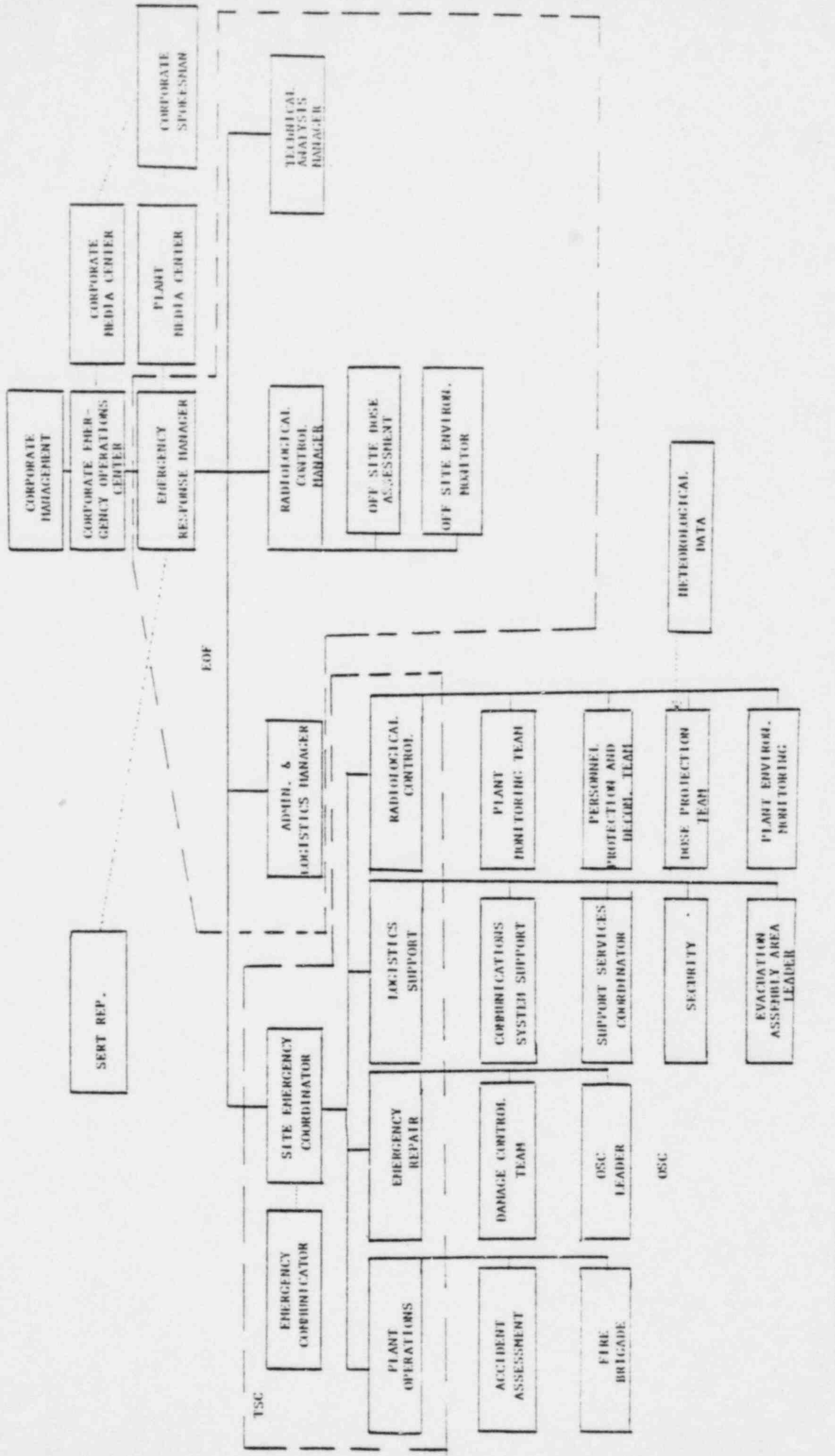

EXHIBIT 1.2-2

EMERGENCY RESPONSE ORGANIZATION

1. Site Emergency Coordinator:	Plant General Manager
Alternates:	Manager - Plant Operations Manager - Operations Manager - Environmental and Radiation Control Manager - Maintenance Manager - Technical Support
Interim:	Shift Operating Supervisor
Alternate Interim:	Shift Foreman
2. Plant Operations Director:	Manager - Operations
Alternates:	Manager - Plant Operations Shift Operating Supervisor
Interim:	Site Emergency Coordinator
2.a. Plant Operators	
Leader:	Shift Operating Supervisor
Alternate:	Shift Foreman or Senior Control Operator
Interim:	Shift Foreman of Affected Unit
2.b. Accident Assessment Team	
Leader:	Engineering Supervisor
Alternate:	Project Engineer - NSSS
Interim:	Site Emergency Coordinator
2.c. Fire Brigade	
Leader:	Shift Foreman
Alternate:	Plant Fire Chief
Interim:	Fire Brigade Member

EXHIBIT 1.2-2

EMERGENCY RESPONSE ORGANIZATION (cont.)

3. Emergency Repair Director: Manager - Maintenance

Alternates: Mechanical Maintenance Supervisor
Electrical Maintenance Supervisor

Interim: Site Emergency Coordinator

3.a. Damage Control Team:

Leader: Mechanical Maintenance Supervisor
Electrical Maintenance Supervisor

The leaders and members of this team will be selected by the Site Emergency Coordinator and/or Emergency Repair Director according to the nature of the task.

3.b. Operational Support Center Leader: Senior Specialist - Electrical

4. Logistics Support Director: Manager - Technical Support

Alternates: Administrative Supervisor

Interim: Site Emergency Coordinator

4.a. Site Communications Systems Coordinator: Technical Aide I (Engineering)

This individual will be designated by the Site Emergency Coordinator when the emergency communications system is activated.

4.b. Support Services Coordinator: Stores Foreman

This individual will be designated by the Site Emergency Coordinator to interface with the Administration & Logistics Manager in the Emergency Operations Facility (EOF) when activated. Prior to EOF activation, this individual will interface with the Corporate Operations Coordinator in the Corporate Emergency Operations Facility if corporate support services are required.

4.c. Emergency Security Team:

Leader: Security Specialist

Alternates: Chief of Security

Interim: Senior Security Person on duty

EXHIBIT 1.2-2

EMERGENCY RESPONSE ORGANIZATION (cont.)

4.d. Evacuation Assembly Area Leader

Leader:	Cost Control Specialist
Alternate:	Environmental & Chemistry Technician

5. Radiological Control Director: Manager - Environmental and Radiation Control (E&RC)

Alternates:	Supervisor - Radiation Control Supervisor - Environmental and Chemistry Project Specialist - Radiation Control
Interim:	Site Emergency Coordinator

5.a. Environmental Monitoring Team:

Leader:	Supervisor - Environmental and Chemistry
Alternate:	Foreman - Environmental and Chemistry
Interim:	Radiological Control Director

5.b. Plant Monitoring Team:

Leader:	Project Specialist - Environmental and Chemistry
Alternates:	Specialist - Chemistry Specialist - ALARA
Interim:	Radiological Control Director

5.c. Personnel Protection and Decontamination Team:

Leader:	Supervisor - Radiation Control
Alternates:	Foreman - Radiation Control Specialist - Radiation Control
Interim:	Radiological Control Director

EXHIBIT 1.2-2

EMERGENCY RESPONSE ORGANIZATION (cont.)

5.d. Dose Projection Coordinator:	Project Specialist - Radiation Control
Alternate:	Specialist - Radiation Control
Interim:	Radiological Control Director
6. Emergency Communicator:	Regulatory Compliance - Senior Specialist
Alternate:	Regulatory Compliance Specialist
Interim:	Available Plant Operator
7. Representative to State Emergency Response Team Headquarters:	Assistant to the Plant General Manager
Alternate:	Emergency Preparedness Specialist
8. Site Public Information Coordinator:	Manager - News Services
Alternates:	Vice President - Corporate Communications Director - Media Relations
Interim:	Plant General Manager or his designee
9. Emergency Response Manager:	Vice President - Nuclear Operations
Alternate:	Manager - Corporate Quality Assurance
10. Administrative & Logistics Manager:	Manager - Construction Procurement Services
Alternate:	Assistant to the Group Executive - Power Supply
11. Technical Analysis Manager:	Director - Nuclear Engineering Safety Review
Alternate:	Principal Specialist - Special Projects Nuclear Operations Administration

EXHIBIT 1.2-2

EMERGENCY RESPONSE ORGANIZATION (cont.)

12.	Radiological Control Manager:	Manager - Environmental and Radiation Control, HE&EC
	Alternate:	Principal Specialist - Environmental, HE&EC
13.	Corporate Emergency Operations Center Manager:	Senior Vice President - Power Supply
	Alternates:	Executive Vice President - Power Supply and Engineering and Construction
14.	Corporate Spokesman:	Vice President - Nuclear Safety and Research or his designee
	Alternate:	Vice President - Technical Services

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CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT NOS. 1 & 2

ENVIRONMENTAL MONITORING TEAM LEADER

PLANT EMERGENCY PROCEDURE PEP-2.6.6

VOLUME XIII

Rev. 2

FOR INFORMATION ONLY

Recommended By: CRGibson Date: 4/9/82

Approved By: RElMorgan for CRDietz Date: 4/9/82
Plant General Manager

PEP-2.6.6 ENVIRONMENTAL MONITORING TEAM LEADER

1.0 Responsibilities and Objectives

The Environmental Monitoring Team Leader is responsible to the Radiological Control Director for providing technical and administrative direction to the Environmental Monitoring Team during a declared emergency. Once the Emergency Operations Facility is activated, the Environmental Monitoring Team Leader will be responsible to the Radiological Control Manager in the Emergency Operations Facility.

2.0 Scope and Applicability

This procedure shall be implemented upon activation of the Environmental Monitoring Team. The actions and responsibilities are limited to the Environmental Monitoring Team Leader and those emergency team members assigned to him.

3.0 Actions and Limitations

3.1 General Requirements

3.1.1 Report your position and readiness to the Radiological Control Director (the Radiological Control Manager after the Emergency Operations Facility is activated).

3.1.2 Announce your name and assumed position title to all team members.

3.1.3 Ensure that all personnel actively assigned to you (i.e., not off site or in the Operational Support Center) are accounted for at all times (see PEP-3.8.2, "Personnel Accountability" for initial accountability requirements).

3.1.4 Determine need for additional equipment, supplies and manpower and make request for same.

3.1.5 A. When assuming the Environmental Monitoring Team Leader position, request a briefing on the emergency and emergency actions status from the previous position holder.

B. When relinquishing the Environmental Monitoring Team Leader position, brief your successor on the emergency and emergency actions status.

C. Notify all appropriate personnel of your name, the position you are assuming, and the name of the person you replace.

3.1.6 Ensure documentation of the following:

- Communications
- Key decisions

- Data collected
- Checklists

(in accordance with PEP-4.1, "Record Keeping and Documentation").

3.1.7 Ensure proper use of communications equipment (per PEP-3.1.3, "Use of Communications Equipment").

3.1.8 Ensure exposure control is in accordance with PEP-3.7.1, "Radiation Work Permits and Exposure Control," (i.e, Radiation Work Permits shall be completed).

3.2 Assign personnel to perform Environmental Monitoring procedures as directed by the Radiological Control Director (the Radiological Control Manager after the Emergency Operations Facility is activated).

Priorities for assignments will depend on plant conditions; the following order for priority of assignments is provided as a guide:

3.2.1 Dose confirmation (PEP-3.5.1, "Confirmation of Initial Off-Site Dose Projections").

3.2.2 Off-site monitoring (PEPs-3.5.2, "Expanded Environmental Monitoring," -3.5.3, "Plume Tracking by Active Measurement," and -3.5.4, "Coordination with State Monitoring").

3.2.3 Other missions as required (interface with Personnel Protection and Decontamination Team Leader and Plant Monitoring Team Leader).

3.3 Guidelines for Monitoring Missions (per PEP Section 3.5)

3.3.1 Advise team members of expected radiological conditions and protective gear to be worn.

3.3.2 Upon discussion with the Radiological Control Director, (the Radiological Control Manager after Emergency Operations Facility activation) provide recommended locations for initial environmental surveys to the Environmental Monitoring Team. These should be determined based upon prevailing wind directions and locations or roads in that direction. The objective is to take measurements at locations close to the distances assumed in the initial dose projection (4000 feet).

3.3.3 Record location of Monitoring Teams on environmental maps.

3.3.4 Advise the Environmental Monitoring Team whenever it appears that the wind direction has shifted more than 45^{o} during the period when the Environmental Monitoring Team is performing surveys.

3.3.5 Provide the results of initial environmental surveys to the Dose Projection Coordinator.

3.3.6 Advise the Radiological Control Director (the Radiological Control Manager after Emergency Operations Facility activation) of the results of the comparisons of initial survey readings and dose projections.

3.4 Guidelines for Expanded Environmental Monitoring (per PEP-3.5.2)

3.4.1 Direct the Environmental Monitoring Team to replace existing TLD's, beginning with the TLD's downwind of the plume.

3.4.2 Direct the placement of additional TLD's approximately every 10 meters along the exclusion area fence in the sector within plus or minus 22.5^{o} of the plume centerline (a total sampling area of 45^{o}).

3.4.3 Direct the initiation of the expanded environmental monitoring program based on the release conditions (e.g., water, and benthic organisms, etc. for liquid releases; grass and milk samples where radioiodine has been released).

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CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT 0

DOSE PROJECTION COORDINATOR

PLANT EMERGENCY PROCEDURE: PEP-02.6.20

VOLUME XIII

Rev 000

FOR INFORMATION ONLY

Recommended By: CRGibson Date: 4/9/82

Approved By: [signature] for CR Dietz Date: 4/9/82

1.0 Responsibilities and Objectives

The Dose Projection Coordinator is responsible to the Radiological Control Director for projecting doses off site during a declared emergency. After activation of the Emergency Operations Facility, the Dose Projection Coordinator will provide meteorological data and source term information to EOF personnel.

2.0 Scope and Applicability

This procedure shall be implemented upon activation of the Dose Projection Team. The actions and responsibilities are limited to the Dose Projection Team Leader and those team members assigned to him.

3.0 Actions and Limitations

3.1 General Requirements:

3.1.1 Report your position and readiness to the Radiological Control Director.

3.1.2 Announce your name and assumed position title to all team members.

3.1.3 Ensure that all personnel actively assigned to you are accounted for at all times. (See PEP-03.8.2, Personnel Accountability, for initial accountability requirements.)

3.1.4 Determine and procure equipment, supplies and manpower necessary for use by the Dose Projection Team.

3.1.5 A. When assuming the Dose Projection Team Leader position, request a briefing on the emergency and emergency actions status from the previous position holder.

B. When relinquishing the Dose Projection Team Leader position, brief your successor on the emergency and emergency actions status.

C. Notify all appropriate personnel of your name, the position you are assuming, and the name of the person you replace.

3.1.6 Ensure documentation of the following:

Communications

Key decisions

Data collected

Data transmitted

(In accordance with PEP-04.1, Record Keeping and Documentation)

3.1.7 Ensure proper use of communications equipment (in accordance with PEP-03.1.3, Use of Communications Equipment).

3.2 Assign personnel to perform dose projection and source term procedures as directed by the Radiological Control Director.

3.3 If the plant computers are not accessible, determine meteorological data in accordance with Exhibit 2.6.20-1, Manual Met Tower Data Acquisition.

3.4 If the on-site meterological station is completely inoperable, National Weather Service data can be used to obtain an estimate of the on-site wind speed and direction, and the appropriate atmospheric stability class. (Refer to Exhibit 2.6.20-3 for steps to follow.)

3.5 Periodically call Licensing and Permits Section in Raleigh and request meteorological forecast data. (PEP Appendix A.4 for phone numbers.) Make use of Exhibits 2.6.20-4 and 2.6.20-5 for recording forecast and other meteorological data.

3.6 Use Exhibit 2.6.20-6 to detail wind direction in terms of degrees from north versus sector wind is blowing from and sector wind is blowing to.

3.7 Record source term data on Exhibit 2.6.20-7 and transmit to EOF if activated.

3.8 Ingestion dose projection procedures are contained in the Harris Environmental and Energy Centers Emergency Procedures should they be needed before activation of the EOF. Copies of HEEC Emergency Procedures are available in the TSC.

Exhibit 2.6.20-1

Manual Met Tower Data Acquisition

1.0 If the CRT, modem circuit, or telephone system for contacting the met tower is out of service, the data is obtained as follows (if unavailable from process computer):

a. Obtain key from E&RC (No. 20) or Security to allow access to the Meteorological Building, located at the base of the tower, northwest of the site.

b. On the shelf in the building, locate the manual pulse counter. This unit should be plugged into a 110 VAC outlet for recharging the internal batteries.

c. The unit has a stop/start switch and a position 1/position 2 switch. It has a black lead and white lead.

d. Unplug manual pulse counter.

e. Open the left-hand cabinet on the right wall of the building.

f. Inside this cabinet you will observe several black jacks and one white jack.

g. Each black jack is labeled as to what parameter is involved.

h. Plug the white lead into the white jack and the black lead into the parameter whose pulses are needed.

j. Reset counter to zero.

k. Place switch into position 2.

m. Observe time, place stop/start to start.

n. At the end of 90 seconds, turn stop/start to stop.

o. Record number of pulses and multiply number by 10. This will scale up the pulses to equal 15 minute values.

p. Proceed to obtain the other parameters.

q. Record readings on Exhibit 2.6.20-2.

r. Record the wind direction and wind speed from the recorders on the data form.

s. Turn switch to stop and plug counter into 110 VAC.

t. Secure all cabinets, lock building, and return keys to E&RC/Security.

u. Perform the E&RC tabletop computer program to convert the pulses to usable parameters as normal.

v. Compare the wind parameters to the values from q above to see if they are reasonable.

2.0 If the calculator is out of service but the pulses can be obtained either automatically or by hand, proceed as follows:

CONVERSION OF PULSES TO ENGINEERNG UNITS

WIND SPEED (MPH) = WIND SPEED PULSES ÷ 15

WIND DIRECTION: A = (SIN PULSES - 750)
B = (COS PULSES - 750)
APPARENT ANGLE = ARCTAN OF ABSOLUTE VALUE OF A/B

A	B	WIND DIRECTION (DEGREES FROM NORTH)
+	+	APPARENT ANGLE
+	-	180 - APPARENT ANGLE
-	-	180 + APPARENT ANGLE
-	+	360 - APPARENT ANGLE

AMBIENT TEMPERATURE (°F) = (TEMP PULSES X 0.12) + ZA
ZA = SITE SPECIFIC ZERO ADJUST FACTOR*

DIFFERENTIAL TEMPERATURE (°F) = (DT PULSES ÷ 60) + ZA
ZA = SYSTEM SPECIFIC ZERO ADJUST FACTOR*
ANSWER IN DEGREES F MULTIPLIED BY SITE SPECIFIC NORMALIZING FACTOR (0.5976) CONVERTS UNITS TO °C/100 METERS.

*NOTE: THE MOST RECENT ZERO ADJUST FACTORS ARE USUALLY POSTED IN THE MET TOWER BUILDING. IF CURRENT FACTORS ARE UNAVAILABLE, ASSUME ZA FOR AMBIENT TEMP = -50 AND ZA FOR DELTA T = -10.

Exhibit 2.6.20-1 (Cont'd)

STABILITY CLASS	DIFFERENTIAL TEMPERATURE ΔT
A	< -1.9 (°C/100m)
B	-1.9 to -1.7
C	-1.7 to -1.5
D	-1.5 to -0.5
E	-0.5 to +1.5
F	+1.5 to +4.0
G	> +4.0

Exhibit 2.6.20-2

MANUAL PULSE COUNTS

DATE ______________ TIME ______________

PARAMETER	PULSES/90 Sec			
WSU		X 10 =	______________	WSU
WDU SIN		X 10 =	______________	WDU SIN
WDU COS		X 10 =	______________	WDU COS
WSL		X 10 =	______________	WSL
WDL SIN		X 10 =	______________	WDL SIN
WDL COS		X 10 =	______________	WDL COS
AMB Temp		X 10 =	______________	AMB Temp
DT 1		X 10 =	______________	DT 1
DT 2		X 10 =	______________	DT 2

Wind speed upper from recorder (avg) ______________ mph

Wind direction upper from record (avg) ______________ degrees

Wind speed lower from recorder (avg) ______________ mph

Wind direction lower from record (avg) ______________ degrees

Exhibit 2.6.20-3

Determining Stability Class from National Weather Service Data

1. Call the National Weather Service office at Wilmington, North Carolina, for the current weather observations. Obtain the following information from the meteorological forecaster who is on duty:

   a. Station for which data is given ____________________

   b. Wind speed (knots) ____________________

   c. Cloud cover (in tenths of total) ____________________

   d. Cloud ceiling (feet above ground) ____________________

   e. Wind direction (N, S, E, etc.) ____________________

2. Load the programmed cassette (the same cassette used in the Automated Dose Projection Procedure, PEP-03.4.5) into the HP9830A, enter LOAD 3 EXECUTE, and enter RUN EXECUTE.

   NOTE: Press the EXECUTE button after each entry into the computer to allow the program to proceed.

3. The display will read WIND SPEED (knots). The program is asking for the wind speed in knots for the NWS observation station. Enter the appropriate response (example...1.0, 3.0, 0.0 for a calm wind).

4. The display will read CLOUD COVER (tenths). The program is asking for the total cloud cover of the sky in tenths. That is, if the sky is overcast, 10/10ths would be to enter 10. If the sky was clear, the appropriate response to the computer would be to enter 0. Enter the appropriate response.

5. The display will read CLOUD CEILING (feet). The program is asking for the height of the most obscure cloud deck above the ground level. Enter the appropriate response (example...1000.). For no cloud ceiling enter 99,999 feet.

6. The display will read JULIAN DATE. The program is asking for the current JULIAN DATE, that is, the number of calendar days since the first of the calendar year. Enter the appropriate response.

7. The display will read CURRENT TIME (24-hour clock). The program is asking for the current time (eastern standard time) in the common 24-hour clock (that is, noon = 1200 and midnight = 0000; all other times are reported such as 1:00 p.m. = 1300). Enter the appropriate response.

Exhibit 2.6.20-3 (Cont'd)

8. The computer program will now compute the appropriate atmospheric stability class, based upon the weather observations entered into the computer. The output will be displayed on the visual screen as follows:

   Wind speed = (number) mph

   Atmospheric stability class = (letter)

   NOTE: The letter for the atmospheric stability class will be the pasquill stability indicator.

9. Obtain and record wind direction and speed on Exhibit 3.4.2-1 or 3.4.3-1. Use the correct atmospheric stability class in the dose calculations.

CP&L

Carolina Power & Light Company

METEOROLOGICAL FORECAST FORM

Date: ____________________ Time Issued: ______________

Issued By: ________________ Received By: ______________

Forecast Location: ____

A) Next 1 Hour

1) Wind Direction: Sector ____________ Deg. __________________

2) Winds Should Remain (Steady; Shifting; Variable)

2a) Variation Should Be ____________ Deg.

3) Wind Velocity: _________ to ________ (MPH)

4) Stability Class ______________

5) Precipitation Activity Will Be (None, Scattered, Steady)

6) Precipitation Type (Rain, Rainshowers, Thunderstorms, Ice, Snow)

7) Precipitation Intensity (Light, Moderate, Severe)

B) Next 3 Hours:

____

____

____

C) Remarks: ____

____

____

____

Exhibit 2.6.20-5

Carolina Power & Light Company

ONSITE METEOROLOGICAL DATA

Date: ____________________

Time ( )	______	______	______	______
Upper Speed (mph) (m/s)	___/___	___/___	___/___	___/___
Upper Direc. (DEG)	______	______	______	______
Lower Speed (mph) (m/s)	___/___	___/___	___/___	___/___
Lower Direc. (DEG)	______	______	______	______
AMB Temp. (^{o}F)	______	______	______	______
ΔT (^{o}C/100m)	______	______	______	______
Stability Class	______	______	______	______

Time ( )	______	______	______	______
Upper Speed (mph) (m/s)	___/___	___/___	___/___	___/___
Upper Direc. (DEG)	______	______	______	______
Lower Speed (mph) (m/s)	___/___	___/___	___/___	___/___
Lower Direc. (DEG)	______	______	______	______
AMB Temp. (^{o}F)	______	______	______	______
ΔT (^{o}C/100m)	______	______	______	______
Stability Class	______	______	______	______

Exhibit 2.6.20-6

WIND DIRECTIONS

WIND FROM	DEGREES FROM NORTH	WIND TOWARD
N	349-11	S
NNE	12-33	SSW
NE	34-56	SW
ENE	57-78	WSW
E	79-101	W
ESE	102-123	WNW
SE	124-146	NW
SSE	147-168	NNW
S	169-191	N
SSW	192-213	NNE
SW	214-236	NE
WSW	237-258	ENE
W	259-281	E
WNW	282-303	ESE
NW	304-326	SE
NNW	327-348	SSE

SOURCE TERM DATA

DATE: ________

TIME: ________

____ ELEVATED RELEASE or ____ GROUND LEVEL REL.

ALARMING MONITOR: ____________

MONITOR INDICATION: ____________

FLOW RATE (SCFM): ____________

OTHER:

SOURCE TERM = [Ci/SEC]

File No. ______________
Unit No. ______________
Q+RLTcd ______________
App'l ______________

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT NOS. 1 & 2

WHOLE BODY DOSE PROJECTIONS

PLANT EMERGENCY PROCEDURE PEP-3.4.2

VOLUME XIII

Rev. 3

Recommended By: C R Gibson Date: 4/9/82

Approved By: [signature] for CR Dietz Date 4/9/82
Plant General Manager

PEP - 3.4.2 WHOLE BODY DOSE PROJECTIONS

1.0 Responsible Individuals and Objectives

The Radiological Control Director or the Dose Projection Coordinator is responsible for calculating Whole Body Dose projections to be used by the Radiological Control Director and the Site Emergency Coordinator in determining and evaluating possible off-site consequences from a release of airborne radioactivity. The Radiological Control Manager shall assume responsibility for calculating off-site whole body dose projections (to be used by the Emergency Response Manager) after the Emergency Operations Facility is activated.

2.0 Scope and Applicability

This procedure is intended to be used for all manual calculations of whole body dose subsequent to that in PEP-3.4.1, "Initial Dose Projections." It is intended to provide realistic assessment of doses at any point in the Emergency Planning Zone (EPZ). This procedure shall be performed periodically as directed by the Radiological Control Director, (Radiological Control Manager after the Emergency Operations Facility is activated). These projections pertain to the radioactive gases at ground level and do not include radiations from an overhead cloud that may contribute to the whole body dose at ground level.

Provisions are included for:

1) Determining the Atmospheric Dispersion Factor (X/Q) at any point downwind in the Plume Exposure Planning Zone based on the Atmospheric Stability Class, wind speed, and the distance to that point from the point of release.

2) Correcting the dose to account for the time after shutdown that the source data is taken when using an assumed mix of noble gases.

3) Correcting for distance away from the centerline of the cloud.

4) Calculating the dose conversion factor for a known nuclide mix of noble gases.

5) Manually constructing dose isopleths.

3.0 Actions

3.1 List of Exhibits:

3.4.2-1	Whole Body Dose Projections Worksheet
3.4.2-2	Determination of Dose Conversion Factor Worksheet
3.4.2-3	Gamma Whole Body Dose Conversion Factors and Decay Constants of Noble Gases
3.4.2-4	$\chi\bar{u}/Q$ with Distance for Elevated Releases
3.4.2-5	$\chi\bar{u}/Q$ with Distance for Ground Level Releases

3.4.2-6 Horizontal Dispersion Coefficient as a Function of Downwind Distance from the Source
3.4.2-7 Vertical Dispersion Coefficient as a Function of Downwind Distance from the Source
3.4.2-8 Whole Body Dose Conversion Factors for Unknown Mix
3.4.2-9 Doses at Various Distances from Cloud Centerline

3.2 Source Term (Q)

Use the source term calculated in accordance with appropriate PEP-Section 3.6, "Source Term Assessments and Estimates of Core Damage." The source term should have units of Ci/sec or Ci. Enter the Source Term Value in Column 1 of Exhibit 3.4.2-1. Also note the source term's units in Column 1.

3.3 Meteorology (χ/Q)

3.3.1 Determine the Atmospheric Stability Class, wind direction, and wind speed. For stack releases, use upper wind speeds and wind directions. For releases from any other location, use lower wind speed and wind directions. The following steps, 3.3.1.1 to 3.3.1.5, should be used in order of preference.

3.3.1.1 If available, use appropriate equipment to access the Met Tower directly. The Control Room's process computer can access the Met Tower and compute usable parameters directly. RC&T must first access the tower via an acoustic coupler and then use a tabletop computer to convert the met pulses to usable parameters. Record the wind speed, wind direction, and atmospheric stability class on the worksheet, Exhibit 3.4.2-1.

3.3.1.2 If the Met Tower is unaccessible via phone lines, dispatch an individual to the Met Tower to manually obtain meteorological pulses for each parameter as per PEP 2.6.20 (Exhibit 2.6.20-1).

3.3.1.3 If the on-site meteorological station is completely inoperable, the necessary met data can be obtained from the National Weather Service (see PEP Appendix A.4 for phone numbers) using the steps given in Exhibit 2.6.20-3 of PEP 2.6.20.

3.3.1.4 Call the Licensing & Permits Section in Raleigh and request meteorological data (see PEP Appendix A.4 for phone numbers).

3.3.1.5 If there is no meteorological data readily available, estimate the wind speed and direction, determine, and circle appropriate Atmospheric Stability Class.

	Sunny Day	Cloudy Day	Cloudy Night	Clear Night
light wind or calm ($\leq$4m/s) = ($\leq$8.9 mph)	B	C	E	F
moderately strong wind (>4m/s) = (>8.9 mph)	C	D	D	D

Record wind speed, wind direction, and stability class in Exhibit 3.4.2-1.

Note: Assume Stability Class D whenever it is raining.

3.3.2 Determine the Atmospheric Dispersion Factor (χ/Q)

3.3.2.1 Determine the Atmospheric Dispersion Factor, χ/Q, by either Step 3.3.2.1.1 or Step 3.3.2.1.2.

3.3.2.1.1 Determine the Atmospheric Dispersion Factor, χ/Q, using either Exhibit 3.4.2-4 if the release is via the stack or Exhibit 3.4.2-5 if the release is considered from ground level.

1) Determine the point of interest from the plant.

2) Read up or down to the line for the appropriate stability class as determined in Step 3.3.1.

3) Record the appropriate $\chi\bar{u}/Q$ from the vertical scale for use in 5 below.

4) Record the $\bar{u}$ (wind speed) from Section 3.3.1 and record below.

5) Calculate the χ/Q for the point of interest and enter in Column 2 of Exhibit 3.4.2-1.

$$\frac{\chi}{Q} = \frac{\chi\bar{u}}{Q} \div \bar{u}$$

$$\frac{\chi}{Q} = \_\_\_\_ \div \_\_\_\_ = \_\_\_\_$$

3.3.2.1.2 Determine the Atmospheric Dispersion Factor, χ/Q, using the following equation where concentration is to be calculated along the centerline of the plume at ground level.

$$\frac{\chi}{Q} = \frac{1}{\pi\sigma_y \sigma_z \bar{u}} \exp\left[-\frac{1}{2} \left(\frac{H}{\sigma_z}\right)^2 \right]$$

where χ/Q = Atmospheric Dispersion Factor, sec/m^3.

π = 3.1415

$\bar{u}$ = average wind speed, m/sec.

H = release emission height (100 m for stack releases, 0 m for ground level releases).

σ_y = horizontal dispersion coefficient, m; (see Exhibit 3.4.2-6).

σ_z = vertical dispersion coefficient m; (see Exhibit 3.4.2-7).

3.4 Dose Conversion Factor (DCF)

3.4.1 If the nuclide mix of the source term is unknown, go to Step 3.4.2. If the nuclide mix is known, go to Step 3.4.3.

3.4.2 Determine the Dose Conversion Factor corresponding to the time after Rx shutdown plus the travel time of cloud to the point of interest.

3.4.2.1 Estimate the arrival time of cloud to the point of interest and add it to the time after Rx shutdown.

$$\text{time after shutdown (in hours)} + \frac{\text{distance to point of interest (in meters)}}{3600\bar{u}}$$

= ______________ hours

3.4.2.2 Select the Dose Conversion Factor from Exhibit 3.4.2-8 corresponding to the cloud passage time of 3.4.2.1. Use the value in units of $(R/hr)/(Ci/m^3)$ if the source term being used is given in terms of Ci/sec. If the source term is in curies, divide the DCF by 3600. Record it in Column 3 of Exhibit 3.4.2-1. Proceed to Step 3.5.

3.4.3 On Exhibit 3.4.2-2, enter the known noble gas radionuclides of the source term and their respective concentrations in Column 1.

3.4.4 Enter the sample time and release time on the top of Exhibit 3.4.2-2. If there is a difference between the estimated or actual release time and the sample time, use Exhibit 3.4.2-3 to obtain the decay constant for each nuclide and calculate the exponential decay. Multiply the sample concentration by its exponential decay (if applicable) for each identified nuclide to obtain the release concentration and record in Column 5. Determine what percent each nuclide contributes to the total release mix and record in Column 6.

3.4.5 From Exhibit 3.4.2-3 obtain the DCF for each nuclide entered in Column 1 and enter these nuclide specific DCF in Column 7.

3.4.6 Multiply the % mix by its nuclide DCF for each nuclide and record. Sum these adjusted DCFs to obtain the DCF for that release. Record this DCF on Exhibit 3.4.2-1, Column 3, when the source term is in units of Ci/sec. When the source term in Column 1 is in units of curies, divide this DCF by 3600 and enter this value in Column 3

3.5 <u>Dose Projection Results</u>

3.5.1 On Exhibit 3.4.2-1 multiply Columns 1, 2, and 3 to obtain the centerline Whole Body Dose Projection in the downwind sector at the point of interest. If the point of interest is not on the centerline of the cloud, then go to Step 3.6. Record in Column 5 and enter the time and your initials in Column 6. Also note in Column 6 the point of interest that the projected dose is calculated for.

3.6 <u>Dose Projection Off the Centerline</u>

3.6.1 If the point of interest is not on the centerline of the cloud, correct the dose for lateral distance (y) deviation.

3.6.1.1 Estimate the lateral distance (y) between the point of interest and the centerline of the cloud using the appropriate maps.

Record: y = ____ (m)

<u>Note</u>: If not otherwise known, the lateral distance (y) between the point of interest and the centerline of the cloud is estimated by use of triangulation of the point with respect to the plant and the cloud centerline sector on an appropriately scaled map.

3.6.1.2 Using Exhibit 3.4.2-6, determine σ_y as a function of distance (downwind distance perpendicular to the point of interest) and Stability Class (Step 3.2) by locating the distance on the horizontal axis, read up to the diagonal line for the stability class, and read the σ_y from the left vertical axis.

3.6.1.3 Divide the later[illegible]stance by σ_y to determine the number of σ_y[illegible]ween the cloud centerline and the point of interest.

3.6.1.4 Using the number of σ_y's, refer to Exhibit 3.4.2-9 and determine the dose conversion factor. Locate the number of σ_y's on the horizontal axis and read up to the distance of σ_y (meters). Read across to the vertical axis to obtain the appropriate correction factor (CF). Enter this value in Column 4 of Exhibit 3.4.2-1.

3.6.1.5 Perform the multiplications and record the projected dose in Column 5 of Exhibit 3.4.2-1. Initial and date each calculation in Column 6. Also note in Column 6 the point of interest that the projected dose is calculated for.

3.7 Report the Whole Body Projected Dose to the Radiological Control Director or Site Emergency Coordinator. Report to the Radiation Control Manager if the Emergency Operations Facility has been activated.

3.8 To estimate a source term based on measured radiation levels in the environment, these procedures need only by performed in reverse order solving for the unknown value in Column 1 of Exhibit 3.4.2-1.

3.9 <u>Manual Method for Isopleth Determination</u>

This step is used to determine the area within which the radiation exposures will be equal to or greater than some specified dose of interest. As an example, a typical need will be to estimate the area where doses will be greater than a Protective Action Guideline.

3.9.1 Select a dose or dose rate of interest and enter into Step 3.9.2.

3.9.2 Solve for $\chi\bar{u}/Q$ using the values for $\bar{u}$, source term, and DCF as previously determined in this procedure. Note: Ensure that the units of dose, source term, and DCF are compatible.

$$\frac{\chi\bar{u}}{Q} = \frac{(\text{Dose: \_\_\_\_\_}) \times (\bar{u}\text{: \_\_\_\_\_ m/sec})}{(\text{Source: \_\_\_\_\_}) \times (\text{DCF: \_\_\_\_\_})}$$

$$\frac{\chi\bar{u}}{Q} = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_} \ (m^{-2})$$

3.9.3 Determine the maximum distance (X-max) downwind for the $\chi\bar{u}/Q$ in Step 3.9.2.

3.9.3.1 Select the appropriate Exhibit. Use Exhibit 3.4.2-4 if the release is via the stack; otherwise, use Exhibit 3.4.2-5.

3.9.3.2 Locate the $\chi\bar{u}/Q$ value on the vertical axis and read across to the appropriate Atmospheric Stability Class curve. If using Exhibit 3.4.2-4, read across to the right-most side of the curve.

3.9.3.3 Read from the horizontal axis the corresponding distance (X-max) for the $\chi\bar{u}/Q$ in Step 3.9.2.

3.9.3.4 Draw a line from the release point (plant) on an appropriately scaled full-size map to X-max in the downwind direction from the plant.

Note: Given the maximum distance downwind just derived, the cross sectional distance (width) of the plume can be determined by Steps 3.9.4 and 3.9.5 in increasing order of sophistication.

3.9.4 Determine maximum width of affected area based on wind speed.

3.9.4.1 If the wind speed is >4 m/sec (8.9 mph), multiply X-max by 0.13 and cross-tee a line at both ends of the X-max line on the map and complete the rectangle.

Note: This represents the maximum width of the area within X-max where the dose may be $\geq$ dose of interest. This assumes wind meandering will not exceed 1 sector.

3.9.4.2 If the wind speed is $\leq$4 m/sec (8.9 mph), multiply the X-max by 0.26 and complete the rectangle.

Note: This assumes wind meandering will not exceed 2 sectors.

3.9.5 Determine the width of the affected area based on the B. Turner method.

3.9.5.1 Divide the line from the plant to X-max into ten equal segments.

3.9.5.2 Determine the width (y) at each division of X-max by solving for y in:

$$y = \sqrt{-2\ \sigma_y{}^2 \ln \left[\frac{\chi\bar{u}/Q \text{ of interest}}{\chi\bar{u}/Q \text{ at centerline}} \right]}$$

1) Select Exhibit 3.4.2-4 if the release was via the stack; otherwise use Exhibit 3.4.2-5.

2) For each distance (division of X-max) determine a $\chi\bar{u}/Q$ at the distance on the horizontal axis, read up or down to the appropriate stability curve and read the $\chi\bar{u}/Q$ from the vertical axis.

<u>Note</u>: This is the $\chi\bar{u}/Q$ at the centerline value to be used in the equation in Step 3.9.2.

3) For each distance (division of X-max) determine σ_y. Find the distance on the horizontal axis, in Exhibit 3.4.2-6, read up to the appropriate stability class and then read the σ_y from the vertical axis.

3.9.5.3 After determining (y) for each division of X-max, draw the isopeth on a map.

1) Draw in the distance y, perpendicular to the centerline, at the appropriate X-max division.

2) Connect the ends of the y lines. The area inside the torpedo shaped isopleth is the area within which the dose is greater than or equal to the dose of interest.

EXHIBIT 3.4.2-1

WHOLE BODY DOSE PROJECTIONS WORK SHEET

Wind			Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)
Speed (m/sec)	Direction (from)	Stability Class	Source Term (Step 3.2)	χ/Q (Step 3.3)	DCF (Step 3.4)	Correction Factor (Step 3.6)	Projected Dose	Initial Time/Date PT OF INTEREST

EXHIBIT 3.4.2-2
DETERMINATION OF DOSE CONVERSION FACTOR
WORKSHEET

Date: ________________

Sample Time _________ Release Time _________ Difference (t) _________(hr)

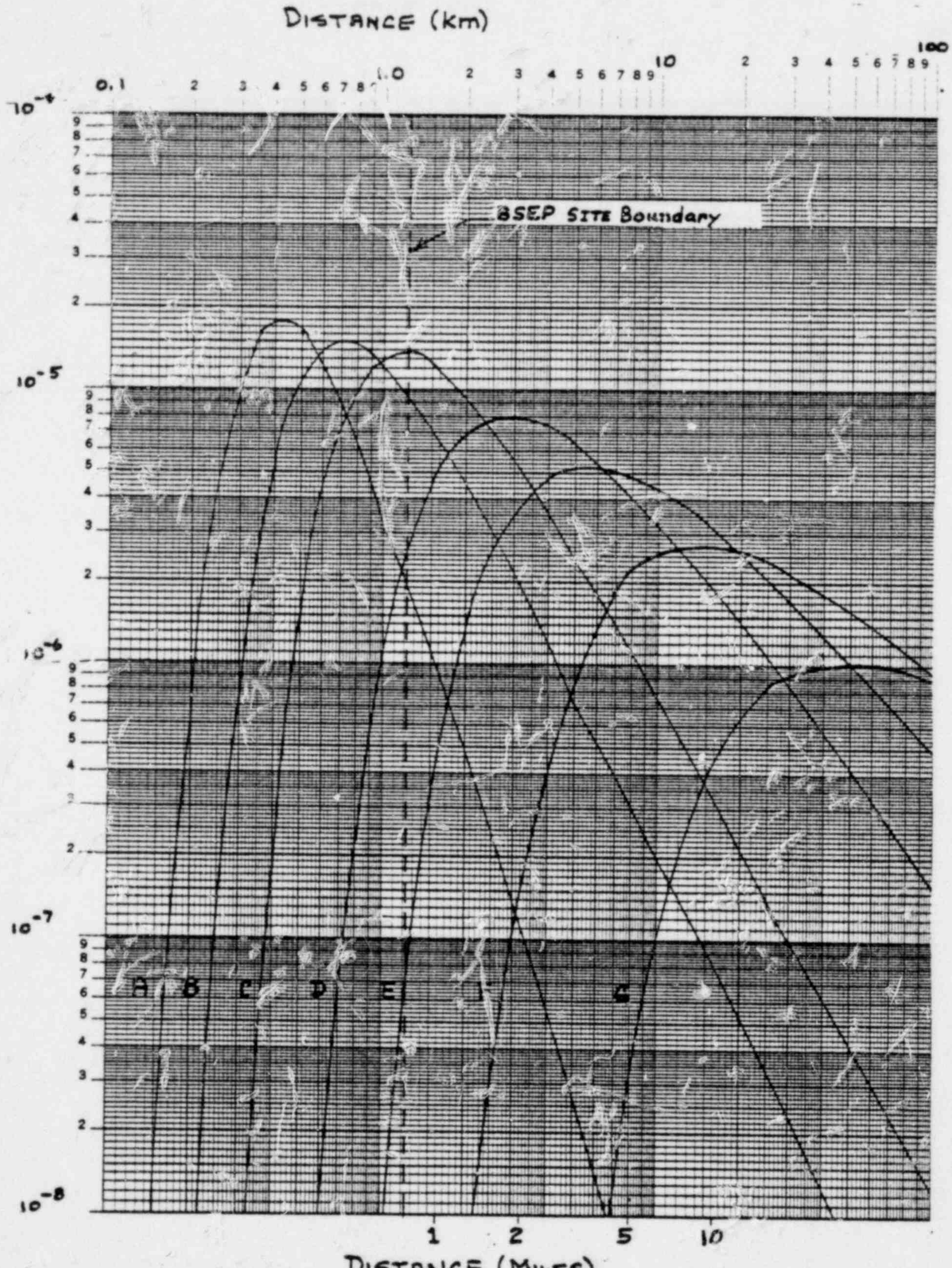
Nuclide	Sample Conc.	$\lambda(HR^{-1})$	$e^{-\lambda t}$	Release Cont.	% of Mix	Nuclide Dose Conversion Factor Exhibit 3.4.2-3	Adjusted DCF
Total DCF $(R/hr/(Ci/m^3)$ Is The Sum Of Adjusted DCFs.→							

EXHIBIT 3.4.2-3
GAMMA WHOLE BODY DOSE CONVERSION FACTORS
AND DECAY CONSTANTS OF NOBLE GASES

Nuclide	Gamma - WB DCF (R/hr)/(Ci/m^3)	λ(HR^{-1})
KR-85M	$8.46 \times 10^{+1}$	0.158
KR-85	$1.12 \times 10^{+0}$	7.4×10^{-6}
KR-87	$4.79 \times 10^{+2}$	0.878
KR-88	$1.23 \times 10^{+3}$	0.248
KR-89	$1.08 \times 10^{+3}$	13.075
XE-131M	$4.46 \times 10^{+0}$	0.002
XE-133M	$1.54 \times 10^{+1}$	0.013
XE-133	$1.78 \times 10^{+1}$	0.005
XE-135M	$2.28 \times 10^{+2}$	2.665
XE-135	$1.52 \times 10^{+2}$	0.076
XE-137	$1.02 \times 10^{+2}$	10.662
XE-138	$6.70 \times 10^{+2}$	2.376

EXHIBIT 3.4.2-4

$\chi\bar{u}/Q$ WITH DISTANCE FOR ELEVATED RELEASES (100 m) BY STABILITY CLASS



$\chi\bar{u}/Q$ WITH DISTANCE FOR GROUND LEVEL RELEASES (Øm) BY STABILITY CLASS

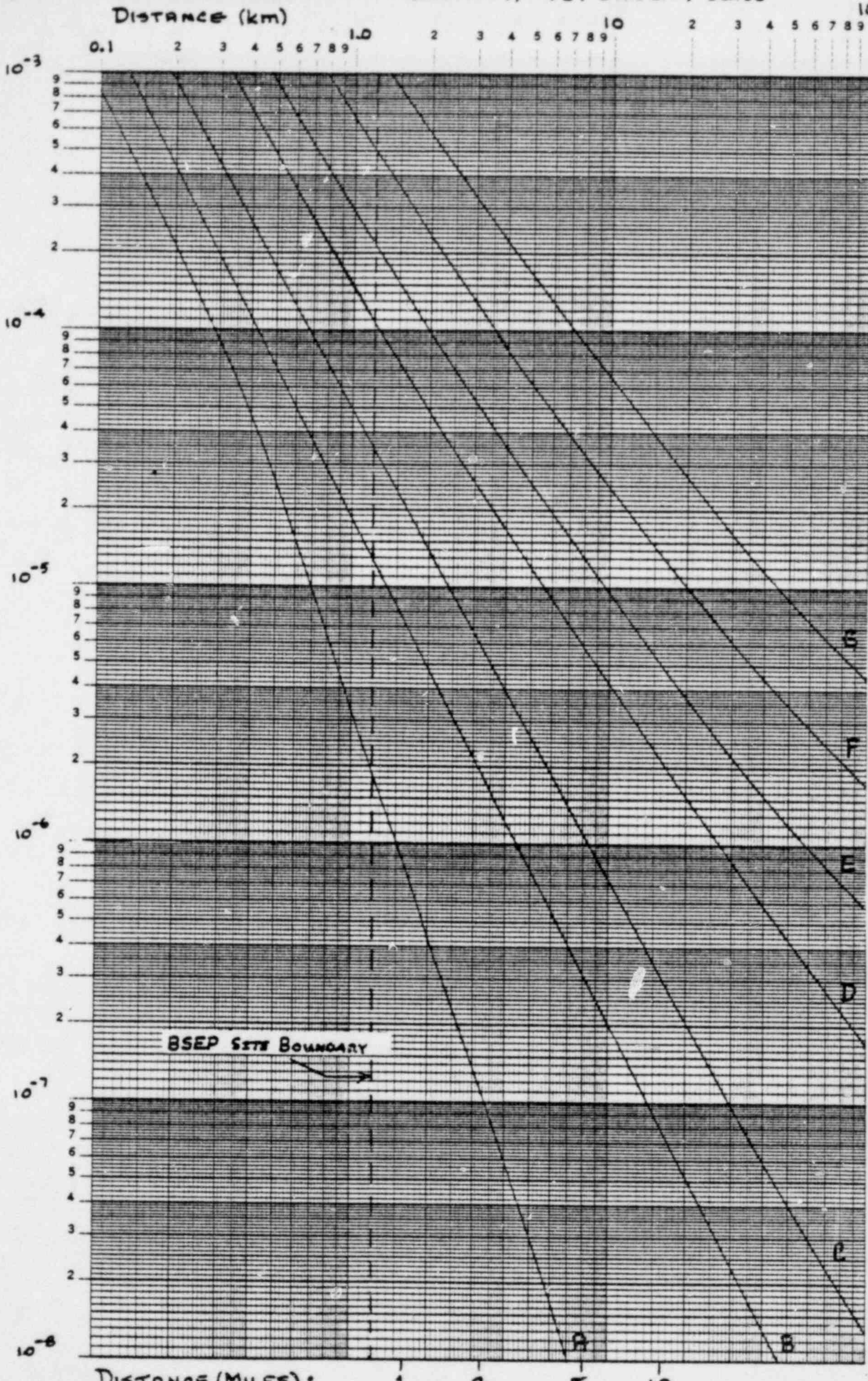


EXHIBIT 3.4.2-5

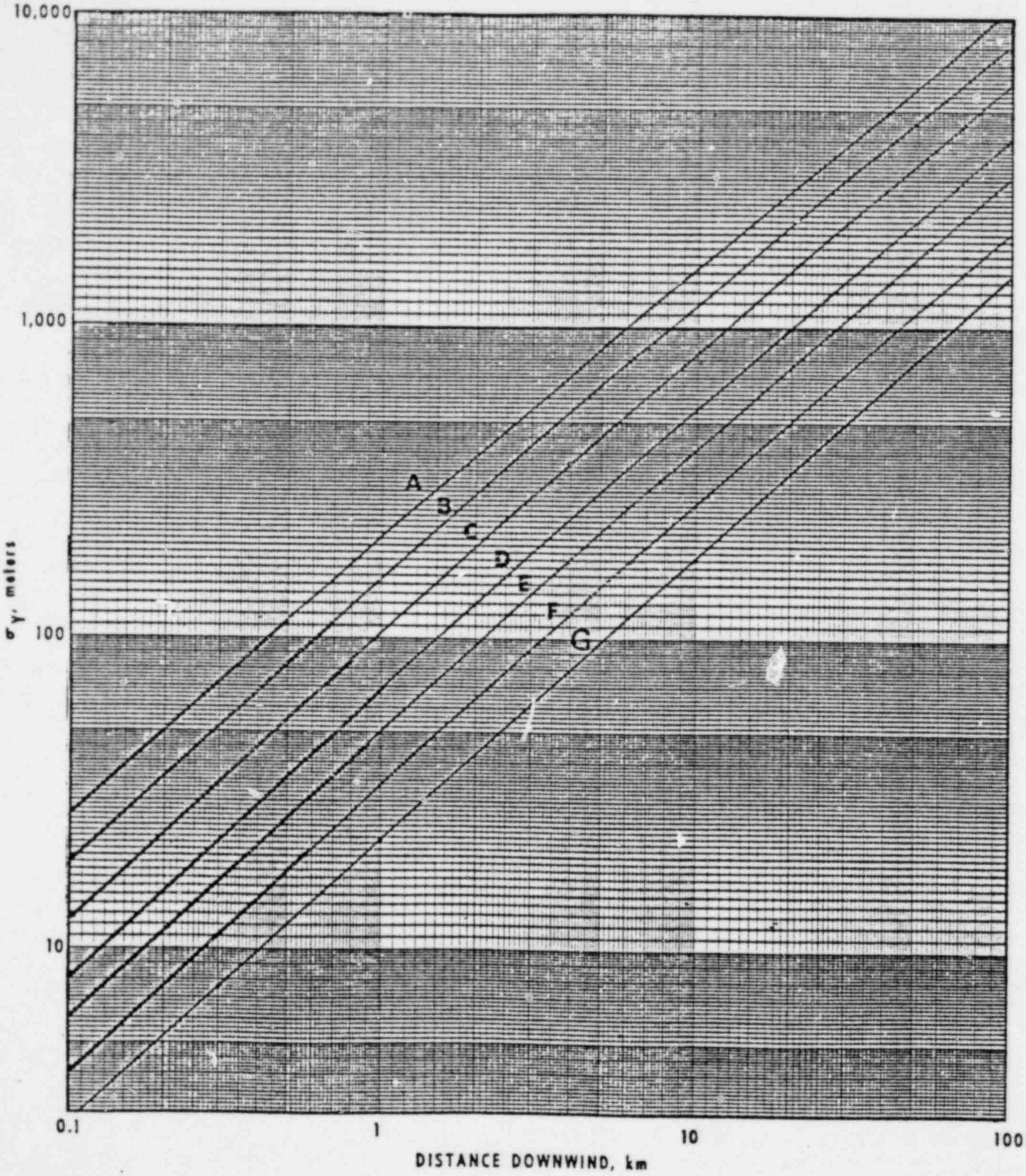


EXHIBIT 3.4.2-6 Horizontal Dispersion Coefficient as a Function of Downwind Distance from the Source

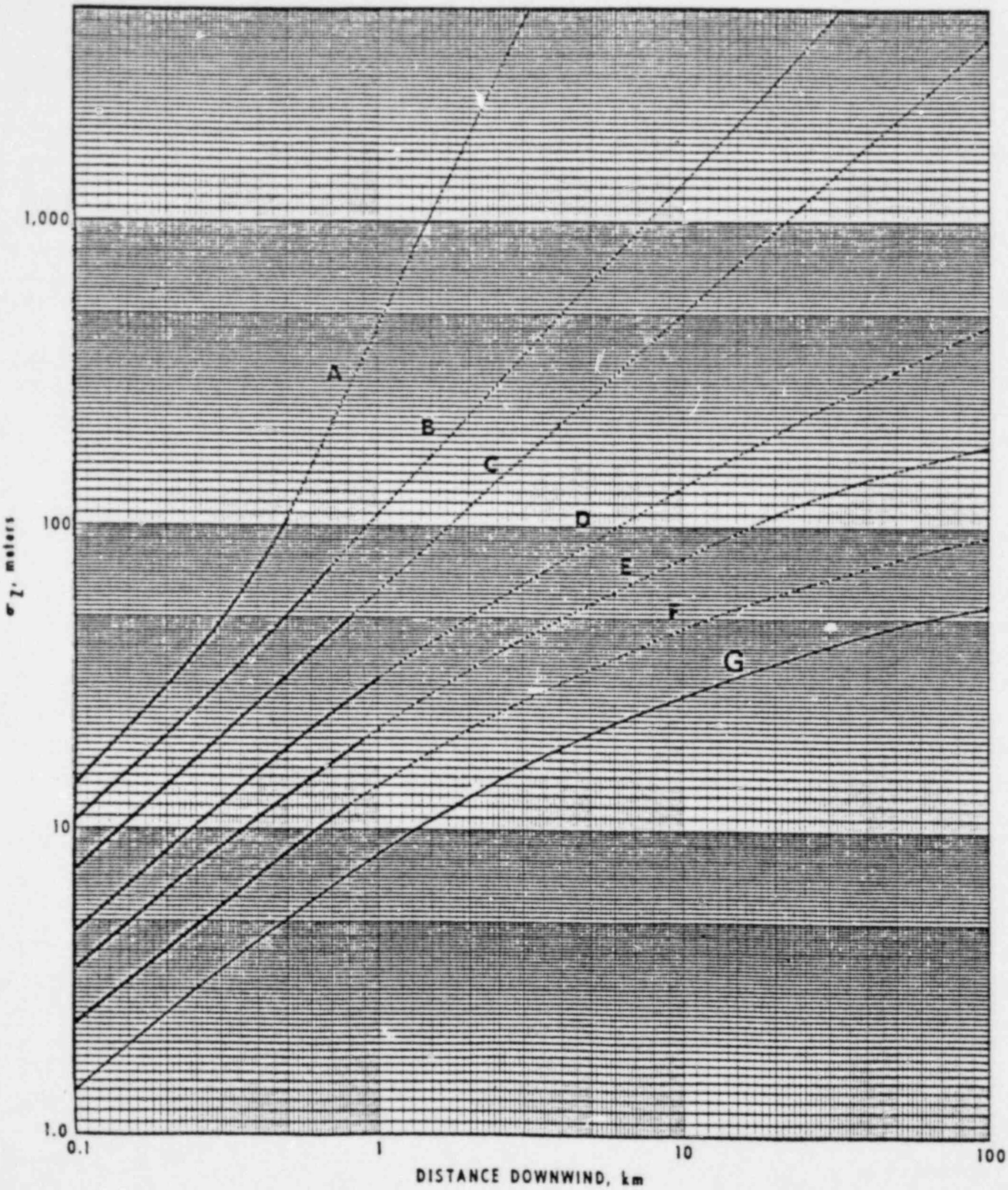


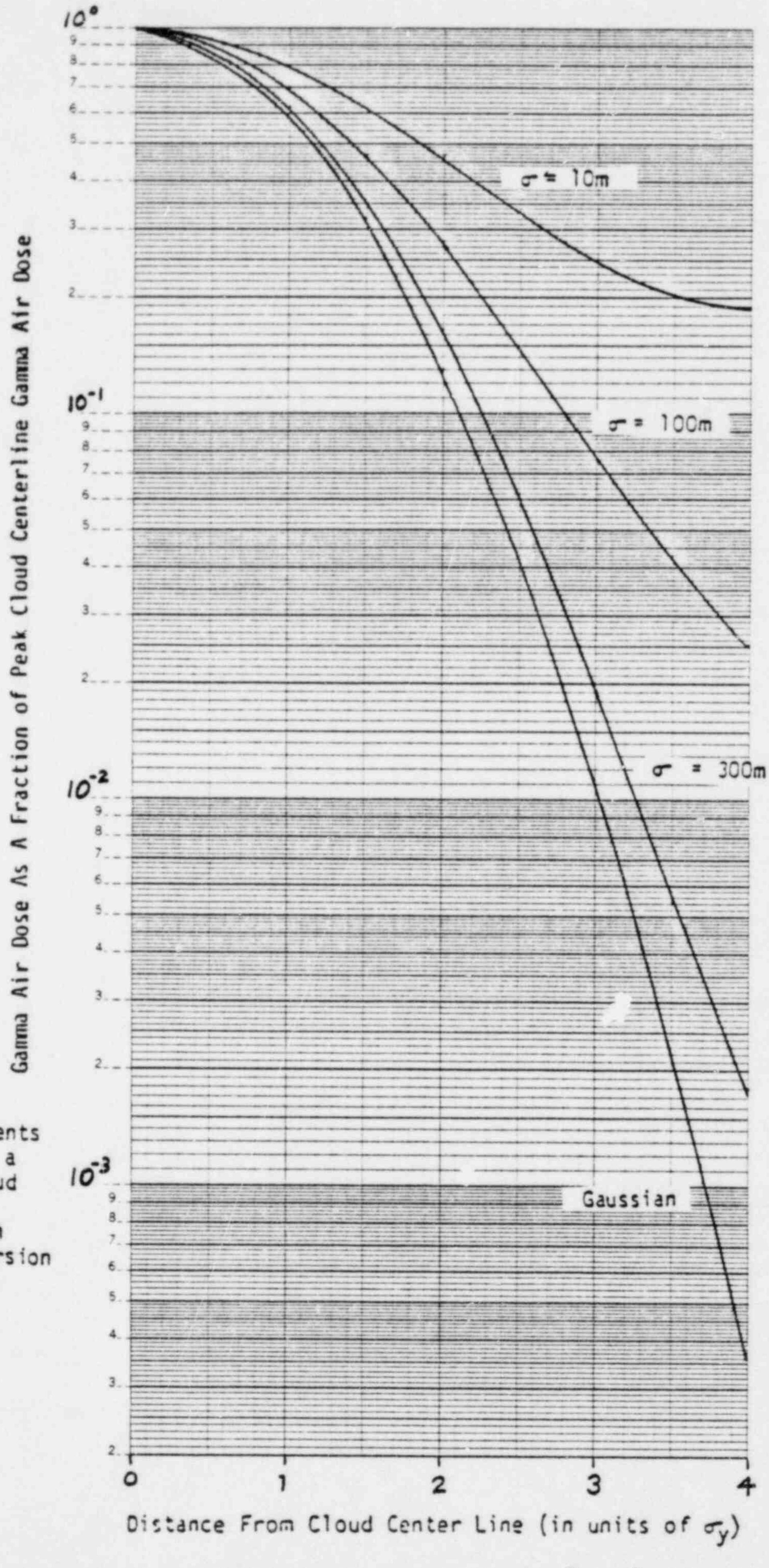
EXHIBIT 3.4.2-7 Vertical Dispersion Coefficient as a Function of Downwind Distance from the Source

EXHIBIT 3.4.2-8

WHOLE BODY CONVERSION FACTORS FOR UNKNOWN MIX

Time After Rx Shutdown (Hr.)	Dose Conversion Factor $(R/hr)/(Ci/m^3)$
0.5	287
1	244
2	202
5	133
8	97
12	72
24	45
72	19

EXHIBIT 3.4.2—9 Dose at Various Distances From Cloud Centerline



[The Gaussian Distribution represents the reduction in concentration as a function of distance from the cloud centerline at any distance. The other curves show the contribution of direct radiation added to immersion - both of which contribute to the gamma dose]

File No. ______________
Unit No. ______________
Q+RETcd ______________
App'l ______________
____

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT NOS. 1 & 2

THYROID DOSE PROJECTIONS

PLANT EMERGENCY PROCEDURE PEP-3.4.3

VOLUME XIII

Rev. 3

Recommended By: ______________ Date: 4/9/82

Approved By: ______________ Date 4/9/82
Plant General Manager

PEP - 3.4.3 THYROID DOSE PROJECTIONS

1.0 Responsible Individuals and Objectives

The Radiological Control Director or the Dose Projection Coordinator is responsible for calculating thyroid dose projections to be used by the Radiological Control Director and the Site Emergency Coordinator in determining and evaluating possible off-site consequences from a release of airborne radioactivity. The Radiological Control Manager shall assume responsibility for calculating off-site thyroid dose projections (to be used by the Emergency Response Manager) after the Emergency Operations Facility is activated.

2.0 Scope and Applicability

This procedure is intended to be used for all manual calculations of thyroid dose subsequent to that in PEP-3.4.1, "Initial Dose Projections." It is intended to provide realistic assessment of doses at any point in the Emergency Planning Zone (EPZ). This procedure shall be performed periodically as directed by the Radiological Control Director, (Radiological Control Manager after the Emergency Operations Facility is activated).

Provisions are included for:

1) Determining the Atmospheric Dispersion Factor (X/Q) at any point downwind in the Plume Exposure Planning Zone based on the Atmospheric Stability Class, wind speed, and the distance to that point from the point of release.

2) Correcting the dose to account for the time after shutdown that the source data is taken when using an assumed mix of radioiodine gases.

3) Correcting for distance away from the centerline of the cloud.

4) Calculating the dose conversion factor for a known nuclide mix of radioiodine gases.

5) Manually constructing dose isopleths.

3.0 Actions

3.1 List of Exhibits:

3.4.3-1	Thyroid Dose Projections Worksheet
3.4.3-2	Determination of Dose Conversion Factor Worksheet
3.4.3-3	Thyroid (iodine inhalation) Dose Conversion Factors and Decay Constants of Radioiodines
3.4.3-4	$\chi\bar{u}/Q$ with Distance for Elevated Releases
3.4.3-5	$\chi u/Q$ with Distance for Ground Level Releases
3.4.3-6	Horizontal Dispersion Coefficient as a Function of Downwind Distance from the Source
3.4.3-7	Vertical Dispersion Coefficient as a Function of Downwind Distance from the Source

3.4.3-8 Thyroid Dose Conversion Factors for Unknown Mix
3.4.3-9 Doses at Various Distances from Cloud Centerline

3.2 Source Term (Q)

Use the source term calculated in accordance with appropriate PEP-3.6, "Source Term Assessments." The source term needs to be in terms of total curies of iodine released. If the source term is based on stack/ vent monitor readings, use 15 percent of this monitor-based source term. If the curies of iodine released can be determined from isotopic analysis, use this source term directly. Enter the Source Term Value in Column 1 of Exhibit 3.4.3-1.

3.3 Meteorology (χ/Q)

3.3.1 Determine the Atmospheric Stability Class, wind direction, and wind speed. For stack releases, use upper wind speeds and wind directions. For releases from any other location, use lower wind speed and wind directions. The following steps, 3.3.1.1 to 3.3.1.5, should be used in order of preference.

3.3.1.1 If available, use appropriate equipment to access the Met Tower directly. The Control Room's process computer can access the Met Tower and compute usable parameters directly. RC&T must first access the tower via an acoustic coupler and then use a tabletop computer to convert the met pulses to usable parameters. Record the wind speed, wind direction, and atmospheric stability class on the worksheet, Exhibit 3.4.3-1.

3.3.1.2 If the Met Tower is unaccessible via phone lines, dispatch an individual to the Met Tower to manually obtain meteorological pulses for each parameter as per PEP-2.6.20 (Exhibit 2.6.20-1).

3.3.1.3 If the on-site meteorological station is completely inoperable, the necessary met data can be obtained from the National Weather Service (see PEP Appendix A.4 for phone numbers) using the steps given in Exhibit 2.6.20-3 of PEP 2.6.20.

3.3.1.4 Call the Licensing & Permits Section in Raleigh and request meteorological data (see PEP Appendix A.4 for phone numbers).

3.3.1.5 If there is no meteorological data readily available, estimate the wind speed and direction, determine, and circle appropriate Atmospheric Stability Class.

	Sunny Day	Cloudy Day	Cloudy Night	Clear Night
light wind or calm ($\leq$4m/s) = ($\leq$8.9 mph)	B	C	E	F
moderately strong wind (>4m/s) = (>8.9 mph)	C	D	D	D

Record wind speed, wind direction, and stability class in Exhibit 3.4.2-1.

Note: Assume Stability Class D whenever it is raining.

3.3.2 Determine the Atmospheric Dispersion Factor (χ/Q)

3.3.2.1 Determine the Atmospheric Dispersion Factor, χ/Q, by either Step 3.3.2.1.1 or Step 3.3.2.1.2.

3.3.2.1.1 Determine the Atmospheric Dispersion Factor, χ/Q, using either Exhibit 3.4.3-4 if the release is via the stack or Exhibit 3.4.3-5 if the release is considered from ground level.

1) Determine the point of interest from the plant.

2) Read up or down to the line for the appropriate stability class as determined in Step 3.3.1.

3) Record the appropriate $\chi\bar{u}/Q$ from the vertical scale for use in 5 below.

4) Record the $\bar{u}$ (wind speed) from Section 3.3.1 and record below.

5) Calculate the χ/Q for the point of interest and enter in Column 2 of Exhibit 3.4.3-1.

$$\frac{\chi}{Q} = \frac{\chi\bar{u}}{Q} \div \bar{u}$$

$$\frac{\chi}{Q} = \_\_\_\_ \div \_\_\_\_ = \_\_\_\_$$

3.3.2.1.2 Determine the Atmospheric Dispersion Factor, χ/Q, using the following equation where concentration is to be calculated along the centerline of the plume at ground level.

$$\frac{\chi}{Q} = \frac{1}{\pi \sigma_y \sigma_z \bar{u}} \exp\left[-\frac{1}{2} \left(\frac{H}{\sigma_z}\right)^2 \right]$$

where χ/Q = Atmospheric Dispersion Factor, sec/m^3.

π = 3.1415

$\bar{u}$ = average wind speed, m/sec.

H = release emission height (100 m for stack releases, 0 m for ground level releases).

σ_y = horizontal dispersion coefficient, m; (see Exhibit 3.4.3-6).

σ_z = vertical dispersion coefficient m; (see Exhibit 3.4.3-7).

3.4 Dose Conversion Factor (DCF)

3.4.1 If the nuclide mix of the source term is unknown, go to Step 3.4.2. If the nuclide mix is known, go to Step 3.4.3.

3.4.2 Determine the Dose Conversion Factor corresponding to the time after Rx shutdown plus the travel time of cloud to the point of interest.

3.4.2.1 Estimate the arrival time of cloud to the point of interest and add it to the time after Rx shutdown.

$$\text{time after shutdown (in hours)} + \frac{\text{distance to point of interest (in meters)}}{3600\bar{u}}$$

= ______________ hours

3.4.2.2 Select the Dose Conversion Factor from Exhibit 3.4.3-8 corresponding to the cloud passage time of 3.4.2.1.

3.4.3 On Exhibit 3.4.3-2, enter the known radioiodine nuclides of the source term and their respective concentrations in Column 1.

3.4.4 Enter the sample time and release time on the top of Exhibit 3.4.3-2. If there is a difference between the estimated or actual release time and the sample time, use Exhibit 3.4.3-3 to obtain the decay constant for each nuclide and calculate the exponential decay. Multiply the sample concentration by its exponential decay (if applicable) for each identified nuclide to obtain the release concentration and record in Column 5. Determine what percent each nuclide contributes to the total release mix and record in Column 6.

3.4.5 From Exhibit 3.4.3-3 obtain the DCF for each nuclide entered in Column 1 and enter these nuclide specific DCF in Column 7.

3.4.6 Multiply the % mix by its nuclide DCF for each nuclide and record. Sum these adjusted DCFs to obtain the DCF for that release. Record this DCF on Exhibit 3.4.3-1, Column 3.

3.5 Dose Projection Results

3.5.1 On Exhibit 3.4.3-1 multiply Columns 1, 2, and 3 to obtain the centerline thyroid dose projection in the downwind sector at the point of interest. If the point of interest is not on the centerline of the cloud, then go to Step 3.6. Record in Column 5 and enter the time and your initials in Column 6. Also note in Column 6 the point of interest that the projected dose is calculated for.

3.6 Dose Projection Off the Centerline

3.6.1 If the point of interest is not on the centerline of the cloud, correct the dose for lateral distance (y) deviation.

3.6.1.1 Estimate the lateral distance (y) between the point of interest and the centerline of the cloud using the appropriate maps.

Record: y = _____ (m)

Note: If not otherwise known, the lateral distance (y) between the point of interest and the centerline of the cloud is estimated by use of triangulation of the point with respect to the plant and the cloud centerline sector on an appropriately scaled map.

3.6.1.2 Using Exhibit 3.4.3-6, determine σ_y as a function of distance (downwind distance perpendicular to the point of interest) and Stability Class (Step 3.2) by locating the distance on the horizontal axis, read up to the diagonal line for the stability class, and read the σ_y from the left vertical axis.

3.6.1.3 Divide the lateral distance by σ_y to determine the number of σ_y's between the cloud centerline and the point of interest.

3.6.1.4 Using the number of σ_y's, refer to Exhibit 3.4.3-9 and determine the dose conversion factor. Locate the number of σ_y's on the horizontal axis and read up to the Gausian curve. Read across to the vertical axis to obtain the appropriate correction factor (CF). Enter this value in Column 4 of Exhibit 3.4.3-1.

3.6.1.5 Perform the multiplications and record the projected dose in Column 5 of Exhibit 3.4.3-1. Initial and date each calculation in Column 6. Also note in Column 6 the point of interest that the projected dose is calculated for.

3.7 Report the Whole Body Projected Dose to the Radiological Control Director or Site Emergency Coordinator. Report to the Radiation Control Manager if the Emergency Operations Facility has been activated.

3.8 To estimate a source term based on measured radiation levels in the environment, these procedures need only by performed in reverse order solving for the unknown value in Column 1 of Exhibit 3.4.3-1.

3.9 Manual Method for Isopleth Determination

This step is used to determine the area within which the radiation exposures will be equal to or greater than some specified dose of interest. As an example, a typical need will be to estimate the area where doses will be greater than a Protective Action Guideline (PAG).

3.9.1 Select a dose or dose rate of interest and enter into Step 3.9.2.

3.9.2 Solve for $\chi\bar{u}/Q$ using the values for $\bar{u}$, source term, and DCF as previously determined in this procedure. Note: Ensure that the units of dose, source term, and DCF are compatible.

$$\frac{\chi\bar{u}}{Q} = \frac{(\text{Dose: \_\_\_\_\_}) \times (\bar{u}\text{: \_\_\_\_\_ m/sec})}{(\text{Source: \_\_\_\_\_}) \times (\text{DCF: \_\_\_\_\_})}$$

$$\frac{\chi\bar{u}}{Q} = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}$$

3.9.3 Determine the maximum distance (X-max) downwind for the $\chi\bar{u}/Q$ in Step 3.9.2.

3.9.3.1 Select the appropriate Exhibit. Use Exhibit 3.4.3-4 if the release is via the stack; otherwise, use Exhibit 3.4.3-5.

3.9.3.2 Locate the $\chi\bar{u}/Q$ value on the vertical axis and read across to the appropriate Atmospheric Stability Class curve. If using Exhibit 3.4.3-4, read across to the right-most side of the curve.

3.9.3.3 Read from the horizontal axis the corresponding distance (X-max) for the $\chi\bar{u}/Q$ in Step 3.9.2.

3.9.3.4 Draw a line from the release point (plant) on an appropriately scaled full-size map to X-max in the downwind direction from the plant.

Note: Given the maximum distance downwind just derived, the cross sectional distance (width) of the plume can be determined by Steps 3.9.4 and 3.9.5 in increasing order of sophistication.

3.9.4 Determine maximum width of affected area based on wind speed.

3.9.4.1 If the wind speed is >4 m/sec (8.9 mph), multiply X-max by 0.13 and cross-tee a line at both ends of the X-max line on the map and complete the rectangle.

Note: This represents the maximum width of the area within X-max where the dose may be $\geq$ dose of interest. This assumes wind meandering will not exceed 1 sector.

3.9.4.2 If the wind speed is $\leq$4 m/sec (8.9 mph), multiply the X-max by 0.26 and complete the rectangle.

Note: This assumes wind meandering will not exceed 2 sectors.

3.9.5 Determine the width of the affected area based on the B. Turner method.

3.9.5.1 Divide the line from the plant to X-max into ten equal segments.

3.9.5.2 Determine the width (y) at each division of X-max by solving for y in:

$$y = \sqrt{-2\ \sigma_y^{\ 2} \ln \left[\frac{\chi\bar{u}/Q \text{ of interest}}{\chi u/Q \text{ at centerline}}\right]}$$

1) Select Exhibit 3.4.3-4 if the release was via the stack; otherwise use Exhibit 3.4.3-5.

2) For each distance (division of X-max) determine a $\chi\bar{u}/Q$ at the distance on the horizontal axis, read up or down to the appropriate stability curve and read the $\chi\bar{u}/Q$ from the vertical axis.

   Note: This is the $\chi\bar{u}/Q$ at the centerline value to be used in the equation in Step 3.9.2.

3) For each distance (division of X-max) determine σ_y. Find the distance on the horizontal axis, in Exhibit 3.4.3-6, read up to the appropriate stability class and then read the σ_y from the vertical axis.

3.9.5.3 After determining (y) for each division of X-max, draw the isopeth on a map.

1) Draw in the distance y, perpendicular to the centerline, at the appropriate X-max division.

2) Connect the ends of the y lines. The area inside the torpedo shaped isopleth is the area within which the dose is greater than or equal to the dose of interest.

EXHIBIT 3.4.3-1

THYROID DOSE PROJECTIONS WORK SHEET

Wind			Column (1)	Column (2)	Column (3)	Column (4)	Column (5)	Column (6)
Speed (m/sec)	Direction (from)	Stability Class	Source Term (Step 3.2)	χ/Q (Step 3.3)	DCF (Step 3.4)	Correction Factor (Step 3.6)	Projected Dose	Initial Time/Date PT OF INTEREST

EXHIBIT 3.4.3-2
DETERMINATION OF DOSE CONVERSION FACTOR
WORKSHEET

Date: ____________________

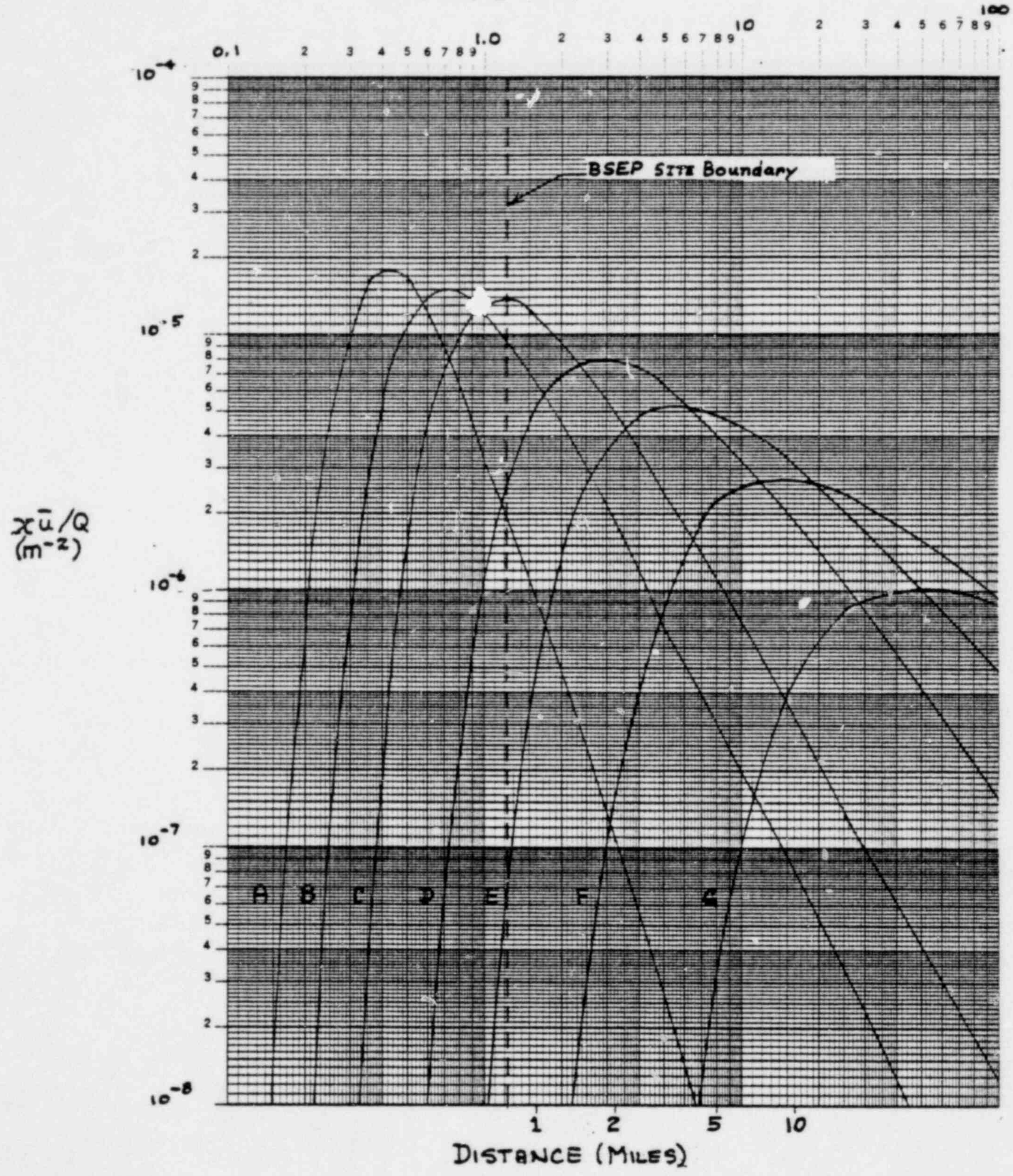
Sample Time __________ Release Time __________ Difference (t) __________(hr)

Nuclide	Sample Conc.	$\lambda(HR^{-1})$	$e^{-\lambda t}$	Release Cont.	% of Mix	Nuclide Dose Conversion Factor Exhibit 3.4.3-3	Adjusted DCF
Total DCF $\frac{R\text{-}M^3}{Ci\text{-}Sec}$ Is The Sum Of Adjusted DCFs.→							

EXHIBIT 3.4.3-3
THYROID (IODINE INHALATION) DOSE CONVERSION FACTORS
AND DECAY CONSTANTS OF RADIOIODINES

Nuclide	DOSE CONVERSION FACTOR $\frac{R\text{-}m^3}{Sec\text{-}Ci}$	$\lambda(HR^{-1})$
I-130	29	5.64E-2
I-131	265	3.59E-3
I-132	3	3.07E-1
I-133	64	3.41E-2
I-134	1	7.97E-1
I-135	13	1.04E-1

$\chi\bar{u}/Q$ WITH DISTANCE FOR ELEVATED RELEASES (100 m) BY STABILITY CLASS



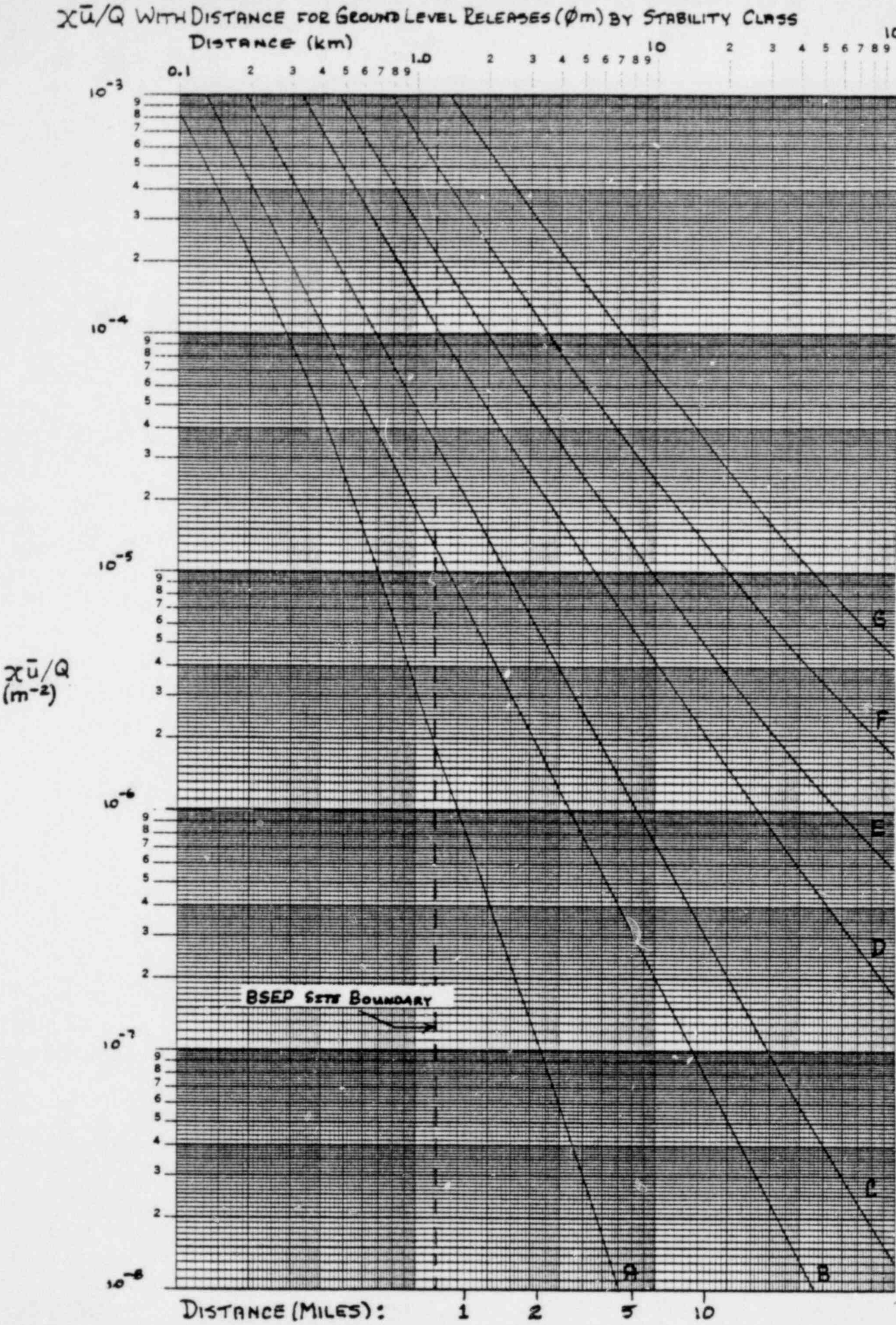


EXHIBIT 3.4.3-5

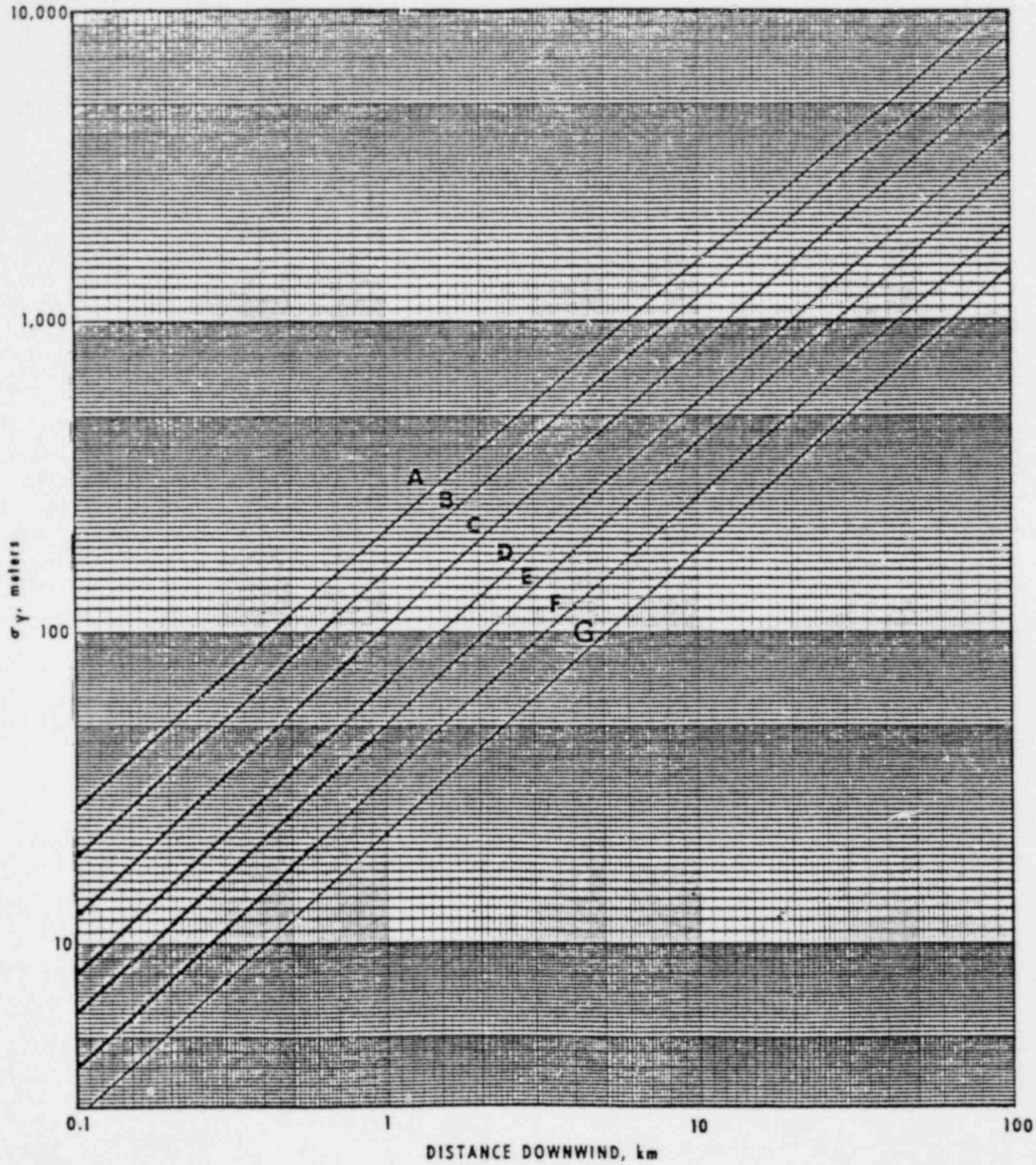


EXHIBIT 3.4.3-6 Horizontal Dispersion Coefficient as a Function of Downwind Distance from the Source

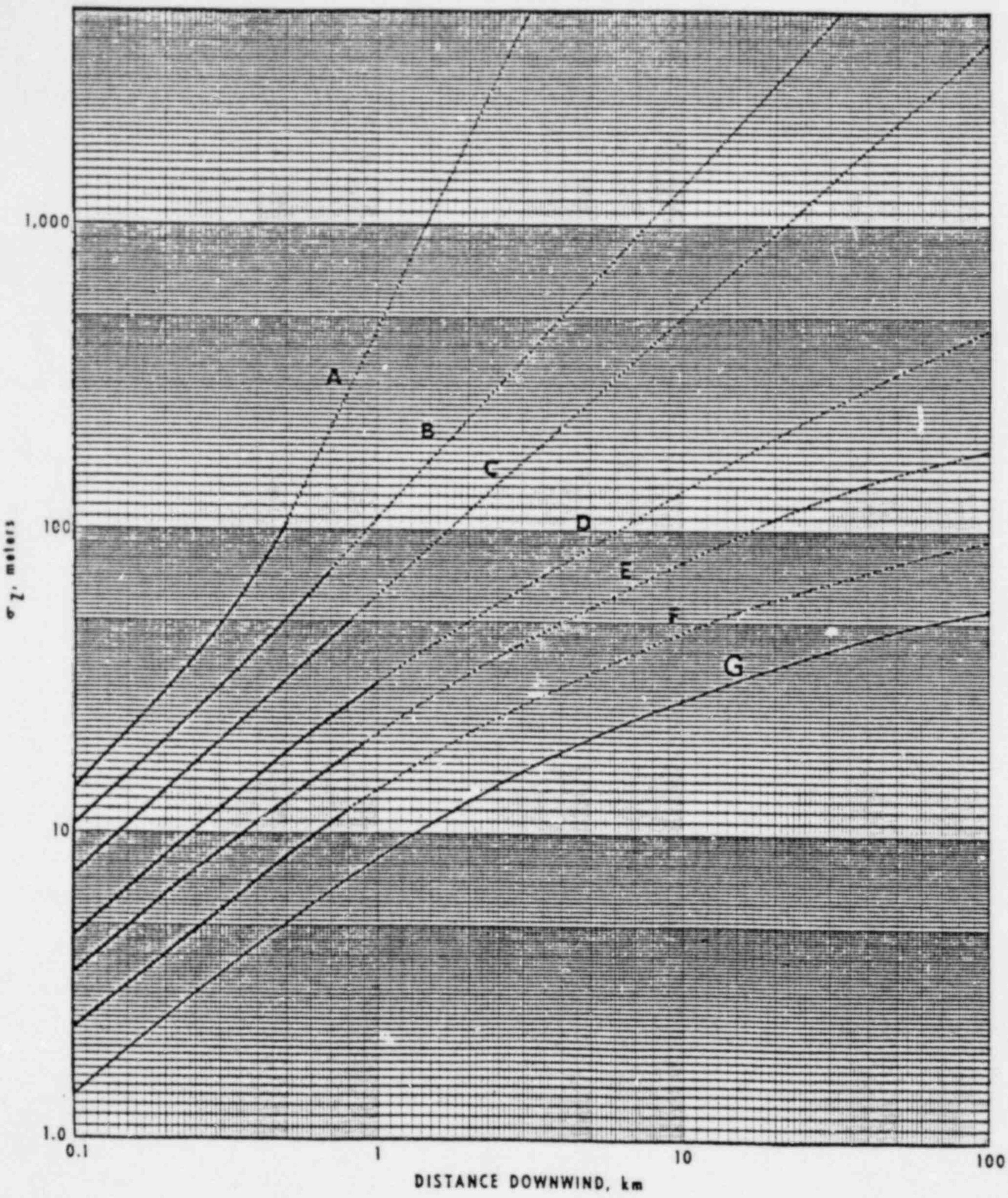


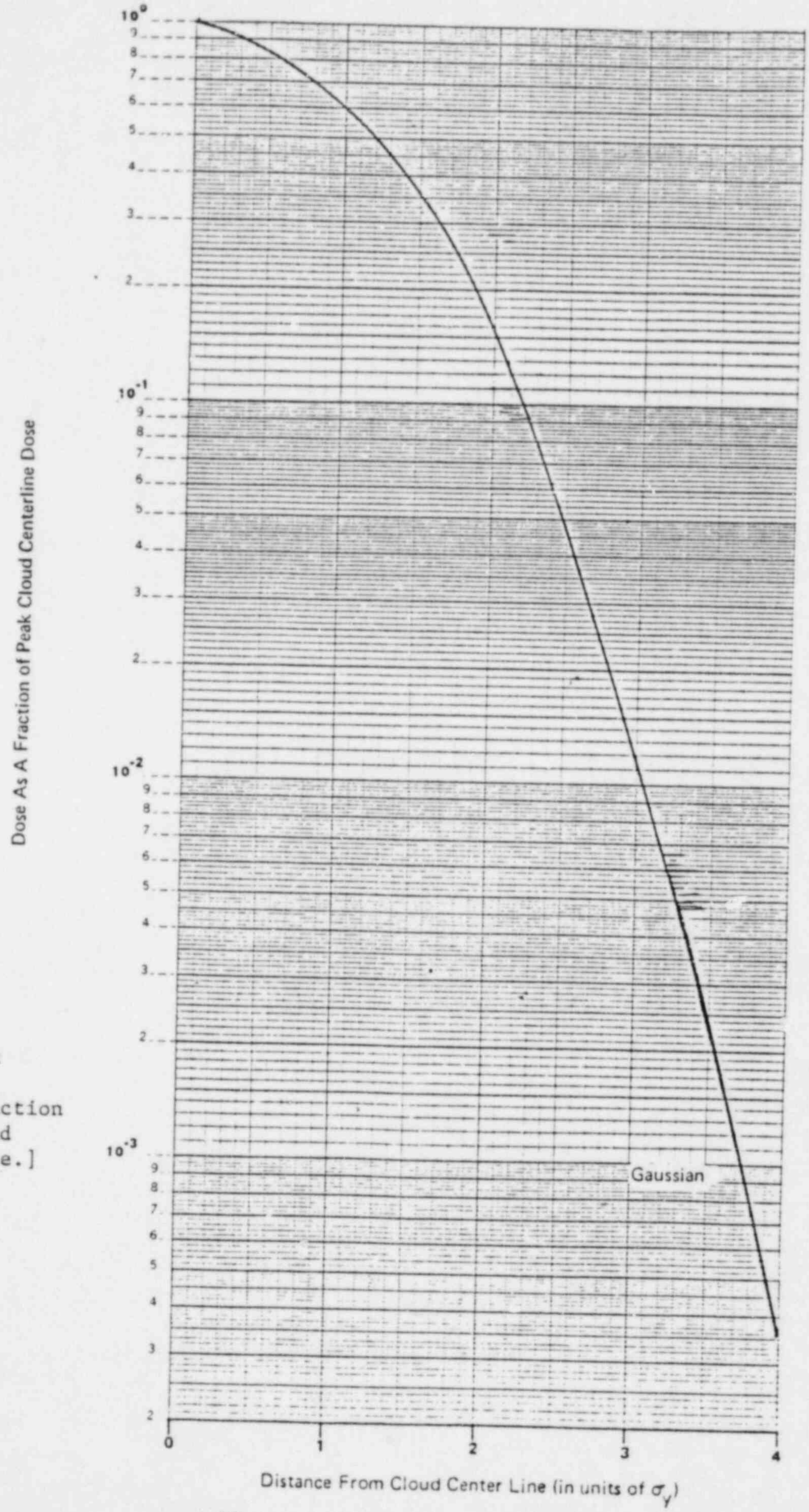
EXHIBIT 3.4.3-7 Vertical Dispersion Coefficient as a Function of Downwind Distance from the Source

EXHIBIT 3.4.3-8

THYROID DOSE CONVERSION FACTORS FOR UNKNOWN MIX

Time After Rx Shutdown (Hr.)	Dose Conversion Factor $\frac{R\text{-}m^3}{Sec\text{-}Ci}$
0.5	58
1	63
2	73
5	97
8	111
12	125
24	159
72	223

Dose at various distances from cloud centerline



[The Gaussian Distribution represents the reduction in concentration as a function of distance from the cloud centerline at any distance.]

File No. __________
Unit No. __________
Q+RETcd __________
App'l __________

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT 0

AUTOMATION OF DOSE PROJECTION PROCEDURES

PLANT EMERGENCY PROCEDURE: PEP-03.4.5

VOLUME XIII

Rev 001

Recommended By: *[signature]* Date: 4/9/82

Approved By: *[signature] for CR Dietz* Date: 4/9/82

1.0 Responsible Individual and Objectives

The Radiological Control Director or the Dose Assessment Coordinator is responsible for calculating dose projections to be used by the Radiological Control Director and the Site Emergency Coordinator in determining and evaluating possible off-site consequences from a release of radioactivity. The Radiological Control Manager shall assume responsibility for calculating off-site dose projections (to be used by the Emergency Response Manager) after the Emergency Operations Facility is activated.

2.0 Scope and Applicability

This procedure is intended to describe the use of a computer program which automates many of the calculations performed in PEP-03.4.2, Whole Body Dose Projections, and PEP-03.4.3, Thyroid Dose Projections. The program is intended for use on : Hewlett-Packard Model 9830A tabletop computer.

Individuals using this program to automate dose projections should be very familiar with the above mentioned procedures. The program allows the capability of calculating downwind centerline doses at any distance including the direction dependent site boundary distance, 1, 2, 5, and 10 miles. The program can also provide X and Y coordinates (X being in the downwind direction) for plotting any desired isopleth. The program does not correct for lateral deviation if the point of interest is not on the centerline of the cloud. These provisions can be included if the correction factors are determined manually and then applied directly to the computer program's results where appropriate.

3.0 Actions

Refer to the appropriate Plant Emergency Procedure for guidance in determining the necessary inputs called for by the computer program. PEP-03.4.2 is for whole body dose projections, and PEP-03.4.3 is for thyroid dose projections. The worksheet EXHIBITS in each of these procedures can be used for recording dose projections.

The computer program uses the same calculational methods as those described in the procedures mentioned above. The program calculates X/Q values from the basic equation using inputs of release height, stability class, wind direction and wind velocity. Other inputs include an appropriate source term and time after reactor shutdown. Inputting the time after shutdown allows the computer to choose the dose conversion factor corresponding to the time that the cloud is projected to pass by the point of interest. The program calculates isopleth coordinates based on the B. Turner method.

The following steps explain the procedure for using the program.

3.1 Load the programmed cassette into the HP9830A, enter REWIND, enter LOAD 0 EXECUTE, and enter RUN EXECUTE.

NOTE: Press the EXECUTE button after each entry into the computer to allow the program to proceed.

3.2 The display will read "PRESET(1) OR KNOWN INVENTORY?" The program is asking if radionuclide mix of the release is known. If the mix is unknown, enter 1 and proceed to Step 3.3; if the mix is known, enter 2 and proceed to Step 3.11.

3.3 The display will read "0=WHOLE BODY...1=THYROID?" The program is asking whether the user intends to make a whole body dose projection or a thyroid dose projection. This entry will allow the program to access the correct dose conversion factors.

3.3.1 If a 0 was entered (whole body), then the display will read "SOURCE TERM=?" Enter the appropriate source term in either Ci/sec or CIs. The display will then read "SOURCE TERM UNITS 0=CI/SEC...1=CI." Enter the appropriate response and proceed to Step 3.4.

3.3.2 If a 1 was entered (thyroid), then the display will read "SOURCE TERM=(CI)?" Enter the source term in total curies.

3.4 The display will read "HEIGHT OF RELEASE (METERS)." If the release was via the stack, enter 100 meters. If the release was from anywhere else, enter 0 meters.

3.5 The display will read "TIME SINCE SHUTDOWN..(X.XX HRS)?" Enter the time since reactor shutdown.

3.6 The display will read "STABILITY CLASS...1=A, 2=B?" Enter the appropriate stability class, i.e., for stability class E, enter a 5.

3.7 The display will read "WIND VELOCITY...(MPH)?" Enter the appropriate wind speed in units of miles per hour.

3.8 The display will read "OUTPUT TO PRINTER (Y OR N)?" The program is asking if a printer is hooked up to the HP9830A for use in printing results. Without a printer, results will need to be transcribed from the 9830 by hand. If there is no printer, then enter a 1. If there is a printer, enter a 0.

NOTE: The rest of the procedure will refer to computer results being given on the display (assuming there is no printer). Keep in mind that with a printer, these same results would automatically be printed out.

3.9 The display will read "DISPLAY TIME DELAY...1=1 SEC, 2=2 SEC?" This allows the program user to delay computer results on the display for any amount of time before displaying the next result. This delay gives the user time to transcribe results from the display. The time delay can be tailored to the user's preference, i.e., an entry of 5 will delay the display for 5 seconds, etc.

3.10 The display will read "SPECIFIC DISTANCES?...1=YES, 0=NO?" The program is asking whether the user wants to look at centerline doses corresponding to the specific downwind distances of site boundary, 1 mile (1609 m), 2 miles (3218 m), 5 miles (8046 m), and 10 miles (16093 m) or to look at centerline doses at downwind distances yet to be specified.

3.10.1 The display will read "ISOPLETH COORDINATES...1=YES, 0=NO?"

3.10.1.1 If a 1 is entered (YES to isopleth coordinates), then the display will read "ISOPLETH VALUE=?" Enter the desired isopleth value keeping in mind that the isopleth dose units will be the same as those just calculated for the centerline (Rem/hr or Rem). The computer will display in sequence the isopleth coordinates for the dose just entered. The X coordinates give the downwind distances in meters corresponding to the site boundary, 1, 2, 5, and 10 miles. The corresponding Y coordinates give in meters one-half the isopleth width at each X distance. After all the isopleth coordinates have been displayed, the display will read "NEXT ISOPLETH...1=YES, 0=NO?" By entering a 1, a new set of isopleth coordinates for a new isopleth value can be determined. By entering a 0, the display will read "ANOTHER RUN (Y OR N)?" Enter the Y is Yes and N if No. If Y is entered, the program will display "ENTER RUN." By entering run, the program will return to Step 3.3. If N is entered, the program will display "PROGRAM TERMINATED" for about two seconds and then display "TO USE AGAIN, ENTER RUN."

3.10.1.2 If a 0 is entered (NO to isopleth coordinates), then the display will read "ANOTHER RUN (Y OR N)?" Enter Y if Yes and N if No. If Y is entered, the program will display "ENTER RUN." By entering run, the program will return to Step 3.3. If N is entered, the program will display "PROGRAM TERMINATED" for about two seconds and then display "TO USE AGAIN, ENTER RUN."

3.10.2 If a 0 is entered, then the display will read "MAX DISTANCE (MI)?" Enter the maximum downwind distance in miles for which centerline doses are desired.

The display will then read "DOWNWIND INCREMENT (MI)?" Enter an incremental distance in miles for which centerline doses out to the maximum downwind distance are desired. The computer will display in sequence the centerline doses for each downwind increment out to the maximum distance (X-max).

3.10.2.1 The display will read "ISOPLETH COORDINATES...1=YES, 0=NO?" Follow Steps 3.10.1 and 3.10.2.

3.11 After a 2 is entered, a brief delay and blank screen will result while the new program is being loaded.

3.12 The display will read "OUTPUT TO PRINTER (Y OR N)?" The program is asking if a printer is hooked up to the HP9830A for use in printing results. Without a printer, results will need to be transcribed from the 9830 by hand. If there is no printer, then enter an N. If there is a printer, enter a Y and skip to Section 3.14.

NOTE: The rest of this procedure will refer to computer results being given on the display (assuming there is no printer). Keep in mind that with a printer, these same results would automatically be printed out.

3.13 The display will read "DISPLAY TIME DELAY...1-1 SEC, 2-2 SEC?" This allows the program user to delay computer results on the display for any amount of time before displaying the next result. This delay gives the user time to transcribe results from the display. The time delay can be tailored to the user's preference, i.e., an entry of 5 will delay the display for 5 seconds, etc.

3.14 The display will read "WILL INPUT AMOUNTS BE IN CONCENTRATION(1) OR PERCENT(2)." If the concentrations of the nuclides are known, enter a 1, if the percents are known, enter a 2.

3.15 The display will read "RELEASE TO SAMPLE TIME=(HRS)?" Enter the appropriate time between sample time and expected or actual release time. Zero may be entered if appropriate.

3.16 The display will read "INPUT ISOTOPE?" Enter the common abbreviation for each isotope, i.e., KR-85, I-131, etc.

NOTE: Depending on which nuclide is entered first, the program will decide whether to compute a whole body dose conversion factor or an iodine inhalation dose conversion factor. Do not mix noble gases and iodine species when entering isotopes. Also when entering percents of nuclides, ensure that the sum of the percents equal 100 percent.

3.17 The display will read "OUTPUT DCF (Y OR N)?" A Y entry will print or display the calculated DCF, an N entry will not.

3.18 The display will flash "WAIT FOR REWINDING." The computer has completed the calculation of the dose conversion factor and is loading the first program.

3.19 The display will read "SOURCE TERM = ?" Enter the source term and proceed back to Step 3.4 for completion of dose projection calculation.

File No. ____________
Unit No. ____________
Q+RETcd ____________
App'l ____________
____

CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT NOS. 1 & 2

RADIATION WORK PERMITS AND EXPOSURE CONTROL

PLANT EMERGENCY PROCEDURE PEP-3.7.1

VOLUME XIII

Rev. 2

Recommended By: CRGibson Date: 4/9/82

Approved By: RMMorgan for CR Dietz Date: 4/9/82
Plant General Manager

PEP-3.7.1 RADIATION WORK PERMITS AND EXPOSURE CONTROL

1.0 Responsible Individuals and Objectives

The Site Emergency Coordinator, Radiological Control Director and/or Team Leader(s) are responsible for informing personnel entering a known or potential radiation area of possible health effects.

Individual workers and team leaders are responsible to the Site Emergency Coordinator for ensuring that emergency worker exposures are maintained within the guidelines of this procedure and ALARA to the extent possible.

2.0 Scope and Applicability

This procedure shall be implemented following declaration of an Alert, Site Emergency or General Emergency. EXHIBIT 3.7.1-1 provides "Guidelines for Control of Personnel Radiation Exposure."

3.0 Actions and Limitations

3.1 Members of the Personnel Protection and Decontamination Team, as designated by the Team Leader, shall perform the following actions:

3.1.1 Set up a dosimetry area in the Operational Support Center (or where designated by Radiological Control Director or Personnel Protection and Decontamination Team Leader) containing the following items:

3.1.1.1 A supply of TLDs.

3.1.1.2 A supply of Self-Reading Pocket Dosimeters.

3.1.1.3 A supply of Exposure Record Sheets (RC&T-0200).

3.1.1.4 A supply of pencils and/or pens.

3.1.2 Complete Personnel Dosimetry forms, and issue proper dosimetry at the Operational Support Center (OSC) for incoming personnel. Dosimetry shall be issued in accordance with RC&T-0200 whenever possible and if time permits. If an RIMS computer terminal is not available at the OSC, dosimetry issue information should be recorded for later entry into the RIMS computer by qualified dosimetry personnel.

3.1.3 Place TLDs in various areas outside the protected area as specified by the Personnel Protection and Decontamination Team Leader.

3.1.3.1 Record location of TLD on EXHIBIT 3.7.1-3.

3.1.3.2 Periodically replace TLDs and record readings obtained from removed TLDs on EXHIBIT 3.7.1-3.

3.1.4 Collect all Exposure Record Sheets and all TLDs for exiting personnel from Security for reading, as directed by the team leader. The information from these forms and TLD readings must be retained for later entry into the RIMS computer by qualified dosimetry personnel.

3.2 Actions of all personnel entering a radiation area.

Note: Contact Personnel Protection and Decontamination Team Leader for where to obtain Radiation Work Permits and special dosimetry.

3.2.1 Obtain and complete a Radiation Work Permit, in accordance with RC&T-0230, "Issuance and Use of Computerized Radiation Work Permits," prior to entering a radiation area.

3.2.2 As directed by Personnel Protection and Decontamination Team member, obtain a high-range dosimeter when:

3.2.2.1 Entering a radiation field $\geq$10 R/hr.

3.2.2.2 Entering a radiation field of unknown intensity.

3.2.3 As directed by Personnel Protection and Decontamination Team member, obtain finger badges when:

3.2.3.1 Handling radioactive material where expected extremity dose rate $\geq$100 R/hr.

3.2.3.2 Working on pipes or equipment where expected extremity dose rate is $\geq$25 R/hr.

3.2.4 Record any and all additional dosimetry on the Radiation Work Permit for each person entering the radiation area. Whenever possible, the finger badges should be labeled with the individual's security badge number, and dosimeter serial numbers should be recorded on the RWP. Having this information available will facilitate data input into this RIMS computer.

3.2.5 Obtain authorization for the Radiation Work Permit from the Site Emergency Coordinator, Plant General Manager, or the Environmental and Radiation Control Manager when exposures are expected to exceed the limits set forth in 10CFR20 (>3 Rem/quarter).

Note: Guidelines for exposure control in excess of 3 Rem/quarter may be found in EXHIBIT 3.7.1-1.

3.2.6 The Site Emergency Coordinator may, at his discretion and as conditions warrant, defer requirements for a Radiation Work Permit, or portions thereof, prior to entry into a radiation area and give his authorization verbally.

3.2.6.1 A Radiation Work Permit shall be completed or a RIMS computerized RWP shall be completed by the individuals making a verbally authorized entry, as time permits, after the entry.

Note: Any person that has received a whole body dose totaling $\geq$5 Rem by TLD for the year shall not be permitted to enter a controlled radiation area without approval of the Site Emergency Coordinator or E&RC Manager.

EXHIBIT 3.7.1-1

GUIDELINES FOR CONTROL OF PERSONNEL RADIATION EXPOSURE

Although an emergency situation transcends the normal requirements for limiting exposures to ionizing radiation, guideline levels are established for exposures that may be acceptable in emergencies. The maximum whole body dose received by any worker should not exceed established regulatory limits. Every reasonable effort will be used to ensure that an emergency is handled in such a manner that no worker exceeds these limits, including, where recommended by expert medical opinion, the administering of radio-protective drugs. The acceptability of higher exposures is restricted to emergency situations where some clear and definite advantage can be gained by such worker exposure. It is compatible with the risk concept to accept exposures leading to doses considerably in excess of those appropriate for normal occupational use when recovery from an accident or major operational difficulty is necessary. Saving of life, measures to circumvent substantial exposures to population groups, or preservation of valuable installations may all be sufficient cause for accepting above normal exposures. These higher dose limits cannot be specified; however, they should be commensurate with the significance of the objective and held to the lowest practicable level. As discussed below, all planned exposures should follow the guidelines set forth in Report No. 39 of the National Council on Radiation Protection, and specifically paragraphs 257-259 of that report, which deal with planned occupational exposure under emergency conditions.

Decision making is based on conditions at the time of an emergency and should always consider the probable effects of an exposure prior to allowing any individual to be exposed to radiation levels exceeding the established occupational limits. The probable high radiation exposure effects are:

1. Up to 50 rem in 1 day - no physiological changes are likely to be observed.

2. 50 to 100 rem - no impairment likely but some physiological changes, including possible temporary blood changes, may occur. Medical observations would be required after exposure.

3. 100 to 300 rem - some physical impairment possible. Some lethal exposures possible.

The following subsections describe the criteria to be considered for lifesaving and facility protection actions.

Lifesaving Actions*

In emergency situations that require personnel to search for and remove injured persons or entry to prevent conditions that would probably injure numbers of people, a planned dose shall not exceed 100 rem to the whole body and a planned additional dose of up to 200 rem (i.e., a total of 300 rem) to the hands, forearms, feet, and ankles. The following additional criteria should be considered:

1. Rescue personnel should be volunteers or professional rescue personnel (e.g., fire fighters or first aid and rescue personnel who volunteer by choice of employment).

2. Rescue personnel should be broadly familiar with the probable consequences of exposure.

3. Women capable of reproduction should not take part in these actions.

4. Other things being equal, volunteers above the age of 45 should be selected whenever possible for the purpose of avoiding unnecessary genetic effects.

5. Internal exposure should be minimized by the use of the most appropriate respiratory protection, and contamination should be controlled by the use of protective clothing when practical.

6. Exposure under these conditions shall be limited to once in a lifetime.

7. Persons receiving exposures as indicated above should avoid procreation for a period up to a few months.

Exposure During Re-entry/Repair Efforts

There may be situations where saving a life is not at issue, but where it is necessary to enter a hazardous area to protect valuable installations, or to make the facility more secure against events which could lead to radioactive releases (e.g., assessment actions or entry of damage repair parties who are to repair valve leaks or add iodine-fixing chemicals to spilled liquids). In such instances, planned dose to emergency workers should not exceed 25 rem to the whole body, 125 rem to the thyroid, or 100 rem to the extremities. The following additional criteria should also be considered:

*This guideline applies to the removal of injured persons if the saving of life is possible, or entry to prevent conditions that, if left uncorrected, could lead to damage or releases that would probably injure numbers of people on or off site.

1. Persons performing the planned actions should be volunteers broadly familiar with exposure consequences.

2. Women capable of reproduction will not take part in these actions.

3. Internal exposures shall be minimized by respiratory protection and contamination controlled by the use of protective clothing.

4. If the retrospective dose from these actions is a substantial fraction of the prospective limits, the actions shall be limited to once in a lifetime.

5. Entry into high radiation areas shall not be permitted unless instrumentation capable of reading radiation levels of up to 1000 R/hour (gamma) is provided.

6. Each emergency worker entering a high radiation area shall wear pocket dosimeters capable of measuring the expected exposure to be received.

7. Entry into radiation fields of greater than 100 R/hour shall not be permitted unless specifically authorized by the Plant General Manager or Environmental & Radiation Control Manager; in their absence the Site Emergency Coordinator may grant approval.

8. Planned exposures in excess of 3 rem may only be approved by:

   a. Plant General Manager, or
   b. Environmental & Radiation Control Manager, or
   c. Site Emergency Coordinator in their absence.

Emergency teams that must enter areas where they might be expected to receive higher than normal doses will be fully briefed regarding their duties and actions and what they are to do while in the area. They will also be fully briefed as to expected dose rates, stay time, and other hazards. All such entries will include one member from the Plant Monitoring Team or other person adequately trained in health physics. All team members will use protective clothing, dosimeters, respiratory devices, and other protective devices as specified by the Radiological Control Director. The team members will be instructed not to deviate from the planned route unless required by unanticipated conditions, such as rescue or performing an operation that would minimize the emergency condition. If the monitored dose rates or stay times encountered during the entry exceed the limits set forth for the operation, the team will immediately communicate with the Site Emergency Coordinator, or the Radiological Control Director, or will return to the area from where they were dispatched.

Once their operation has been completed, the team personnel will follow established monitoring and personnel decontamination procedures or as specified by the Radiological Control Director.

(EXAMPLE)

EXHIBIT 3.7.1-2

DOSIMETRY ISSUE INSTRUCTIONS

1. Fill in Name, Company and Social Security number on Exposure Record Sheet.

2. Obtain a TLD and a dosimeter.

3. Record TLD number and dosimeter number above name as shown.

CP&L CO
FORM NO 1737
1/3/78

Page ________

EXPOSURE RECORD SHEET
Revised October 1, 1976

TLD #
Dosimeter #

AUTHORIZED EXPOSURE ________ mrem NAME ____________________
COMPANY ______________________________ BADGE NUMBER ________
POST RESULTS BY BADGE NUMBER, NOT NAME!! SS NO. ________

Date	Dosimeter	TLD[1.]	Total[2.]	Allowed[3.]	Comments

4. Place dosimetry between waist and shoulders on outside of clothing.

5. Leave Exposure Record Sheet at the Operational Support Center when entering the plant area.

6. When Leaving the plant area, turn in dosimetry at the Operational Support Center and complete additional forms as required.

EXHIBIT 3.7.1-3

TLD LOCATION AND LOG SHEET				
TLD Location	TLD#	Time/Date Placed	Time/Date Retrieved	Reading

File No. ______________
Unit No. ______________
Q+RET'd ______________
App'l ______________
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CAROLINA POWER & LIGHT COMPANY
BRUNSWICK STEAM ELECTRIC PLANT

UNIT NOS. 1 & 2

EMERGENCY PERSONNEL MONITORING AND DOSIMETRY

PLANT EMERGENCY PROCEDURE PEP-3.7.2

VOLUME XIII

Rev. 2

FOR INFORMATION ONLY

Recommended By: CR Gibson Date: 4/9/82

Approved By: RE Morgan for CR Dietz Date: 4/9/82
Plant General Manager

PEP-3.7.2 EMERGENCY PERSONNEL MONITORING AND DOSIMETRY

1.0 Responsible Individual and Objectives

The Personnel Protection and Decontamination Team is responsible to the Radiological Control Director for:

1.1 Determining personnel exposures, utilizing the Radiological Information Management Systems (RIMS) or a manual backup system during an emergency.

1.2 Maintaining exposure records through the use of the RIMS computer in a real-time mode or by using an alternate record keeping system which can later be loaded into the RIMS data base.

1.3 Determining need for and issuing special personnel monitoring devices.

2.0 Scope and Applicability

This procedure shall be implemented upon activation of the Personnel Protection and Decontamination Team.

3.0 Actions and Limitations

3.1 Designated members of the Personnel Protection and Decontamination Team shall be trained in the use of the RIMS computer terminals to allow them to determine and document personnel exposures in accordance with RC&T-0200, "Control of Personnel Exposure to Ionizing Radiation," with the following additions and exceptions:

3.1.1 Set up a dosimetry issue area in the Operational Support Center as detailed in PEP-3.7.1, "Radiation Work Permits and Exposure Control."

3.1.1.1 Assist at the dosimetry issue area and complete additional documentation as required by RC&T-0200 if the RIMS terminal is not available and in use. Such assistance will be given as time and conditions permit.

Note: Appropriate documentation shall be completed on paper or entered through a RIMS terminal when exiting the plant for personnel who bypassed the additional documentation due to plant/emergency conditions.

3.1.1.2 Ensure that all TLDs are read and that results are documented or entered into the RIMS system as conditions allow.

3.1.2 Issue special dosimetry (e.g., high-range dosimeters or finger badges) as specified in PEP-3.7.1, "Radiation Work Permits and Exposure Control," or as otherwise directed by the Personnel Protection and Decontamination Team Leader.

3.1.2.1 Record dosimeter numbers and to whom issued on EXHIBIT 3.7.2-1, "Special Dosimetry Log."

3.1.2.2 Instruct personnel issued special dosimetry to have dosimeter numbers recorded on the Radiation Work Permit, either on the printed RWP form or by having a qualified RIMS user enter the information via a computer terminal.

3.1.3 Collect specimens and perform bioassays or whole body counts for personnel suspected of having internal contamination using the following guidelines:

3.1.3.1 Contamination present in the hair or on the face.

3.1.3.2 Unremovable contamination on the body.

3.1.3.3 Greater than 3 Rem by TLD.

3.1.3.4 Respirator filters show contamination greater than 100 mR/hr.

3.1.3.5 As indicated by risk situations, e.g.,:

i. Respirator defeated

ii. Retrospective recognition of airborne hazard

3.1.4 The results of body counts and/or bioassays not directly generated by and/or stored in the RIMS computer will be documented such that these results can readily be entered into the RIMS data files directly from such documentation as time and conditions permit.

EXHIBIT 3.7.2-1

SPECIAL DOSIMETRY LOG		
Name	Dosimeter Type	Dosimeter Number

APPENDIX A.1 BSEP PERSONNEL

BSEP Personnel

	Home Phone	Office
PLANT GENERAL MANAGER (SITE EMERGENCY COORDINATOR)		
C. R. Dietz	(pager)	210
Alternate		
MANAGER - PLANT OPERATIONS		
R. E. Morgan	(pager)	342
MANAGER - OPERATIONS (PLANT OPERATIONS DIRECTOR)		
R. E. Knoble		214
Alternate		
R. E. Morgan		342
MANAGER - ENVIRONMENTAL & RADIATION CONTROL (RADIOLOGICAL CONTROL DIRECTOR)		
G. J. Oliver		447
Alternate		
L. F. Tripp		262
MANAGER - MAINTENANCE (EMERGENCY REPAIR DIRECTOR)		
M. D. Hill		212
Alternate		
J. P. Dimmette		367
MANAGER - TECHNICAL SUPPORT (LOGISTIC SUPPORT DIRECTOR)		
W. M. Tucker		213
Alternate		
L. E. Boyer		225

ASSISTANT TO PLANT GENERAL MANAGER (REPRESENTATIVE TO THE SERT)

C. R. Gibson (Sea Captain) (Weekends, Cary, N.C.) 211

RADIATION CONTROL SUPERVISOR (PERSONNEL PROTECTION AND DECONTAMINATION LEADER)

L. F. Tripp 262

Alternate

Radiation Control Foreman (See Attached)

ENVIRONMENTAL AND CHEMISTRY SUPERVISOR (ENVIRONMENTAL MONITORING LEADER)

R. D. Pasteur 237

Alternate

A. H. Caylor 264

PROJECT SPECIALIST - RADIATION CONTROL (DOSE PROTECTION COORDINATOR)

R. F. Queener 521

Alternate

J. L. Kiser/P. B. Snead 520/521

PROJECT SPECIALIST - ENVIRONMENTAL AND CHEMISTRY (PLANT MONITORING LEADER)

C. E. Robertson 530

Alternate

J. W. Davis 529

MECHANICAL MAINTENANCE SUPERVISOR (DAMAGE CONTROL LEADER)

J. P. Dimmette 367
G. C. Campbell 367

I&C ELECTRICAL MAINTENANCE SUPERVISOR (DAMAGE CONTROL LEADER)

K. E. Enzor 368
J. R. Jefferson 389

SENIOR SPECIALIST ELECTRICAL (OPERATIONAL SUPPORT CENTER LEADER)

K. D. Creech 368
T. L. Brown 389

ENGINEERING SUPERVISOR (ACCIDENT ASSESSMENT LEADER)

E. A. Bishop	[ ]	271
Alternate		
J. S. Boone	[ ]	317

SECURITY SPECIALIST (EMERGENCY SECURITY LEADER)

W. Hatcher	[ ]	252
Alternate		
G. Spies	[ ]	253

COST CONTROL SPECIALIST (EVACUATION ASSEMBLY LEADER)

J. L. Bovte	[ ]	230
Alternate		
R. G. Lee	]	231

REGULATORY COMPLIANCE (EMERGENCY COMMUNICATOR)

D. E. Novotny	[	316
M. J. Pastva		315
R. M. Poulk	]	314

Environmental and Radiation Control

Foreman

	Home	Office
A. H. Caylor (E&C)		264
J. B. Cook (RC)		239
B. E. Failor (RC)		241
J. D. Henderson (RC)		453
J. A. Kaham (E&C)		238
W. A. Nurnburger (E&C)		263
J. D. Ward (RC)		476

Specialists

	Home	Office
J. W. Davis (E&C)		530
J. L. Kiser (RC ALARA)		520
R. E. Queener (RC)		521
C. E. Robertson (E&C)		529
P. B. Snead (RC)		521

Operations

Shift Operating Supervisors

	Home	Office
C. F. Blackmon		312
A. S. Hegler		375
C. W. Martin		375
P. T. McNeill		375
W. L. Johnson		375
J. D. Lichty		375
D. C. Cooper		375

Shift Foreman

	Home	Office
M. R. Foss		200/423
J. D. Lichty		201/202
W. D. Link		201/202
J. L. Simon		200/201
R. D. Tart		200/423
S. B. York		200/201
R. A. LaBelle		200/201
S. C. Carr		384
C. S. Briney		200/201
E. C. Hawkins		200/201
R. M. Stiffler		201/202
K. F. Horn		200/201

Electrical and I&C Maintenance Foremen

	Home	Office
J. R. Jefferson		389
G. N. Batton		365
W. M. Bracey		349
R. D. Creech		371
J. E. King		379
C. D. Parker		364
G. W. Stegall		366
J. W. Bruner		365
L. R. Stohler		363
W. B. Moore		366

Mechanical Maintenance

	Home	Office
J. D. Thrift		266
W. M. Cain		348
E. G. Conner		354
H. R. Harrelson		310
T. P. Harrison		355
K. W. Huggins		356
J. D. Schwab		355
D. Stidham		430
C. Treubel		372

Qualified Operators for Emergency Switchboard

	Home	Office
Annette Clemmons		300
Charlotte Frye		219
Kay Hewett		215
Cindy Long		328
Brenda McKeithan		373
Amy Rhodes		369
Sally Stocum		215
Marsha Stone		300
Theresa Tripp		215
Geri Cahill		215
Helen Nichelson		224

Security

	Home	Office
W. R. Hatcher		252
G. Spies		253