VERMONT YANKEE EMERGENCY PLAN

IMPLEMENTING PROCEDURES

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September 30, 1982

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September 30, 1982

IMPLEMENTING PROCEDURES TO THE VY EMERGENCY PLAN

Change #16

- INSTRUCTIONS -

1. Under the tab "CONTACT LIST" remove the existing table of contents and replace it with the table of contents dated September 30, 1982.

2. Under the tab "CLASSIFICATION OF EMERGENCIES" remove the procedure numbered A.P. 3125, Rev. 3 and replace it with the attached procedure numbered A.P. 3125, Rev. 4.

3. Under the tab "EVALUATION OF RADIOLOGICAL DATA" remove the procedure numbered O.P. 3513, Rev. 5 and replace it with the attached procedure numbered O.P. 3513, Rev. 6. Also remove and discard the Dept. Instruction.

4. Under the tab "OFF-SITE MONITORING" remove the procedure numbered O.P. 3510, Rev. 9 and replace it with the attached procedure numbered O.P. 3510, Rev. 10.

5. Insert the tab "PROTECTIVE ACTION RECOMMENDATIONS" and the procedure numbered O.P. 3511, Rev. 0 after the tab "OFF-SITE MONITORING" and the procedure numbered O.P. 3510, Rev. 10.

6. Insert the tab "POST ACCIDENT SAMPLING" and the procedure numbered O.P. 3530, Rev. 3 after the tab "ENVIRONMENTAL SAMPLE COLLECTION" and the procedure numbered O.P. 3509, Rev. 7.

VERMONT YANKEE EMERGENCY PLAN

IMPLEMENTING PROCEDURES

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September 30, 1982

Dept. Supv.	R.J. Branch	Proc. No.	A.P. 3125
PORC	[signature]	Rev. No.	4
Plant Mgr.	[signature]	Issue Date	9/30/82
Mgr. of Ops.	E.W. Jackson	Review Date	9/30/84

EMERGENCY PLAN CLASSIFICATION AND ACTION LEVEL SCHEME

Purpose:

To describe how operators recognize plant operations that require a level of the Vermont Yankee Power Station Emergency Plan to be initiated.

Discussion:

Operators are trained so that when they sense that plant operations are off-normal or exceeding administrative controls, they have cause to refer to emergency operating procedures which will subsequently refer them to this procedure if necessary.

* This procedure in table form is designed to assign the appropriate emergency class for events which are in process or have occurred. The Emergency Plan is then implemented on the basis for the classification. The table does not necessarily list all situations which would require implementation of the Emergency Plan; therefore, any off-normal condition should be evaluated in light of the "General Criteria." Additionally, there may be events listed in the table at high levels which may be rapidly terminated and therefore not require full implementation of the Emergency Plan, but should more appropriately be classified at a lower level. The minimum response to any event listed in the table once it has occurred would be to classify the event at the Unusual Event level and to implement the Emergency Plan accordingly. *

The table directs the Operator to the following four classes of
* Emergency Action Level Operating Procedures:

1. Unusual Event, O.P. 3500
2. Alert, O.P. 3501
3. Site Area Emergency, O.P. 3502
4. General Emergency, O.P. 3503

*

The definitions of Emergency Classifications are:

* 1. Unusual Event Unusual events in process or have occurred which involve potential degradation of plant safety margins, which are not likely to affect personnel on-site or the public off-site or result in radioactive releases requiring off-site monitoring. *

* * 2. Alert Events are in process or have occurred which involve an actual or potential substantial degradation of plant safety margins and could affect on-site personnel, could require off-site impact assessment, but is not likely to require off-site public protection action.

3. Site Area Emergency Events are in process or have occurred which involve likely or actual major failures of plant functions needed for protection of the public.

4. General Emergency Events are in process or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity.

* * The responsibility and authority for classifying the level of emergency is assigned to the duty Shift Supervisor, or in his absence from the Control Room, to the duty Supervisory Control Room Operator.

The following table is attached:

Table I Table of Categories and Events

References:

A. Tech. Specs.

1. All Tech. Specs.

B. Admin. Limits

1. None

C. Other

1. Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants (NUREG-0654)
2. Final Safety Analysis Report (FSAR)
* 3. Plant Operating Procedures

Procedure:

*

1. Refer to Table I and based on the event to be classified, locate the appropriate "Event Categories."

2. Determine if any of the Emergency Action Levels (EALs) have been reached for any of the four classes of emergency (Unusual Event, Alert, Site Area Emergency, General Emergency).

3. If any of the EALs have been reached, classify the emergency at the highest emergency class for which an EAL has been reached. For EALs which have been reached but are no longer present, the emergency may be classified at a lower level consistant with the "General Criteria" for the emergency class.

NOTE: For any EAL reached the minimum classification is Unusual Event.

*

4. If events are in process or have occurred and no specific EALs in Table I have been reached but in the opinion of the duty Shift Supervisor or in his absence the duty Senior Control Room Operator, conditions warrant implementation of the Emergency Plan, refer to the "General Criteria" and classify the event as appropriate.

   NOTE: The Shift Supervisor and/or Supervisory Control Room Operator in making the classification determination should request assistance from any source immediately available (Security, Chemistry & Health Physics, I & C, Maintenance, Engineering Support, etc.). Input from these sources must be prompt, informal, and advisory in nature.

5. Once the classification has been assigned, implementation of the appropriate Emergency Operating Procedure should be initiated with the prompt notifications of off-site authorities performed, consistant with the need for other emergency actions.

6. Request the on-shift Chemistry and Health Physics Tech. to perform O.P. 3513 (Subsequent Evaluation of Off-Site Radiological Conditions) until the Emergency Operating Facility is manned.

7. Utilize the Shift Technical Advisor for operational support.

8. Changing conditions may require re-classification. Assess conditions periodically and be prepared to initiate the appropriate change.

REB/emr

1. RADIOLOGICAL CONDITIONS

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. >Tech. Spec. limit for effluents. 1. Increase in stack monitor followed by analysis: a. Gross activity exceeds 0.08/$\bar{E}\gamma$ Ci/sec. OR b. I-131 activity exceeds 0.48 μci/sec. OR c. Radioactive particulates with half lives >8 days exceed $1.6\text{x}10^{3}$ MPCa ci/sec. 2. Any liquid release which analysis shows following limits at point of discharge were exceeded. a. Concentration of radioactive material except tritium and dissolved noble gases exceeded $1\text{x}10^{-7}$ μci/ml or, when analyzed on an isotopic basis, 10CFR20, App. B, Table II, Column 2 limits. OR b. Concentration of tritium exceeds $3\text{x}10^{-3}$ μci/ml. OR c. Concentration of dissolved noble gases exceeds $4\text{x}10^{-5}$ μci/ml.	A. >10X Tech. Spec. limit for effluents. 1. Increase in stack monitor followed by analysis indicates: a. Gross activity exceeds 0.8/$\bar{E}\gamma$ ci/sec. OR b. I-131 activity exceeds 4.8 μci/sec. OR c. Radioactive particulates with half lives >8 days exceed $1.6\text{x}10^{4}$ MPCa ci/sec. 2. Any liquid release which analysis shows following limits at point of discharge were exceeded: a. Concentration of radioactive material except tritium and dissolved noble gases exceed $1\text{x}10^{-6}$ μci/ml or, when analyzed on an isotopic basis, 10X (10 CFR20, App. B, Table II, Column 2 limits). OR b. Concentration of tritium exceeds $3\text{x}10^{-2}$ μci/ml. OR c. Concentration of dissolved noble gases exceeds $4\text{x}10^{-4}$ μci/ml. B. Unexpected area radiation levels 1000 times normal.	A. Plant condition producing projected or actual site boundry whole body dose rates >500mR/hr for more than 2 min. or >50mR/hr for more than 30 min. 1. Dose rates determined by direct field monitoring. OR 2. Dose rates determined by projected off-site dose rate correlation (O.P. 3513).	A. Plant conditions producing projected or actual site boundry whole body dose rates >1R/hr. 1. Dose rates determined by direct field monitoring. OR 2. Dose rates determined by projected off-site dose rate correlation (O.P. 3513).

2. FUEL DAMAGE

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Indication of in-core fuel damage during operation as indicated by any of the following: 1. Air ejector offgas timer trip isolation OR 2. Rx water sample analysis exceeds 1.1 μci/cc I-131 dose equivalent. OR 3. Main steam line high radiation isolation.	A. In-core fuel damage which results in apparent loss of fuel cladding integrity as indicated by the following: 1. Air ejector offgas sample activity >5ci/sec. OR 2. Reactor coolant sample activity >360μci/cc I-131 dose equivalent.	A. Indication of actual or potential significant in-core fuel damage. 1. Containment radiation monitors reading >1x10^{3} R/hr. OR 2. Inability to maintain reactor water level above - 48 inches.	A. Indication of actual or potential gross in-core fuel damage with the actual or likely failure of the primary coolant and/or primary containment. 1. Loss of 2 of 3 fission product barriers with potential loss of the third. a. Loss of significant amount of the fuel clad as evident by containment radiation monitors reading >1x10^{4} R/hr. AND/OR b. Failure of the primary coolant boundry as evident by loss of coolant. AND/OR c. Failure of the primary containment as evident by failure of two in series containment isolation valves, observed structural damage, or high reactor building radiation levels detected indicating containment failure.
	B. Spent fuel assembly accident with release to the reactor building resulting in trip of the reactor building ventilation and start of the Standby Gas Treatment System due to: 1. Refuel floor radiation monitors high radiation trip. OR 2. Reactor building ventilation radiation monitor high radiation trip.	B. Indication of actual or potential major irradiated fuel assembly damage: 1. Refuel floor radiation monitors reading >1000mR/hr. OR 2. Reactor building ventilation radiation monitor reading >140mR/hr. OR 3. Spent fuel pool water level below the top of the spent fuel assemblies.	

TABLE I

3. COOLANT INVENTORY

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Indication of loss of coolant from the primary coolant system as evidenced by any of the following: 1. high containment sump flow as follows with reactor coolant temperature above 212°F. a. Unidentified leakage >5gpm. OR b. Total primary containment leakage >25 gpm. 2. Failure of primary coolant safety or safety relief valve to close following reduction of pressure below their respective setpoints. 3. ECCS initiated and injecting to the reactor vessel due to low reactor water level or high drywell pressure.	A. Loss of primary coolant as indicated by the following: 1. Coolant leakage within the primary containment >50gpm as indicated by continuous sump pumping and radwaste tank level increases. 2. Primary coolant line break outside the primary containment which has been isolated as evident by: a. High area temperature and/or high flow indications and/or high area radiation levels. AND b. Line isolation valves closed.	A. Loss of coolant outside primary containment without isolation as indicated by the following: 1. High area temperatures and/or high system line flow and/or high area radiation conditions. AND 2. System line isolation valves not closed.	A. Loss of all normal reactor makeup systems. 1. All of the following systems are inoperable: a. High Pressure Coolant Injection b. Reactor Core Isolation Cooling c. Core Spray d. Residual Heat Removal e. Condensate f. Feedwater AND 2. Fuel melt or primary containment failure has occurred or is imminent.

TABLE I

4. FIRE (O.P. 3020)

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Any on-site or in-plant fire not extinguished within 10 minutes.	A. Any in-plant fire which affects or will likely affect a safety system function.	A. Any in-plant fire which disables all high pressure safety injection systems when reactor pressure is above 150 psig. 1. High Pressure Coolant Injection System disabled, AND 2. Reactor Core Isolation Cooling System disabled. AND 3. Automatic Depressurization System B. Any in-plant fire which disables all low pressure safety injection systems when the plant is not in cold shutdown. 1. Low Pressure Coolant Injection Systems disabled, AND 2. Core Spray Systems disabled.	A. Any in-plant fire which results in either the radiological or fuel damage conditions described in General Emergency event categories 1 and 2.

TABLE I

5. NATURAL PHENOMENON (O.P. 3021)

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Any of the following natural phenomenon recognized by either observation, detection or notification: 1. Any earthquake sensed on-site, OR 2. River water level above 235' or below 212', OR 3. Any hurricane or tornado causing on-site winds exceeding 75 mph.	A. Any natural phenomenon which results in the following: 1. Earthquake which damages plant systems or structures, OR 2. River water level above 250' or below 200', OR 3. Hurricane or tornado with on-site winds >100 mph, OR 4. Severe lightning which disables a safety system or safety system function.	A. Severe natural phenomenon being experienced with the plant not in a cold shutdown which renders safe shutdown equipment inoperable.	A. Any natural phenomenon resulting in the conditions of General Emergency event catagories 1 and 2.

TABLE I

6. LOSS OF POWER

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Loss of off-site AC power when in other than cold shutdown: 1. Loss of availability of all incoming 345KV and 115KV transmission lines. a. 345KV and 115KV bus voltage becomes zero, OR b. Loss of both start-up transformers. B. Loss of on-site AC power when in other than cold shutdown: 1. Both Diesel generators inoperable.	A. Loss of either all AC or all 125VDC power: 1. No off-site or on-site AC power supply is capable of energizing either 4160 volt bus 3 or 4, OR 2. Neither 125VDC station battery bus A or B is energized. NOTE: For power loss extended beyond 15 minutes, see Site Area Emergency	A. Loss of either all AC or all 125VDC power for >15 minutes: 1. No off-site or on-site AC power supply is capable of energizing 4160 volt buses 3 or 4, OR 2. Neither 125VDC station battery bus A or B is energized.	

7. LOSS OF SYSTEMS OR EQUIPMENT

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Loss of any system function or engineered safety feature which requires a plant shutdown in accordance with the Limiting Conditions for Operation in the Technical Specifications.	A. Loss of functions needed for plant cold shutdown: 1. Loss of the normal shutdown cooling mode function, AND 2. Loss of the alternate cooling mode function.	A. Loss of functions needed for plant hot shutdown: 1. Loss of systems or equipment such that reactor pressure cannot be maintained below 1240 psig, OR 2. Loss of systems or equipment such that Reactor water level cannot be maintained above -48 inches, OR 3. Loss of both the condenser and torus as heat sink for decay heat removal.	A. Loss of systems or equipment such that fuel melt and primary coolant and primary containment failure is imminent. Examples of these sequences are as follows: 1. Reactor shutdown occurs but no requisite decay heat removal systems are available: a. Main condenser is not available as heat sink, AND b. Residual Heat Removal System is unavailable as heat sink for either the Reactor or the Containment. 2. Failure to complete a required SCRAM with fuel melt and primary coolant boundary and primary containment failure immienent: a. Automatic or manual SCRAM signal present, AND b. Not all control rods fully inserted, AND c. Reactor power remains above 5%, AND d. Reactor water level is decreasing, AND e. Main condenser is not available as heat sink.
	B. Loss of all Control Room panel alarms.	B. Loss of all Control Room panel alarms during plant transient.	
	C. Failure of the Reactor Protection System to accomplish a required SCRAM: 1. Automatic or manual SCRAM signal is present, AND 2. Not all control rods are fully inserted, AND 3. Reactor power remains above 5%.	C. Failure of the Reactor Protection System to accomplish a required SCRAM with the main condenser unavailable: 1. Automatic or manual SCRAM signal present, AND 2. Not all control rods are fully inserted, AND 3. Reactor power remains above 5%, AND 4. Main condenser not available as heat sink.	

8. OTHER HAZARDS OR CONDITIONS

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
A. Other events near or on-site having an impact on normal plant operation. 1. Any near or on-site train derailment or tank truck accident with actual or potential release of toxic or hazardous substances which will likely affect the plant operation, OR 2. Unusual aircraft activity over the facility or any on-site plane crash, OR 3. Transportation of contaminated injured individual to off-site medical facility, OR 4. Significant loss of assessment capability: a. Loss of all meteorological instrumentation, OR b. Indications or alarms on process or effluent parameters not functional in the Control Room to the extent requiring plant shutdown.	A. Other events on-site causing potential or actual substantial degradation of the level of plant safety: 1. Any crash impact or explosion which results in damage to in-plant safety systems or vital structures, OR 2. Entry of uncontrolled toxic or flammable gas into vital areas of the plant threatening to render safety related equipment inoperable, OR 3. Turbine failure resulting in casing penetration, OR 4. Evacuation of the Control Room anticipated or required with control of shutdown systems established locally.	A. Other severe events being experienced or projected near or on-site with the plant not in cold shutdown: 1. Any crash impact or explosion which renders safe shutdown equipment inoperable, OR 2. Entry of uncontrolled toxic or flammable gas into vital areas where lack of access constitutes a safety problem, OR 3. Evacuation of the Control Room without control of shutdown systems established locally within 15 minutes.	A. Any major near or on-site event with massive common damage to plant systems resulting in actual or potential releases which would result in the radiological conditions of events category 1. Examples of these events are as follows: 1. Any crash impact or explosion which renders all decay heat removal systems inoperable or causes containment and primary coolant boundary failure.

TABLE I

9. SECURITY EVENTS

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Site Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
Notification and response in accordance with the Security Plan.	Notification and response in accordance with the Security Plan.	Upon notification to the Control Room by the Security Force that loss of physical control of the plant is imminent.	Upon notification to the Control Room by the Security Force that loss of physical control of the plant has occurred.

TABLE

GENERAL CRITERIA

Unusual Event Refer to O.P. 3500	Alert Refer to O.P. 3501	Area Emergency Refer to O.P. 3502	General Emergency Refer to O.P. 3503
Events in process or have occurred which warrant plant staff notification and increased awareness for off-site authorities.	Events in process or have occurred which warrant precautionary activation of the Technical Support Center and the Emergency Operations Facility.	Events in process or have occurred which warrant activation of emergency centers, initiation of off-site monitoring and/or notification of the public.	Events are in process or have occurred which warrant initiation of predetermined protective action for the public.

Dept. Supv.	[signature]	Proc. No.	O.P. 3513
PORC	[signature]	Rev. No.	6
Plant Mgr.	[signature]	Issue Date	9/30/82
Mgr. of Ops.	[signature]	Review Date	9/30/84

EVALUATION OF OFF-SITE RADIOLOGICAL CONDITIONS

Purpose:

To specify the method used to evaluate the stack release rate and projected off-site whole body dose rate, and to determine estimated and actual downwind whole body and thyroid doses, based on field measurements and current meteorology.

Discussion:

In an emergency declared on the basis of an actual stack or ground release, the Plant Emergency Director/Shift Supervisor determines the initial projected off-site whole body dose rate. In an emergency declared on the basis of a potential high level release (i.e., high level activity in containment, but no actual release), the Technical Support Center Coordinator, or Emergency Operations Facility Coordinator, will determine and report the initial whole body off-site dose rate to State Officials should an actual release occur. An Off-Site Dose Nomogram (See Figure 1 and Appendix A) is used for this initial determination.

* Additionally, in the event that a loss of all core cooling capability has occurred with likely subsequent release of large quantities of radioactive material to the atmosphere, the SS/PED shall recommend protective actions to states' representatives utilizing the criteria in O.P. 3511, Offsite Protective Action Recommendations. *

Following the initial evaluation, a subsequent method to further evaluate and refine the downwind off-site radiological conditions based on actual field measurements and current meteorology has been developed. The results of this evaluation are reported to the various State Health Officials as they call into the Emergency Operations Facility (EOF) for more detailed and refined information.

The method described in Appendix B utilizes two sets of diffusion factor ($\bar{u}X/Q$) values: one set for ground level releases which are independent of wind direction, and the other set for elevated stack releases which are dependent on wind direction because of our valley location. Both sets of diffusion factors are presented as a function of atmospheric stability class and distance from the plant out to 10 miles.

In order to help qualitatively define plume width, a transparent overlay has been prepared for the area base map. This transparency consists of three colored angles as follows:

Blue - For all unstable meteorological classes
Red - For neutral meteorology
Orange - For all stable meteorological classes

Included within each angle are areas lateral to the plume centerline
* having I-131 concentrations of at least 5% of the plume centerline value. Centering the stability-dependent angles over the appropriate downwind direction on the area base map will help qualitatively define the plume width. Using the sector/zone designation appropriate to the plume width, Vermont Yankee can provide State officials with the affected area and corresponding projected whole body dose rates, or airborne concentrations of I-131, out to ten miles.

To facilitate and expedite the necessary classification of meteorological conditions, the selection of the appropriate diffusion factor table and subsequent calculations, two programs for the Texas Instrument programmable (TI-59) calculator-printer have been developed. The first, MET DATA, expeditiously calculates the following:

1. Actual time of arrival of the plume downwind for any given distance,

2. The downwind direction corresponding to the "wind from" direction indicated by the meteorology typer,

3. The meteorological stability classification for any given ΔT, and,

4. The proper colored angle to use on the mapboard overlay.

The second, RADOSE II, then calculates the following:

*

1. The projected whole body sector dose rate at any assumed distance from any field measured sector dose rate at a known distance,

* 2. The projected I-131 concentration at any assumed distance from any field measured I-131 concentration at a known distance, and,

3. The 5% I-131 concentration value at the angle boundary.

This procedure utilizes the above programs. In the event the calculator should become inoperable, hand calculations will be made as indicated in Appendix B.

Responsibility for completion of Section A of this procedure rests primarily with the Plant Emergency Director/Shift Supervisor, however, during off-shift hours he also has a collateral responsibility to initiate Section B of this procedure to the extent that such action does not impair his ability to bring the plant to a safe condition. Upon activiation of the EOF, the EOF Coordinator "takes over" and completes this procedure. A mapboard, angle overlay and calculator-printer are provided in the Control Room emergency kit.

* Offsite protective action recommendations shall be made based
* on the guidelines established in O.P. 3511.

The following table, forms, figures and appendices are attached:

Table I	Air Sample Codes
* Table II	Major Points of Interest by Sector
VYOPF 3513.01	Meteorological Data Sheet
VYOPF 3513.02	Doses at Selected Locations
* VYOPF 3513.03	Dose Projections Based on Site Data Worksheet
* VYOPF 3513.04	Dose Projections Based on Field Data Worksheet
Figure 1	VY Emergency Off-Site Dose Nomogram
Figure 2	Field Sample Thyroid Dose Nomogram
Appendix A	VY Emergency Off-Site Dose Rate Nomogram, Description and Use
Appendix B	Diffusion Factors
Appendix C	TI-59 Calculator-Printer Instructions

References:

A. Tech. Specs.

1. None

B. Admin. Limits

1. None

C. Other

1. 10 CFR 50, Appendix E
2. VY Meteorology System Manual
3. O.P. 3510, Off-Site Monitoring

Precautions:

1. Actual location of reported off-site monitoring team data relative to plant should be verified prior to using the data in calculations.

2. Periodically check on the quarter hour for significantly changed meteorological conditions.

Procedure:

A. Immediate action by the Plant Emergency Director/Shift Supervisor, or his designated assistant, in the event a high level stack release
* is occurring at the time of the emergency declaration.

NOTE: In the event an emergency is declared on the basis of a potential release (i.e., activity confined in containment), the Technical Support Center Coordinator, or his designated assistant, will complete this section should a subsequent release occur.

Initials

1. Determine the elapsed time in hours following reactor shutdown. ________(hrs) ________

2. Obtain current windspeed__________(mph) ________

3. Obtain high range stack gas monitor reading. ______________(mR/hr) (from PNL 9-2) ________

NOTE: In the event that installed instrumentation is not functional or a ground or combination release is in progress, dispatch a Security Site Boundary Team for a whole body dose rate at the fence line (0.35 miles) in the downwind direction in accordance with O.P. 3510. Record this dose rate in Step #5 below and proceed to Section B. Request a silver zeolite cartridge sample from the main stack sample point as per O.P. 3530, Post Accident Sampling.

NOTE: If the high range stack gas monitor equals or exceeds 20mR/hr, request the Chem. & HP Technician to obtain a silver zeolite cartridge from the main stack sample point for an iodine release rate determination in accordance with O.P. 3530, Post Accident Sampling. Ensure that this information is passed on to the EOF Coordinator when the EOF is activated.

4. Obtain the stack flow.__________(ft/min) ________

NOTE: Data Point C062 may be accessed on the Plant Computer to obtain stack flow rate.

$$\frac{\text{C062 value}}{144.9} = \text{Stack Flow (ft/min)}$$

5. Go to Figure 1 and determine the off-site dose rate at .35 miles__________(mR/hr) ________

B. Action initiated by the Plant Emergency Director or his designated assistant pending activation of the Emergency Operations Facility, or by the EOF Coordinator upon activation of the EOF. Utilize VYOPF 3513.03, Dose Projections Based on Site Data Worksheet.

1. Obtain data called for in item 1 of Meteorological Data Sheet (VYOPF 3513.01).

NOTE: 1. In the event the meteorological computer and printer are not operating properly, this data may be obtained from strip charts in the Relay House.

2. In the event that the primary meteorological tower instrumentation is not functioning, instrumentation on the secondary tower provides a read-out of wind speed, wind direction, ambient temperature and one value for delta t (Δt). CRP 9-48 contains all of this information.

3. In the event all instrumented meteorological parameters are unavailable, a generalized determination of atmospheric stability may be made by observing the cloud cover as follows:

   a. Heavy overcast day or night = D-neutral
   b. Any clear sky in daytime = B-mod. unstable
   c. Any clear sky at night = F-mod. stable

4. The Albany National Weather Service (NWS) Station (tel. 1-518-472-6586, and ask for "Public Forcaster") may be consulted regarding meteorological observations and forecasts.

2. After obtaining the TI-59 calculator-printer and program cards, press 4, 2nd, 917 (display should show 639.39), then CLR, and load the four sides of MET DATA program. (After each side is loaded and a steady number is seen on display, press CLR.) *

NOTE: 1. See appendix C for basic calculator instructions.

2. In the event the calculator is inoperable, complete the Meteorological Data Sheet (VYOPF 3513.01) by hand.

a. Enter time of day the release commenced in HH.MM format. (e.g., 9:15 AM = 9.15, 2:37 PM = 2.37 PM or 14:37 = 14.37)

   1) If in AM, or 24 hour "Navy" time - Press A *
   2) If in PM clock time - Press 2nd A

b. Enter wind speed ($\bar{u}$ mph) - Press B

c. Calculate estimated time of arrival of plume (in actual 24 hour time), for specific locations. *

d. Post arrival times at mile markers on mapboard with wax crayon.

e. Enter "WIND FROM" as indicated by meteorology typer and press C. The printer will show "Calculated Wind Toward."

f. Enter appropriate ΔT.

1) If stack release, enter upper ΔT - Press 2nd D
2) If ground, or combination, enter lower ΔT - Press D
* 3) The printer will display calculated met. class no. and angle color.

g. In the event the wind speed changes significantly (per MET system typer) enter actual time of new average (from MET typer) in 24 hour time (HH.MM) and press E. The printer will display calculated plume distance.

1) Enter new data as in Step B.2.b, above.

NOTE:
1. A new "wind from" or "ΔT" may be entered as in Steps B.2.e and f above at any time (i.e., Do <u>NOT</u> press E).
2. Future time and distance calculations (Step B.2.c) are corrected from the time and distance the new wind speed ($\bar{u}$) was specified.
3. The calculator can no longer calculate time or distance problems <u>prior</u> to the wind speed change. If attempted, the display will flash and a question mark will be printed.

3. Position mapboard angle wheel in above (Step 2.e) downwind direction and note the distance to the most significant population center within the above specified color angle. (Step 2.f). Consult Table II for major points of interest.

4. Determine the appropriate Gamma dose $\mu X/Q$ value from Tables in Appendix B.

a. Elevated or ground release (Step B.2.f)

b. Met class (Step 2.f with 1=A, 2=B, 3=C, etc.)

c. Gamma dose $\mu X/Q$ value for the selected distance

5. a. Calculate the projected whole body dose rate (mR/hr) at the selected location, (from B.3 above) as follows:

$D = [(5 \times 10^4)] \times [\text{Gamma Dose } \mu X/Q \times 10^{-6}] \times [\text{Dose rate in mR/hr}]$

where: Dose rate = The off-site dose rate at 1/3 mi. from Fig. 1, if an elevated release;
<u>OR</u>
The reported measured site boundary dose rate, if a ground release.

b. Calculate thyroid dose (based on measured stack release rate):

$$X_i = [\frac{\overline{\mu X}}{Q}]_i \cdot \frac{1}{\bar{\mu}} \cdot Q$$

where: X_i = Plume concentration at selected downwind distance i (μci/cc)

$[\frac{\overline{\mu X}}{Q}]_i$ = Concentration $\bar{\mu}X/Q$ value for selected distance i (from Table B-2)

$\frac{1}{\bar{\mu}}$ = Wind speed in meters/second

Q = I^{131} release rate (stack sample) in curies/second (from O.P. 2611)

6. Post projected dose at selected location on mapboard with wax crayon and record on VYOPF 3513.02.

7. Utilize O.P. 3511, Offsite Protective Action Recommendations, as required, to formulate recommendations to the states' representatives when they call in.

8. As State Health Department personnel call in for additional details, report the following information when available:

   a. Nature of emergency
   b. Elevated or ground release
   c. Off-site "boundary" dose rate
   d. Downwind direction of plume
   e. Estimated time of arrival at selected locations
   f. Estimated projected dose rate at selected locations
   g. Other information requested and available, including Off-site Protective Action Recommendations from O.P. 3511

C. Actions by the EOF Coordinator or the Radiological Assistant upon activation of the Emergency Operations Facility. Utilize VYOPF 3513.04, Dose Projections Based on Field Data Worksheet.

1. Determine the status of actions required in Section B above from the Plant Emergency Director and assume responsibility for completion, if necessary. Assign this and following duties to the F diological Assistant.

2. If the SS/PED has not previously requested a main stack gas silver zeolite cartridge sample be obtained, ensure that this sample is obtained as soon as possible. Utilize the results of this sample to determine downwind I^{131} concentrations following the formula in Appendix B, Section III. Determine projected thyroid dose values from Figure 2.

3. Turn calculator OFF, then ON, and load RADOSE II program (sides 1 and 2) and appropriate memory data (sides 3 and 4).

NOTE: 1. For ground releases, use "ground release" card (sides 3 and 4) for all wind directions.

2. For elevated releases, use the "elevated release" card (sides 3 and 4) with the applicable "wind to" designation.

a. Enter appropriate Met Class # (see printer readout, Step A.2.e above, or Met Data Sheet) and press A.

* b. Enter current average wind speed (miles per hour) ($\bar{u}$) and press 2nd A.

c. As monitoring teams report "air code" numbers, determine the corresponding net CPM from Table I, then enter Figure 2 to determine the I-131 concentration.

NOTE: Unless otherwise specified, a "standard" sample is as follows:

Counting efficiency (RM-14) = 2.5%
Flow rate = 10 LPM
Collection time = 1 minute

d. Enter the above data, and reported dose rates, on VYOPF 3513.02.

e. Enter the reported data and the distance to the monitored location in the TI-59 as follows:

Enter	Press	Enter	Press
Dose rate (mR/hr)	B	Distance (mi)	C
I-131 Conc. (μCi/cc)	2nd B	Distance (mi)	2nd C

* f. Determine the projected downwind (or upwind) radiological conditions for any number of selected locations by entering the selected distance in miles and pressing D (for average sector dose rate), or 2nd D (for I-131 sector and 5% angle boundary concentrations).

NOTE: A flashing display following a selected upwind distance indicates the plume is still elevated at the selected distance.

g. Log results of Step f above on VYOPF 3513.02 - Doses at Selected Locations.

h. Report results to the Emergency Operations Facility Coordinator for relay to State Officials, and post on mapboard.

i. Request off-site monitoring, or other special teams to change TLD's and/or air samples at environmental monitoring stations (O.P. 3509), if appropriate.

Final Conditions:

1. Turn in all log sheets and calculator printouts to the EOF Coordinator.

SPS/emr

TABLE I

AIR SAMPLE CODES

"AIR CODE"	NET CPM	"AIR CODE"	NET CPM
0	<40	24	1750
1	40	25	2000
2	60	26	2250
3	80	27	2500
4	100	28	2750
5	125	29	3000
6	150	30	3250
7	175	31	3500
8	200	32	3750
9	225	33	4000
10	250	34	4250
11	275	35	4500
12	300	36	5000
13	325	37	7500
14	350	38	10000
15	375	39	12500
16	400	40	15000
17	425	41	17500
18	450	42	20000
19	500	43	25000
20	750	44	30000
21	1000	45	35000
22	1250	46	40000
23	1500	47	50000

TABLE II

MAJOR POINTS OF INTEREST BY SECTOR

SECTOR	WIND TOWARD	DESCRIPTION	DISTANCE(mi)
NORTH (A)	348.5-11.5	W. Chesterfield Village	8.5
		Dutton Pines State Park	10.0
NNE (B)	11.5-33.5	Chesterfield Village & School	7.75
		Lake Spofford (Seasonal)	9.0
NE (C)	33.5-56.5	(None Within 10 Miles)	
		W. Swanzey	11.0
		Keene	15.0
ENE (D)	56.5-78.5	Hinsdale Schools	0.75
		Hinsdale Town Hall	1.75
		Rte. 10 Raceway (Seasonal)	8.5
EAST (E)	78.5-101.5	Southern Hinsdale	1.0
		Ashuelot	4.6
		Winchester	6.5
ESE (F)	101.5-123.5	(None Within 10 Miles)	
SE (G)	123.5-146.5	Northfield Boarding School	5.5
SSE (H)	146.5-168.5	Vernon Green Nursing Home	1.1
		Northfield Public Schools	6.25
		Pioneer Valley Regional School	6.75
		Mt. Hermon Boarding School	7.75
South (J)	168.5-191.5	(None Within 10 Miles)	
SSW (K)	191.5-213.5	Bernardston	7.5
		Northern Greenfield Schools	12.0
SW (L)	213.5-236.5	Vernon School	0.35
WSW (M)	236.5-258.5	(None Within 10 Miles)	
WEST (N)	258.5-281.5	(None Within 10 Miles)	
WNW (P)	281.5-303.5	Guilford Center School	5.8
NW (Q)	303.5-326.5	Fort Dummer State Park	3.5
		Guilford Village	4.0
		West Brattleboro	6.0
NNW (R)	326.5-348.5	Hinsdale Race Track	2.1
		Southern Brattleboro Boundary	4.25
		Brattleboro High School	4.75
		Brattleboro Hosp. & Nursing Home	5.1
		Brattleboro Business District	5.5
		Vt. Forward EOF (& WTSA)	6.9
		No. Brattleboro Shopping Centers	7.25

METEOROLOGICAL DATA SHEET

Time____________________

Date____________________

1. Meteorological Data

Type of Release	ΔT°F	Wind Speed (MPH)	Wind Direction (FROM)
Elevated (Stack only) or	______	___________	____________
Ground Level (ground or stack/ground comb.)	______	___________	____________

2. Wind Direction Correction

Wind direction FROM ___________°

If direction ≤180°, add 180° = ______________° Wind direction toward

If direction >180°, subtract 180° = _________°

3. Stability Class (Circle appropriate MET Class)

Δt(°F) Ground Release	Δt(°F) Elevated Release	MET Class	Stability Category	Use Angle
Δt≤-1.72	Δt≤-2.74	1-A	Extremely Unstable	Blue
-1.71≤Δt≤-1.54	-2.73≤Δt≤-2.45	2-B	Moderatly Unstable	Blue
-1.53≤Δt≤-1.36	-2.44≤Δt≤-2.16	3-C	Slightly Unstable	Blue
-1.35≤Δt≤-0.46	-2.15≤Δt≤-0.72	4-D	Neutral)	Red
-0.45≤Δt≤+1.35	-0.71≤Δt≤+2.15	5-E	Slightly Stable	Orange
+1.36≤Δt≤+3.62	+2.16≤Δt≤+5.74	6-F	Moderately Stable	Orange
+3.63≤Δt	+5.75≤Δt	7-G	Extremely Stable	Orange

4. Wind Speed Conversion

Last 15 min ave__________MPH X 0.447 = _______________meters/sec.

5. Data Summary

Type of release (Circle One)	Wind from	Stability (Circle One)	Wind Speed Meters/sec.	Wind Toward
Elevated	________	Stable	__________	______
		Neutral		
Ground	________	Unstable	__________	______

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DOSES AT SELECTED LOCATIONS

Date & Time	Location	Results(1) Type	Gamma Dose Rate (mR/hr)	I-131 Conc. µCi/cc	Estimated Duration (hrs)	Off-Site Doses			Initials
						Whole Body (REM)	Thyroid (REM)		
							Adult	Child	

(1) P = Projected; A = Actual field measurement; or C = Concurred (i.e., concurred in by State and Federal agencies)

DOSE PROJECTIONS BASED ON SITE DATA WORKSHEET

A. "MET DATA" PROGRAM SET UP

1. Complete Step 1 of the Meteorological Data Sheet (VYOPF 3513.01)
2. Load MET DATA program into the TI-59 calculator-printer.
   a. Press 4
   b. Press 2nd,
   c. Press 917 (display should show 639.39)
   d. Press Clear (CLR)
   e. Load the four sides of the MET DATA program, pressing CLR after each card is entered and a steady number is seen on the display.

B. MET DATA AND PLUME ARRIVAL TIME

1. Enter the time of day the release commenced in HH.MM format ____________.
   (24 hour time)
2. Press A.
3. Enter wind speed in mph ______________________.
4. Press B.
5. Enter "WIND FROM" in degrees.
6. Press C. Record the calculated "WIND TOWARD" value in degrees that is displayed on the readout___________________.
7. Enter appropriate ΔT (only one of the following).
   a. If a stack release, enter upper ΔT, then press 2nd D.
   b. If a ground or combination release, enter lower ΔT, then press D.
8. Record the Calculated Met Class Number_________and the Angle Color________.
9. Position the mapboard angle wheel using the number recorded in #6 above.
10. Using preselected points of interest (population centers, etc.) listed in Table II, calculate the estimated time of arrival of the plume (in actual 24 hour time) by entering the distance in miles and then pressing B on the keyboard. Record the location and the estimated time of arrival in the spaces provided below.

Location	Distance(mi)	Arrival Time (24 hr Time)

C. WIND SPEED CHANGES

1. Enter actual time of the new average wind speed in 24 hour time__________.
2. Press E.

3. Record Calculated Plume Distance from printer _______________ (miles).

4. Enter new wind speed (in miles per hour) _______________.

5. Press B.

NOTE: Recalculate arrival times per Step B.10.

D. WHOLE BODY DOSE RATES AT SELECTED LOCATIONS

1. Determine the Gamma dose μX/Q values as follows:

Elevated or ground level release (from B.7 above) ___________________.

Met Stability Class (from B8 above) 1=A, 2=B, 3=C, 4=D, 5=E, 6=F, 7=G __________.

Gamma dose μX/Q value for the selected distance. (Gamma dose values found in Appendix B, Locations found in Table II.)

(Table B)

Location	Distance	Gamma dose μX/Q value
1.		$x10^{-6}$
2.		$x10^{-6}$
3.		$x10^{-6}$

2. Calculate the projected whole body dose rates for locations listed in Step #1 as follows:

a. Determine the Site Boundary Dose Rate from Procedure Section A.

OR

b. Determine the Site Boundary Dose Rate from a measured dose rate at the fenceline in a downwind location for a ground release, a combined release or failure of installed Control Room instrumentation.

c. Record the Dose Rate from a. or b. above ___________________ mr/hr.

d. For each location listed in Step #1 above, calculate the projected whole body dose rate.

Location #1 ________________________________

(5×10^4) x (Gamma dose μX/Q value) x (mr/hr Dose rate from 2.c) = (mr/hr Whole body dose rate)

Location #2 ________________________________

(5×10^4) x (Gamma dose μX/Q value) x (mr/hr Dose rate from 2.c) = (mr/hr Whole body dose rate)

Location #3 ________________________________

(5×10^4) x (Gamma dose μX/Q value) x (mr/hr Dose rate from 2.c) = (mr/hr Whole body dose rate)

3. Post projected dose at selected locations from above on mapboard with a wax pencil and record on VYOPF 3513.02.

____
Initials

4. If a ground level or combination release is in progress, proceed to Section F.

____
Initials

E. I-131 CONCENTRATIONS AT SELECTED LOCATIONS

1. Determine the concentration µX/Q value as follows:

ELEVATED RELEASE ONLY. (Based on Iodine sample from plant vent stack)

Met. Stability Class (from B.8 above) 1=A, 2=B, 3=C, 4=D, 5=E, 6=F, 7=G__________.

Concentration µX/Q values for the selected distances. (Concentration values found in Appendix B (Table B-2), Locations found in Table II.)

Location	Distance	Concentration µX/Q value
1.		$x10^{-6}$
2.		$x10^{-6}$
3.		$x10^{-6}$

2. Calculate the projected concentration values for locations listed in Step #1 as follows:

a. Determine the I-131 release rate from the stack and record this value in curies per second.

______________________Ci/sec

b. For each location listed in Step #1 above, calculate the projected concentration.

NOTE: (miles/hour x .447 = metero/second)

Location #1______________________________

(Conc µX/Q value) x (Ci/sec I-131 release rate) ÷ (meters/sec Wind Speed) = (µci/cc Sector Concentration)

Location #2______________________________

(Conc. µX/Q value) x (Ci/sec I-131 release rate) ÷ (meters/sec Wind Speed) = (µci/cc Sector Concentration)

Location #3______________________________

(Conc. µX/Q value) x (Ci/sec I-131 release rate) ÷ (meters/sec Wind Speed) = (µci/cc Sector Concentration)

c. Refer to Figure 2 for Thyroid Dose.

3. Post projected dose at selected locations from above mapboard with wax pencil and record on VYOPF 3513.02.

____
(initials)

F. OFF-SITE RECOMMENDATIONS/INFORMATION

1. Utilize O.P. 3511, Off-site Protective Actions Recommendations, as required to formulate recommendations to the state's representatives when they call in.

2. As states' representatives call in for additional information, report the following information when available:

   a. Nature of emergency
   b. Elevated or groundlevel release
   c. Off-site "boundary" dose rate
   d. Downwind direction of the plume
   e. Estimated time of arrival at selected locations
   f. Estimated projected dose rate at selected locations
   g. Other information requested and available, including Off-site Protective Actions Recommendations from O.P. 3511.

   Reported to:

States' Representatives	State	Date	Time
______________________	______	________	_________
______________________	______	________	_________
______________________	______	________	_________

Performed by__________________________________ Date____________ Time____________

Approved by___________________________________ Date____________ Time____________

DOSE PROJECTIONS BASED ON FIELD DATA WORKSHEET

A. "RADOSE II" PROGRAM SET UP (If previously set up, initial here________________)

1. Load the RADOSE II program into the TI-59 Calculator-printer.

   a. Turn calculator OFF, then ON
   b. Load RADOSE II program sides 1 and then 2 for all releases
   c. For ground releases, use "ground release" card sides 3 and then 4 for all wind directions.

   OR

   d. For elevated releases, use one of the "elevated release" cards sides 3 and 4 labelled with the appropriate "wind to" designation. (Refer to latest VYOPF 3513.03, Section B.6 for "wind to" information.)

B. METEOROLOGICAL DATA (If Meteorological data previously entered and still valid, initial here___________)

1. Enter the appropriate Met Stability Class Number (From VYOPF 3513.03, Section B.8)

2. Press A.

3. Enter current average wind speed in mph_____________.

4. Press 2nd A.

C. RECEIPT AND LOGGING OF FIELD DATA INFORMATION

1. As monitoring teams report air sample and dose rate information, interpret data using Table I and Figure 2 and then record the information calculated on VYOPF 3513.02.

2. Enter the field data (dose rate and I-131 concentration) and the distance to the monitored location as follows: (Use Figure 2 for Thyroid Dose estimation)

   Date___________

   Monitoring Location_____________________________________ Time___________

   a. Enter Dose Rate (mr/hr)________________Press B.
   b. Enter Distance (mi)____________________Press C.
   c. Enter I-131 conc. (μci/cc)______________________Press 2nd B.
   d. Enter distance (mi)__________________Press 2nd C.
   e. Record W.B. Dose______________REM, and Thyroid Dose (adult_________REM Child______________REM (also record on VYOPF 3513.02)

3. Determine the projected radiological conditions for any number of selected locations as follows:

   a. Enter the distance to the selected location (mi)_______.
   b. Press D.
   c. Record the calculated sector dose rate on VYOPF 3513.02
   d. Enter the distance to the selected location (mi.)__________.
   e. Press 2nd D.
   f. Record the calculated I-131 sector concentration on VYOPF 3513.02

4. NOTE: Step 3 may be repeated as often as required to provide the necessary information for plume mapping and dose projection.

5. Complete the Off-site Doses Calculations required on VYOPF 3513.02, and utilizing O.P. 3511, Off-site Protective Actions Recommendations, transmit this information to the Emergency Operations Facility Coordinator for relay to states' representatives.

Performed by______________________________ Date_________ Time_________

Approved by_______________________________ Date_________ Time_________

VERMONT YANKEE
EMERGENCY OFFSITE DOSE RATE
NOMOGRAM

REV: 2
DATE: 1-21-82

O.P. 3513
Rev. 6

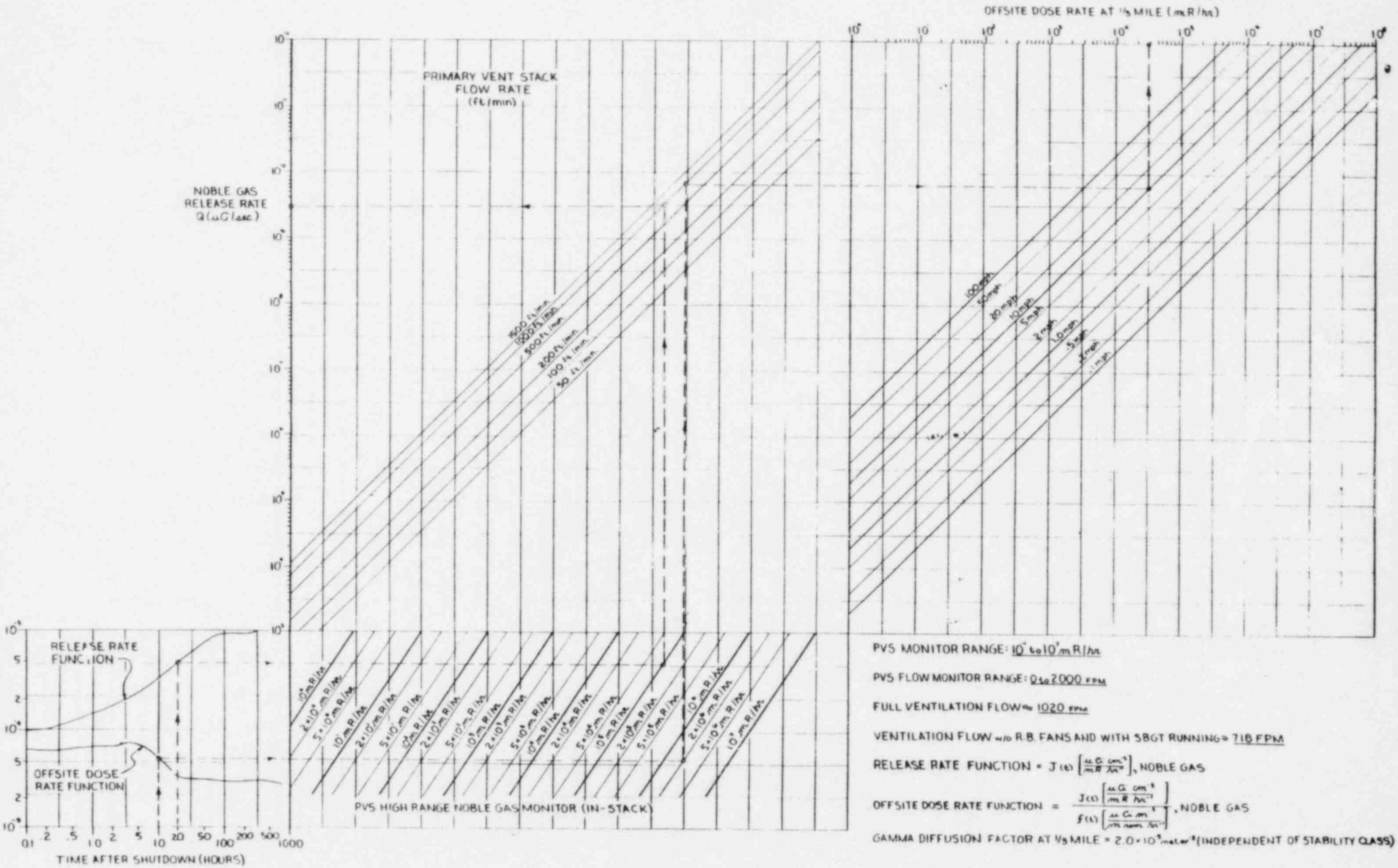


Figure I

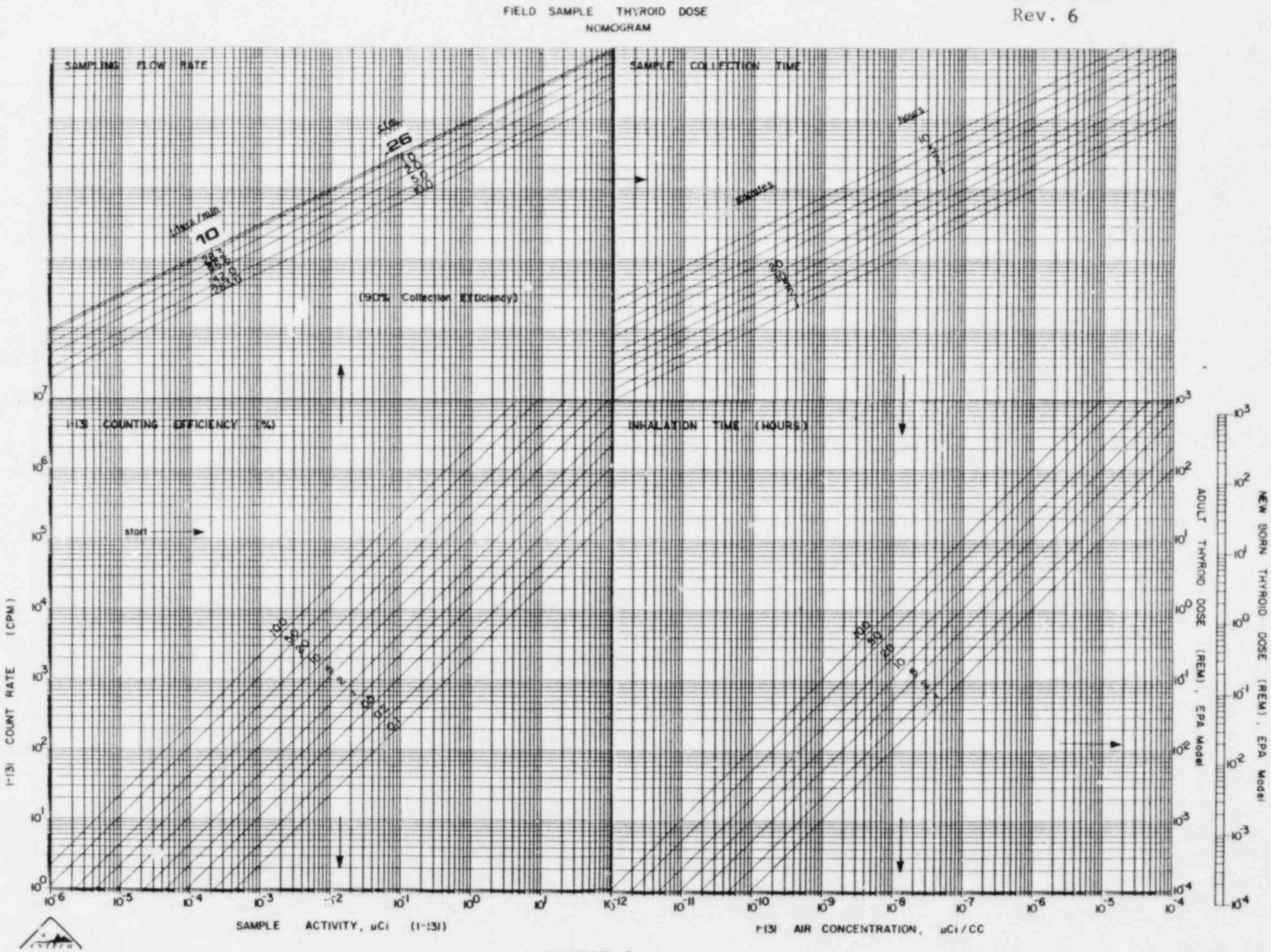

FIELD SAMPLE THYROID DOSE
NOMOGRAM
SAMPLING FLOW RATE
SAMPLE COLLECTION TIME
(90% Collection Efficiency)
I-131 COUNTING EFFICIENCY (%)
INHALATION TIME (HOURS)
start
I-131 COUNT RATE (CPM)
SAMPLE ACTIVITY, µCi (I-131)
I-131 AIR CONCENTRATION, µCi/CC
ADULT THYROID DOSE (REM), EPA Model
NEW BORN THYROID DOSE (REM), EPA Model

FIGURE 2

APPENDIX A

EMERGENCY OFF-SITE DOSE NOMOGRAM, DESCRIPTION AND USE

Description:

This nomogram should be used to determine the release rate and off-site dose rate at 1/3 mile (i.e., the "site boundary") when the high range noble gas stack monitor is on scale >.2 mR/hr. The information required to use this nomogram is: 1) time after reactor shutdown, T, 2) the stack high range monitor response, 3) The stack flow rate, and 4) wind speed.

The stack high range monitor is a Victoreen 847A-1 ion chamber which measures the radiation in the base of the stack. The monitor has a readout in the Control Room on CRP 9-2 with a range from 0.1 mR/hr to 1×10^7 mR/hr.

The stack flow is determined from a local readout in the stack monitoring room and may be approximated by accessing data point C062 on the Plant Computer and applying the following formula:

$$\frac{\text{C062 value}}{144.9} = \text{Stack Flow (ft/min)}$$

The wind speed (in mph) may be determined from the Met computer terminal in the rear of the Control Room, from the secondary meteorological instrumentation readout on CRP 9-48 in Control Room, or from primary meteorological instrumentation readouts in the Relay House.

APPENDIX B

DIFFUSION FACTORS

Description:

Two sets of diffusion factors for both ground and elevated releases are presented in the attached tables. Both sets are presented as a function of atmospheric stability and downwind distance from the plant, and in the case of elevated releases, the specific downwind direction. The two types of diffusion factors are as follows:

Concentration μX/Q Values - Can be used to evaluate airborne radionuclide concentrations which contribute to thyroid exposure through inhalation.

Effective Gamma Dose μX/Q Values - Can be used to evaluate gamma radiation levls which contribute to the whole body exposure.

NOTE: Use care that the correct μX/Q value is selected from the table for use in the following equations.

I. Initial and Subsequent Off-Site Whole Body Gamma Dose Estimates

An estimate of the sector average whole body gamma dose rates D_i at other downwind distances i can be determined as follows:

$$D_i = \frac{[(\mu X/Q)\gamma]_i}{[(\mu X/Q)\gamma]_o} \cdot D_o \qquad (1)$$

Rewritten: $D_i = 5 \times 10^4 \cdot [(\mu X/Q)\gamma]_i \cdot D_o$

Where: D_i = Whole body gamma dose rate at selected downwind distance i (mRem/hr)

$[(\mu X/Q)\gamma]_i$ = Elevated effective gamma dose μX/Q value for downwind distance i (from tables).

$[(\mu X/Q)\gamma]_o$ = Elevated effective gamma dose μX/Q value at the downwind distance of 0.35 miles (equals 2×10^{-5}).

NOTE: This is an average value for initial estimate only.

D_o = Whole body gamma dose rate at the downwind distance of 0.35 miles (mRem/hr, from emergency nomogram).

(1) As field measured dose rates (D_o) at known distances become available, select the appropriate $[\mu X/Q]_o$ from the tables and substitute in the above equation.

APPENDIX B (Continued)

II. Estimating I-131 Concentrations at Other Downwind Distances

Similarly, measured ground level plume centerline I-131 concentration at one downwind distance can be extrapolated to estimate a centerline I-131 concentration at another downwind distance as follows:

$$X_i = \frac{[(\mu X/Q)]_i}{[(\mu X/Q)]_0} \cdot X_0$$

Where: X_i = Plume centerline concentration at selected downwind distance i (μCi/cc).

$[(\mu X/Q)]_i$ = Concentration μX/Q value for selected downwind distance i.

X_0 = Measured plume centerline concentration (μCi/cc).

$[(\mu X/Q)]_0$ = Concentration μX/Q value for measurement location.

III. Estimating I-131 Concentrations Based on Measured Stack Release Rate

Measured stack release rate can be extrapolated to estimate a centerline I-131 concentration at a downwind distance as follows:

$$X_i = \left[\frac{\bar{\mu} X}{Q}\right]_i \cdot \frac{1}{\bar{\mu}} \cdot Q$$

Where: X_i = Plume centerline concentration at selected downwind distance i (μCi/cc)

$\left[\frac{\bar{\mu} X}{Q}\right]_i$ = Concentration $\bar{\mu}X/Q$ value for selected downwind distance i (from Table B-2)

$\frac{W}{\bar{\mu}}$ = Wind speed in meters/second.

Q = I^{131} release rate (stack sample) in ci/sec

TABLE B-1

GROUND LEVEL RELEASE DIFFUSION FACTORS

A. GROUND LEVEL RELEASE - PLUME AVERAGE EFFLUENT CONCENTRATION $(u\chi/Q)_\gamma (m^{-2})$ *
(For Air Particulate and Iodine Concentrations)
(Multiply all values by 10^{-6})

Downwind Distance	Stability Category						
	Pasquill A	Pasquill B	Pasquill C	Pasquill D	Pasquill E	Pasquill F	Pasquill G
0.5 miles	6.4	27.	61.	160.	260.	450.	920.
1.0	1.3	4.9	19.	60.	110.	210.	350.
2.0	0.70	0.96	5.9	21.	41.	86.	170.
3.0	0.50	0.66	3.0	12.	24.	53.	110.
4.0	0.39	0.51	1.8	7.6	16.	38.	80.
5.0	0.32	0.42	1.2	5.5	12.	29.	62.
6.0	0.28	0.36	0.92	4.3	9.6	23.	50.
7.0	0.24	0.32	0.72	3.5	7.9	20.	43.
8.0	0.21	0.29	0.58	3.0	6.8	17.	37.
9.0	0.19	0.26	0.48	2.5	5.8	15.	32.
10.0	0.18	0.24	0.41	2.2	5.1	13.	29.

*NOTE: These values are independent of wind direction.

TABLE B-1

(For Whole Body Exposure Only)

B. GROUND LEVEL RELEASE - EFFECTIVE GAMMA DOSE $(u\chi/Q)_{\gamma}(m^{-2})$ *

(Multiply all values by 10^{-6})

Downwind Distance	Stability Category Pasquill A	Pasquill B	Pasquill C	Pasquill D	Pasquill E	Pasquill F	Pasquill G
0.5 miles	8.3	19.	26.	34.	37.	41.	47.
1.0	1.3	4.3	9.5	14.	16.	19.	20.
2.0	0.63	0.68	3.1	5.8	6.9	8.3	9.5
3.0	0.42	0.42	1.6	3.3	4.2	5.2	6.1
4.0	0.31	0.31	0.97	2.2	2.9	3.7	4.4
5.0	0.25	0.25	0.66	1.6	2.2	2.9	3.4
6.0	0.21	0.21	0.49	1.3	1.7	2.3	2.8
7.0	0.18	0.18	0.37	1.0	1.4	2.0	2.4
8.0	0.16	0.16	0.30	0.85	1.2	1.7	2.1
9.0	0.14	0.14	0.24	0.72	1.0	1.5	1.8
10.0	0.13	0.13	0.20	0.62	0.92	1.3	1.6

*NOTE: These values are independent of wind direction.

TABLE B-2 (Sheet 1 of 7)

VY ELEVATED RELEASE DIFFUSION FACTORS (m^{-2})

(Multiply all values by 1.0E-6)

Stability A Concentration $u\chi/Q$ (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.11	6.15	6.15	6.11	6.11
1.0	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
2.0	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70	.70
3.0	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50	.50
4.0	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39	.39
5.0	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33	.33
6.0	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28	.28
7.0	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24
8.0	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21
9.0	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19
10.0	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18

Stability A Gamma Dose $u\chi/Q$ (For whole body exposure only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.71	7.71	7.66	7.66
1.0	1.25	1.25	1.25	1.25	1.25	1.25	1.24	1.24	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.24
2.0	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62	.62
3.0	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42
4.0	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31
5.0	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25
6.0	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21
7.0	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18
8.0	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16
9.0	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14
10.0	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12

TABLE B-2 (Sheet 2 of 7)

VY ELEVATED RELEASE DIFFISION FACTORS (m^{-2})

(Multiply all values by 1.0E-6)

Stability B Concentration uχ/Q (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	17.11	18.16	18.16	17.11	17.11
1.0	4.82	4.76	4.79	4.82	4.79	4.79	4.70	4.70	4.73	4.85	4.89	4.91	4.91	4.82	4.82	4.70
2.0	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96
3.0	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66	.66
4.0	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51	.51
5.0	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42
6.0	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36	.36
7.0	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32
8.0	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29
9.0	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26	.26
10.0	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24

Stability B Gamma Dose uχ/Q (For whole body exposures only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	13.67	14.13	14.13	13.67	13.67
1.0	4.08	4.04	4.06	4.08	4.06	4.06	3.99	3.99	4.01	4.10	4.13	4.14	4.14	4.08	4.08	3.99
2.0	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67	.67
3.0	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42	.42
4.0	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31	.31
5.0	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25	.25
6.0	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21	.21
7.0	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.18	.16
8.0	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16	.16
9.0	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14	.14
10.0	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12	.12

TABLE B-2 (Sheet 3 of 7)

VY ELEVATED RELEASE DIFFUSION FACTORS (m^{-2})

(Multiply all values by 1.0E-6)

Stability C Concentration uχ/Q (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	14.98	14.98	14.98	14.98	14.98	14.98	14.98	14.98	14.98	14.98	14.98	14.98	18.09	18.09	14.98	14.98
1.0	15.13	13.77	14.46	15.13	14.46	14.46	12.34	12.34	13.06	15.77	16.93	17.43	17.43	15.13	15.13	12.34
2.0	5.83	5.91	5.92	5.92	5.89	5.75	5.50	5.57	5.75	5.92	5.92	5.92	5.92	5.92	5.92	5.57
3.0	2.96	2.98	2.98	2.98	2.98	2.98	2.94	2.93	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.90
4.0	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83	1.83
5.0	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
6.0	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
7.0	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72	.72
8.0	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58	.58
9.0	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48	.48
10.0	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41	.41

Stability C Gamma Dose uχ/Q (For whole body exposure only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	13.47	14.37	14.37	13.47	13.47
1.0	7.64	7.23	7.44	7.64	7.44	7.44	6.80	6.80	7.02	7.82	8.15	8.30	8.30	7.64	7.64	6.80
2.0	2.94	2.96	2.97	2.97	2.96	2.90	2.81	2.84	2.90	2.97	2.97	2.97	2.97	2.97	2.97	2.84
3.0	1.51	1.52	1.52	1.52	1.52	1.52	1.51	1.50	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.49
4.0	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94	.94
5.0	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65
6.0	.48	.48	.48	.48	.48	.48	[illegible]	.48	.48	.48	.48	.48	.48	.48	.48	.48
7.0	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37	.37
8.0	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29	.29
9.0	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24	.24
10.0	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20	.20

VY ELEVATED RELEASE DIFFUSION FACTORS (m^{-2})
(Multiply all values by 1.0E-6)

Stability D Concentration $u\chi/Q$ (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	1.42	1.42	.68	.68
1.0	20.47	12.96	16.44	20.47	16.44	16.44	7.60	7.60	10.02	25.01	35.25	40.67	40.67	20.47	20.47	7.60
2.0	20.09	21.74	22.07	22.07	21.33	18.36	14.03	15.17	18.36	22.07	22.07	22.07	22.07	22.07	22.07	15.17
3.0	11.18	11.82	11.82	11.82	11.82	11.82	10.76	10.60	11.82	11.82	11.82	11.82	11.82	11.82	11.82	9.87
4.0	7.71	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72	7.72
5.0	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59	5.59
6.0	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34	4.34
7.0	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56	3.56
8.0	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99	2.99
9.0	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55	2.55
10.0	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19

Stability D Gamma Dose $u\chi/Q$ (For whole body exposure only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	11.47	12.30	12.30	11.47	11.47
1.0	8.51	7.40	7.94	8.51	7.94	7.94	6.41	6.41	6.89	9.09	10.28	10.85	10.85	8.51	8.51	6.41
2.0	5.01	5.22	5.26	5.26	5.17	4.78	4.19	4.35	4.78	5.26	5.26	5.26	5.26	5.26	5.26	4.35
3.0	2.94	3.04	3.04	3.04	3.04	3.04	2.87	2.85	3.04	3.04	3.04	3.04	3.04	3.04	3.04	2.74
4.0	2.04	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
5.0	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51	1.51
6.0	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17
7.0	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96	.96
8.0	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80
9.0	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68	.68
10.0	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59	.59

VY ELEVATED RELEASE DIFFUSION FACTORS (m^{-2})

(Multiply all values by 1.0E-6)

Stability E Concentration uχ/Q (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.03	.03	.01	.01
1.0	12.98	5.28	8.43	12.98	8.43	8.43	1.85	1.85	3.18	19.25	37.81	50.12	50.12	12.98	12.98	1.85
2.0	35.98	42.41	43.78	43.78	40.78	29.83	17.01	20.04	29.83	43.78	43.78	43.78	43.78	43.78	43.78	20.04
3.0	21.70	24.72	24.72	24.72	24.72	24.72	19.85	19.16	24.72	24.72	24.72	24.72	24.72	24.72	24.72	16.24
4.0	16.62	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69	16.69
5.0	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39	12.39
6.0	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79	9.79
7.0	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10	8.10
8.0	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87	6.87
9.0	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94	5.94
10.0	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18	5.18

Stability E Gamma Dose uχ/Q (For whole body exposure only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.09	11.86	11.86	11.09	11.09
1.0	8.01	6.83	7.39	8.01	7.39	7.39	5.88	5.88	6.32	8.70	10.25	11.09	11.09	8.01	8.01	5.88
2.0	5.77	6.21	6.30	6.30	6.10	5.33	4.29	4.55	5.33	6.30	6.30	6.30	6.30	6.30	6.30	4.55
3.0	3.58	3.81	3.81	3.81	3.81	3.81	3.43	3.37	3.81	3.81	3.81	3.81	3.81	3.81	3.81	3.12
4.0	2.66	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67	2.67
5.0	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
6.0	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
7.0	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32	1.32
8.0	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12	1.12
9.0	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97	.97
10.0	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85

TABLE B-2 (Sheet 6 of 7)

VY ELEVATED RELEASE DIFFUSION FACTORS (m^{-2})
(Multiply all values by 1.0E-6)

Stability F Concentration uχ/Q (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1.0	.53	.04	.16	.53	.16	.16	.00	.00	.01	1.58	10.40	22.82	22.82	.53	.53	.00
2.0	58.77	92.92	101.51	101.51	83.29	34.86	7.28	11.50	34.86	101.51	101.51	101.51	101.51	101.51	101.51	11.50
3.0	41.19	59.02	59.02	59.02	59.02	59.02	32.17	29.21	59.02	59.02	59.02	59.02	59.02	59.02	59.02	18.47
4.0	40.88	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36	41.36
5.0	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91	30.91
6.0	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69	24.69
7.0	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79	20.79
8.0	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93	17.93
9.0	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72	15.72
10.0	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95	13.95

Stability F Gamma Dose uχ/Q (For whole body exposure only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	10.87	10.87	10.87	10.87	10.87	10.87	10.87	10.87	10.87	10.87	10.87	10.87	11.60	11.60	10.87	10.87
1.0	7.35	6.35	6.83	7.35	6.83	6.83	5.53	5.53	5.91	7.98	9.50	10.47	10.47	7.35	7.35	5.53
2.0	6.43	7.52	7.77	7.77	7.23	5.53	3.94	4.29	5.53	7.77	7.77	7.77	7.77	7.77	7.77	4.29
3.0	4.16	4.78	4.78	4.78	4.78	4.78	3.82	3.69	4.78	4.78	4.78	4.78	4.78	4.78	4.78	3.20
4.0	3.39	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41	3.41
5.0	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62	2.62
6.0	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13
7.0	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79
8.0	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53	1.53
9.0	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34
10.0	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19

TABLE B-2 (Sheet 7 of 7)

VY ELEVATED RELEASE DIFFUSION FACTORS (m^{-2})

(Multiply all values by 1.0E-6)

Stability G Concentration ux/Q (Wind Toward) (For air particulate and iodine concentrations)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00	.00	0.00	0.00
1.0	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.17	1.18	1.18	.00	.00	.00
2.0	51.17	191.42	246.95	246.95	139.69	11.37	.13	.47	11.37	246.95	246.95	246.95	246.95	246.95	246.95	.47
3.0	49.91	144.90	144.90	144.90	144.90	144.90	24.01	18.02	144.90	144.90	144.90	144.90	144.90	144.90	144.90	4.64
4.0	96.12	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49	99.49
5.0	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45	74.45
6.0	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32	59.32
7.0	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43	49.43
8.0	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33	42.33
9.0	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97	36.97
10.0	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78	32.78

Stability G Gamma Dose ux/Q (For whole body exposure only)

MILES	N 349-11	NNE 12-33	NE 34-56	ENE 57-78	E 79-101	ESE 102-123	SE 124-146	SSE 147-168	S 169-191	SSW 192-213	SW 214-236	WSW 237-258	W 259-281	WNW 282-303	NW 304-326	NNW 327-348
.5	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	10.80	11.53	11.53	10.80	10.80
1.0	7.17	6.22	6.67	7.17	6.67	6.67	5.43	5.43	5.80	7.73	9.09	9.94	9.94	7.17	7.17	5.43
2.0	6.39	8.62	9.31	9.31	7.92	5.16	3.65	3.95	5.16	9.31	9.31	9.31	9.31	9.31	9.31	3.95
3.0	4.33	5.83	5.83	5.83	5.83	5.83	3.72	3.55	5.83	5.83	5.83	5.83	5.83	5.83	5.83	2.93
4.0	4.13	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
5.0	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
6.0	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65
7.0	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22
8.0	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
9.0	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68	1.68
10.0	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49	1.49

APPENDIX C

TI-59 CALCULATOR-PRINTER INSTRUCTIONS

After obtaining "met" data from "met" typer, (or Relay House), the TI-59 calculator-printer and the type of release:

1. Turn printer ON, then calculator ON. (Printer switch on right side to rear, and calculator switch on top left.) TRACE button on printer should be in UP position.

2. Prepare calculator to accept "Met Data" program "mag" cards by pressing the sequence 4, 2nd, 917. (The display should show 639.39) Clear the display by pressing CLR.

3. From the mag card folder, select the two "Met Data" cards. Insert side 1 (upper left corner on card) into lower slot (top right) of calculator.

   NOTE: A <u>steady</u>-"1" (or other negative side number) displayed by the calculator indicates side-1 of the program was loaded successfully. A <u>flashing</u>-"1" indicates the opposite. In this event, clean the dark side of card by wiping gently on soft cloth (i.e., shirt sleeve or pant leg, etc.), press CLR and reinsert as required to obtain a steady display.

4. Invert card, press CLR and insert side 2 as in Step 3, above.

5. Using second card, press CLR and insert sides 3 and 4 as in Steps 3 and 4 above.

   NOTE: The display should be cleared prior to entering each side of a card.

6. Place first card in upper slot (top right) to cue you for future data entry locations. (Return second card to card folder).

7. Run "MET DATA" or RADOSE II programs as indicated in the procedure.

8. At any time, the calculator may be used for "side calculations" that may be desired without affecting the program entered. Should the operator desire to "log" the result of a "side calculation" press PRINT on the printer when the calculator answer is displayed. Press ADV ↑ on printer to advance tape to identify the printed value, its limits, or make other notes.

9. When use of the calculator-printer is no longer required, return displayed cue card to the card folder and turn calculator and printer OFF in the stated order.

Dept. Supv.	[signature]	Proc. No.	O.P. 3510
PORC	[signature]	Rev. No.	10
Plant Mgr.	[signature]	Issue Date	9/30/82
Mgr. of Ops.	[signature]	Review Date	9/30/84

OFF-SITE AND SITE BOUNDARY MONITORING

Purpose:

To survey and report off-site radiological conditions to the Emergency Operations Facility Coordinator.

Discussion:

The prime objective of the Off-Site and Site Boundary Monitoring Teams is to rapidly survey areas downwind of the plant site in order to determine the extent and magnitude of any release of radioactive material following an incident. It should be stressed that the initial off-site and boundary survey is of great importance; decisions regarding the extent and types of protective actions required by the public will be based upon initial data reported by the survey teams.

The task of each monitoring team is to collect radiological data and air samples, and transmit information to and/or receive instructions from the Emergency Operations Facility. Unless directed otherwise by the Emergency Operations Facility Coordinator, the basic duties and responsibilities of the monitoring teams are as follows:

Site Boundary ("Yellow" or Security Teams) - Obtains a dose rate reading and a 1 minute (10 LPM) air sample, unless otherwise directed, at the site boundary downwind location where maximum radiation levels are detected.

Off Site (Green) - Proceeds off-site to inner predetermined sample location in downwind sector (i.e., green dot in appropriate downwind sector on area map) obtaining radiation level readings enroute and a 1 minute (10 LPM) air sample, unless otherwise directed, when on station. The data obtained is radioed to the Emergency Operations Facility.

Off-Site (Blue) - Proceeds off-site to the vicinity of the outer predetermined sample location in downwind section (i.e., blue dot in appropriate downwind sector of area map) and tranverses the plume to determine maximum radiation levels, or the plume centerline. A 1 minute (10 LPM) air sample, unless otherwise directed, is taken at that location and data obtained is radioed to the Emergency Operations Facility.

NOTE: Additional air sampling, utilizing silver zeolite cartridges, will be performed when the count rate on the charcoal cartridge sample exceeds 100 cpm over background. Silver zeolite retains only radioiodines and allows noble gases to pass through. The value of 100 cpm over background is

* based upon a 5 REM exposure to the thyroid (child) if exposure is 8 hours and a standard 1 minute air sample at 10 liters per minute with a 2.5% efficiency rate for the RM-14 counting instrument. *

The overriding consideration in the initial survey is speed combined with reasonable accuracy. Information is required with as little delay as possible; therefore, the survey consists of simple methods to approximate the magnitude of the accident. Once the * initial urgency of the situation is satisfied subsequent surveys and/or analysis may be made to obtain more accurate detailed information and a more precise evaluation. Additionally, samples will be collected and returned to the Emergency Operations Facility for further analysis as the emergency and recovery phases continue.

The following table is attached:

Table 1 1 Minute Air Sample I-131 Cartridge Results

References:

A. Tech. Spec.

1. None

B. Admin. Limits

1. None

C. Other

1. None

Precautions:

1. Use care not to contaminate monitoring equipment.
2. During foul weather, use care not to damage filters by exposing them to the elements. (e.g., sample under hood or inside car.)
3. The individual driving the vehicle will not perform radio communications or take radiological readings while he is driving the vehicle.

Prerequisites:

1. None

Procedure:

NOTE: 1. If an incident occurs during normal work hours, the EOF Coordinator will assign tags (i.e., duties) to personnel. If an incident occurs during off hours, the Emergency Assignment Tag Board will be used in numerical sequence.

2. Each step of this procedure is to be initialed by a member of the monitoring team.

NOTE: If any equipment malfunctions or is missing,
* notify the EOF Coordinator or the Radiological
* Assistant.

Section I - TO BE COMPLETED PRIOR TO LEAVING SITE (Unless otherwise directed by the EOF Coordinator)

Team Name ______________________________

Team Members ____________________ Date ______________

____________________ Time ______________

Initial

A. Site Boundary ("Yellow" or Security) Team - Obtain respirator, high range dosimeter, dose rate rate meter (PIC-6) and air sampler. ______

Off-Site ("Green"& Blue") Teams - Obtain Off-Site Monitoring Kit, air sampler, Eberline RM-14, and dose rate meter (PIC-6). ______

B. Perform the following checks:

1. Air Sampler

   a. Insure that a new filter paper and charcoal cartridges are properly installed in their respective holders. ______

2. RM-14 (Off-Site Teams only)

   a. Turn range switch to BATTERY CHECK position and insure meter reads in the BATT OK range. ______

   b. Insure that the response switch is in SLOW position and that the test switch in back is in the DOWN position. ______

   c. Verify instrument responds properly to radiation by use of the check source in the emergency kit. ______

   d. Serial #______________. ______

3. PIC-6

   a. Turn range switch to BATTERY CHECK position and verify that the battery condition is within the indicated range. ______

   b. Verify that instrument responds properly to radiation by use of the check source in the emergency kit. ______

   c. Serial #______________. ______

Initial

C. Determine wind speed and downwind direction from the EOF Coordinator, the Radiological Assistant, or by calling Control Room. ________

1. Wind speed ________mph; Direction __________ ________

NOTE: If use of a company vehicle is required, request same from the Manpower and Planning Assistant.

D. Rezero high range dosimeter, if necessary, and/or note initial reading of each. ________ ________
________ ________

* * E. Obtain potassium iodide (KI) treatment from EOF Coordinator, if conditions indicate. ________

F. Proceed to outer gatehouse and obtain one portable radio transceiver per team and your assigned TLD badges.

1. Check operability of radio as follows:

a. Place frequency selector switch to position 3.

NOTE: In the event of failure of Freq. 3 in the field, switch to Freq. 1.

b. In a normal voice and with microphone approximately 8-10 inches in front of mouth, push microphone button and say: "Coordinator Base, this is (specify color) Team requesting a radio check. Do you read me?" Release microphone button. (The Operation Facility base radio should respond to your call.)

c. Acknowledge response by pushing microphone button and saying: "Coordinator Base, this is (specify color) Team. We are proceeding to predetermined sample location in <u>(downwind)</u> sector unless you have special instructions for us. Over." (Base station will acknowledge or will give special instructions.)

d. Upon completion of transmissions, the last unit to leave the air should say "This is WRZ-941. Clear."

NOTE: If this is a drill, then state "This is a drill."

2. If radio is inoperable, obtain a replacement and repeat above step.

3. Radio operable and contact made with Coordinator Base. ________

Initial

NOTE: Boundary and off-site teams should attempt to minimize their radiation exposure, as practicable, while performing their duties. Inform the Radiological Assistant by radio in the event a high range dosimeter exceeds 1R while performing this procedure. *

SECTION II - OFF-SITE SURVEY ENROUTE - (Off-Site Teams only, Site Boundary Team proceed to Section III)

A. Monitor tires of vehicle prior to leaving the site and note initial general background on RM-14 in vicinity of Emergency Operations Facility.

Bkg______________________cpm ________

NOTE: Unless otherwise specified by the EOF Coordinator:

Green Team proceeds directly to inner (green) down wind sample location and takes air sample.

Blue Team proceeds to vicinity of outer (blue) sample location and attempt to locate the approximate centerline of plume prior to taking air sample.

B. While enroute, team passenger holds probe of RM-14 inside car window (shielded from wind) and notes the approximate location at which the above background doubles or commences to increase.

Location_________________________ ________

NOTE: This is intended to locate the approximate plume boundary. Do not stop to determine a precise location.

C. Note additional readings enroute at easily identified landmarks. (Should the RM-14 go off the highest scale, switch to PIC-6.)

Location	Reading (Circle one)
______________________	________(RM-14)(PIC-6)
______________________	________(RM-14)(PIC-6)
______________________	________(RM-14)(PIC-6)
______________________	________(RM-14)(PIC-6)
______________________	________(RM-14)(PIC-6)

Initial

NOTE: Step D below for "Blue" Team only. (Green team proceed to Step E.)

D. In the vicinity of the outer (blue) sample location on map, seek out nearest roads crossing the direction of the plume and determine the location of the maximum reading as precisely as possible.

NOTE: While crossing the plume, a rapid dose rate change is not anticipated. Look for a wide maximum plateau and do not spend more than 5 minutes in selecting a sampling location.

Location________________________________

____

Reading____________________(RM-14)(PIC-6) ________

* E. Contact the Radiological Assistant and advise him your team is on location and (in accordance with the following note) summarize the results of Steps B & C. (Blue team also reports on findings in Step D.) ________

* NOTE: Announce actual measurement units over radio; simply refer to them as "counts per minute," "MR/hr," or "R/hr."

* NOTE: While on station, keep the Radiological Assistant advised of any significant changes in radiation levels, wind direction, rain, etc.

Section III - ON LOCATION MONITORING

A. Site Boundary (Yellow or Security) Teams - Determine downwind location at site boundary where maximum radiation levels are detected.

Off-Site (Green and Blue) Teams - Upon arrival at sampling location, insure that release cloud has arrived by observing stable elevated RM-14 or PIC-6 background, or by calculating arrival time based on wind speed. ________

B. Using the PIC-6, take the following survey: (Green Team and Blue Team use RM-14 if dose rate is less than 1 mR/hr) ________

1. Monitor the radiation level at waist height.

Initial

* Waist level:________"Counts per minute", _______
* "mR/hr" or _________"R/hr" ________

2. Check the radiation level 2" above the ground.

* Ground level:________"Counts per minute", ________
* "mR/hr" or _____________"R/hr" ________

NOTE: All teams report these readings by radio to
* the Radiological Assistant (or Plant Emergency Director).

C. Using the stopwatch, start air sample by connecting leads to car battery. Record time here and on air sample envelopes (one for particulate filter and one for charcoal cartridge).

Time _________________ ________

D. Check air flow indication.

1. Adjust to 10 LPM and note the flow on air sample envelope. ________

E. Maintain flow rate during the one minute (or as otherwise directed) sample period, and end the sample by use of the stopwatch. ________

F. After air sampler has operated for the sampling period, disconnect from battery. ________

NOTE: Yellow or Security Team - Return to the EOF, request personnel monitoring prior to entry, obtain an RM-14; do an
* instrument check (Step B.2), then, complete Steps G through Q.

G. Retreat to nearest area outside the plume (background RM-14 readings), run air sampler an additional period of time to approximately equal the sample duration and rate of flow. This step is to purge noble gases from the charcoal cartridge.

H. Check RM-14 background level.

Background__________________cpm ________

I. Remove charcoal cartridge wrap in parafilm, and place in probe holder on RM-14. (The sample should be centered in the circled area.) Place filter paper in properly labelled envelope. ________

J. Place the probe directly over the sample. ________

K. Obtain count rate of sample after the needle is relatively stable.

Gross count rate____________cpm ________

Initial

L. Correct for background in the following manner:

Step K______cpm minus Step H_______cpm = ______net cpm

M. Refer to Table I "NET cpm" column and locate net cpm value of Step L above and note the corresponding "Air Code" number.

"Air Code" number is ____________. ________

* N. Report the "Air Code" number to the Radiological Assistant at the Coordinator Base.

NOTE: Use of "Walkie-Talkies"

a. To make initial call, say: "Coordinator Base, this is (specify team color) Team. Over."

b. When Coordinator Base responds:

1) Identify your team by color.
2) Describe sample location.
3) Results are "Air Code _____."
4) Request acknowledgement.

c. Upon acknowledgement or completion of other message exchanges, end final transmission with: "This is WRZ-941, Clear." If a drill, state: "This is a drill."

d. The only known radio "dead area" is on Broadbrook Road midway between Guilford and Rte. 142. If samples are taken in this area, it may be necessary to proceed to either end (i.e., Guilford or Rte. 142) to establish radio communications and report sample results.

e. In the event radio communications cannot be established at other locations, seek higher elevations then attempt to contact Coordinator Base or relay message through other teams who are in contact with the EOF Coordinator.

NOTE: Telephone - In the event of a radio breakdown, proceed to nearest available phone and call (802) 257-7090, or 254-4418.

Initial

O. Check and log high range dosimeter reading.

Team member #1 ________ ________

Team member #2 ________ ________

* P. If the net counts per minute value is greater than or equal to 100 cpm in Step L, then return to the sample location and repeat Steps C-L using a silver zeolite cartridge but omit the purge step from Step G. Report the results to the Radiological Assistant at the Coordinator Base and also report that a silver zeolite cartridge was used.

____________ - ____________ = ______________
Gross CPM Bkgd CPM Net CPM

Air Code (from Table I) for net CPM value.

____
Air Code ________

Q. Place sample cartridge in separate labelled envelope and deliver both samples to the Radiological Coordinator for further analysis and storage. ________

NOTE: After each survey, the Off-Site Monitoring Teams should check their equipment and themselves for contamination using
* the RM-14. If contamination is found,
* notify the Radiological Assistant. In any case, contact Radiological Assistant and request further instructions. If a new location is assigned, complete Sections II and III on a blank copy of this procedure. ________

Final Conditions:

1. Return radio to outer gatehouse.
2. Return Emergency Kit and equipment to the Emergency Operations Facility locker.
3. Submit completed copy of this procedure to the Radiological Assistant at the EOF.
4. Turn in all dosimeters to the Radiological Assistant for evaluation.

SPS/emr

TABLE I

1 MINUTE AIR SAMPLE I-131 CARTRIDGE RESULTS

"AIR CODE"	NET CPM
0	<40
1	40
3	80
4	100
5	125
6	150
7	175
8	200
9	225
10	250
11	275
12	300
13	325
14	350
15	375
16	400
17	425
18	450
19	500
20	750
21	1000
22	1250
23	1500
24	1750
25	2000
26	2250
27	2500
28	2750
29	3000
30	3250
31	3500
32	3750
33	4000
34	4250
35	4500
36	5000
37	7500
38	10000
39	12500
40	15000
41	17500
42	20000
43	25000
44	30000
45	35000
46	40000
47	50000

NOTE: AS SOON AS POSSIBLE, samples should each be reevaluated isotopically on available laboratory counting equipment to determine more accurate concentrations and projected doses.

OFF-SITE PROTECTIVE ACTIONS RECOMMENDATIONS

Purpose:

To provide a procedure to make protective action recommendations to the Emergency Planning Zone States.

Discussion:

This procedure describes the criteria which will be used in recommending protective actions to the appropriate state and local authorities during an emergency. The Radiological Assistant to the EOF Coordinator gathers the appropriate information concerning projected and measured dose rates. The population at risk is determined based upon the meteorological data (speed, direction and stability). The exposure time is based upon available information such as plant condition or type of accident. In the event that this cannot be readily approximated, a default release duration estimate is given. The projected dose is calculated from this information. The protective action recommendation is based upon Environmental Protection Agency guidance contained in Table I.

If the EPA levels are reached, the Radiological Assistant communicates this information to the EOF Coordinator and this information and recommendation is subsequently passed on to state representatives.

Additionally, loss of all core cooling capability shall require protective action recommendations even before any releases are actually in progress or before the activation of the emergency response facilities takes place. The recommendation to evacuate shall be made by the Shift Supervisor/Plant Emergency Director during his initial declaration of this event to the EPZ states.

The following form and tables are attached:

VYOPF 3511.01	Public Protective Action Recommendation Work Sheet
Table I	Protective Action Recommendation Guidelines
Table II	Major Points of Interest by Sector

References:

A. Tech. Specs.

   1. None

B. Admin. Limits

   1. None

C. Other

1. NUREG 0654, Rev. 1, "Criteria for Preparation and Evaluation of the Radiological Emergency Response Plans at Nuclear Power Plants."
2. EPA-520/1-78-001 A&B, "Protective Action Evaluation-Evacuation and Sheltering as Protective Actions Against Nuclear Accidents Involving Gaseous Releases."
3. EPA-520/1-75-001, "Manual of Protective Action Guides and Protective Actions for Nuclear Accidents."

Precautions:

1. It shall be emphasized to states' representatives that no compensation in the recommendation is made for the time to implement and complete protective actions.

Procedure:

A. After the activation of the Emergency Operations Facility, the Radiological Assistant (or the SS/PED pending activation of the EOF) shall perform the following upon receipt of off-site release information:

1. Using VYOPF 3511.01, document the information in the appropriate spaces as this procedure is performed. For LOSS OF ALL CORE COOLING CAPABILITY go to Procedure Section B for specific recommendations.

2. Obtain current wind direction.

3. Determine the location of concern (Population at Risk from Table II, and Definition, Table I, Section B).

4. Obtain the latest dose rate information at the location of concern from any of the following:

   a. In-plant 0.35 mile dose projections
   b. Off-site monitoring results
   c. Projections from other sources of information

5. Determine the plume duration. If better information is not available, a value of 8 hours duration shall be used.

6. Calculate the projected dose.

7. In accordance with Table I, determine the appropriate protective actions as listed in the table and forward this recommendation to the EOF Coordinator.

8. The EOF Coordinator shall evaluate the recommendation and forward the protective action recommendations along to the states' representatives through the Recovery Manager.

B. In the event of rapidly occurring events where the EOF has not been fully activated, the Operations Shift Supervisor/Plant Emergency Director shall be responsible for the following actions:

1. In the event that <u>all</u> core cooling capability is lost and the subsequent meltdown of the core and release of large quantities of radioactive material is likely, immediate protective action recommendations shall be made to states' representatives.

2. <u>After</u> the initial notification of General Emergency to the State Police agencies, advise the Vermont and New Hampshire representatives when they call in that the protective action recommendation for the towns of Hinsdale, N.H. and Vernon, Vermont is evacuation.

Final Conditions:

1. Ensure that all documentation is maintained in an orderly fashion and route all documentation to the Emergency Plan Coordinator for review and filing at the conclusion of the emergency response process.

SPS/emr

PUBLIC PROTECTIVE ACTION RECOMMENDATION WORK SHEET

Date__________ Time_________

DATA BASE

Wind Direction: From__________________ Toward___________________________

Affected Area Location:____

Dose Rate:_________ rem/hr(whole body); Air conc:_______________ μci/cc I^{131}

Plume Duration:____________________(8 hours if no better information available)

Plume Arrival Time:_______________________________________

Projected Dose:_______________ rem(whole body); _______________ rem (thyroid) child
rem (thyroid) adult

EPA PAG (Specify)____

PROTECTIVE ACTION RECOMMENDATION

1. Protective action recommendation: (if EPA PAG's exceeded):

   No Action_______ Shelter_____ Evacuate______

2. Emergency Responder making recommendation:

   a. Radiological Assistant:_______________________________________

   b. EOF Coordinator:____

   c. Shift Supervisor/Plant Emergency Director:_________________________

   d. Recovery Manager____

3. States' Representatives receiving recommendation and information:

   a. Name:_________________________________ State_________ Time________

   b. Name:_________________________________ State_________ Time________

   c. Name:_________________________________ State_________ Time________

VYOPF 3511.01
Original

TABLE I

PROTECTIVE ACTION RECOMMENDATION GUIDELINES

A. EPA PROTECTIVE ACTION GUIDES

Whole Body	Thyroid	Protective Action
<1 rem	<5 rem	No Action
1 to <5 rem	5 to <25 rem	Seek Shelter, await further instructions
≥5 rem	≥25 rem	EVACUATION

B. POPULATION AT RISK

For all sectors the population at risk is in the downwind direction from the point of release- based on stability class angle and plume dispersion meteorology.

TABLE II

MAJOR POINTS OF INTEREST BY SECTOR

SECTOR	WIND TOWARD	DESCRIPTION	DISTANCE(mi)
NORTH (A)	348.5-11.5	W. Chesterfield Village	8.5
		Dutton Pines State Park	10.0
NNE (B)	11.5-33.5	Chesterfield Village & School	7.75
		Lake Spofford (Seasonal)	9.0
NE (C)	33.5-56.5	(None Within 10 Miles)	
		W. Swanzey	11.0
		Keene	15.0
ENE (D)	56.5-78.5	Hinsdale Schools	0.75
		Hinsdale Town Hall	1.75
		Rte. 10 Raceway (Seasonal)	8.5
EAST (E)	78.5-101.5	Southern Hinsdale	1.0
		Ashuelot	4.6
		Winchester	6.5
ESE (F)	101.5-123.5	(None Within 10 Miles)	
SE (G)	123.5-146.5	Northfield Boarding School	5.5
SSE (H)	146.5-168.5	Vernon Green Nursing Home	1.1
		Northfield Public Schools	6.25
		Pioneer Valley Regional School	6.75
		Mt. Hermon Boarding School	7.75
South (J)	168.5-191.5	(None Within 10 Miles)	
SSW (K)	191.5-213.5	Bernardston	7.5
		Northern Greenfield Schools	12.0
SW (L)	213.5-236.5	Vernon School	0.35
WSW (M)	236.5-258.5	(None Within 10 Miles)	
WEST (N)	258.5-281.5	(None Within 10 Miles)	
WNW (P)	281.5-303.5	Guilford Center School	5.8
NW (Q)	303.5-326.5	Fort Dummer State Park	3.5
		Guilford Village	4.0
		West Brattleboro	6.0
NNW (R)	326.5-348.5	Hinsdale Race Track	2.1
		Southern Brattleboro Boundary	4.25
		Brattleboro High School	4.75
		Brattleboro Hosp. & Nursing Home	5.1
		Brattleboro Business District	5.5
		Vt. Forward EOF (& WTSA)	6.9
		No. Brattleboro Shopping Centers	7.25

Dept. Supv.	[signature]	Proc. No.	O.P. 3530
PORC	[signature]	Rev. No.	3
Plant Mgr.	[signature]	Issue Date	9/30/82
Mgr. of Ops.	[signature]	Review Date	9/30/84

POST ACCIDENT SAMPLING

Purpose:

To outline the special procedures necessary to handle samples during post accident conditions.

Discussion:

During post accident conditions, system samples may be very radioactive. Because of the high radiation levels, these samples require special handling. This procedure will outline that special handling.

* Table of Contents — Page

In addition to the above procedures, conductivity readings of the reactor vessel water may be useful during an accident. Readings can be obtained in the Control Room up to 10 µmho/cm, if exceeded, conductivity readings may be taken at a later date at the discretion of the Chemistry and Health Physics Supervisor. *

The following figures and forms are attached:

Figure 1 Liquid Post Accident Sampler
Figure 2 Flow Diagram - Liquid Post Accident Sampler
Figure 3 Emergency Off-Site Dose Rate Nomogram
* VYOPF 3530.01 Post Accident Data/Analysis
* VYOPF 3530.02 Primary Containment Data/Analysis

References:

A. Tech. Specs.

1. None

B. Admin. Limits

1. None

C. Other

1. None

Precautions:

1. A portable dose rate meter should always be used during post accident sampling.

2. Respiratory protection should be worn during sampling.

3. Personnel involved in sampling and analysis should wear extremity dosimetry.

4. During sampling, communications should be maintained using either a portable radio or a Gai-tronics.

5. Dose commitment limits have been established and should be adhered to for all Post Accident Sampling. Consult with the OSC Coordinator for specific instructions.

Prerequisites:

1. None

Procedure:

I. Stack Iodine Particulate and Gas Sampling

A. If dose rates permit, the samples will be taken the same as the iodine and particulate samples in O.P. 2611 except as specified below, otherwise proceed to Section I.B.

1. No background determination will be made during post accident sampling.

2. A dose rate will be determined on the filter holder prior to removal of the cartridge. A dose commitment will be established for this sample prior to the sample being removed. The dose rate will be used to determine that the dose commitment will not be exceeded. If it appears from the dose rate survey that the dose commitment will be exceeded, the sample should not be taken until the need for the sample is reevaluated.

3. A vehicle will be used to transport the sample from the stack to the point of analysis to maximize the distance between the sample and the person doing the sampling and to minimize the transport time. A shield should be used to minimize the exposure rate during transportation (e.g., concrete blocks or lead blankets etc., in car trunk.)

4. If the plant lab and counting room are accessible, the sample will be taken to the Chem. Lab and placed in a hood.

5. The noble gasses should be purged from the charcoal cartridge prior to counting using plant air or bottled air or nitrogen. A purge rate and duration should be utilized to approximately equal the sample time and flow.

* 6. Both the air sample cartridge and the particulate filter shall be wrapped prior to counting to prevent detector contamination.

* 7. The air sample cartridges and particulate filter will be counted using O.P. 2611 methods.

* 8. If the Chem. Lab and counting room are not accessible, the charcoal cartridge can be purged as in Step 5 above and counted using an RM-14 as in O.P. 3010, a SAM-2 as outlined below, or transported to an off-site multichannel analyzer for analysis. The particulate filter can be counted this way also but need not be purged prior to counting.

* 9. Report all results to the OSC Coordinator.

NOTE: Report release rate in Ci/sec.

B. High Dose Rate Post Accident Iodine/Particulate Sampling using a Silver Zeolite Cartridge.

1. Obtain lead shielding pig for transportation.

* 2. Obtain vehicle and and portable radio, then proceed to stack base.

3. Notify Control Room of intent to sample.

4. Open inlet (SRS-23) and outlet (SRS-24) valves.

5. Insure bypass valve (SRS-25) is closed.

6. Start pump by turning switch on and note time.

7. Adjust flow through rotometer to 100 cc/min (65mm).

CAUTION: Dose rates will increase when flow is established.

8. Run pump for 10 minutes; then disengage inlet quick connect and run pump for 15-30 sec. to purge gases from holder. (Sampling times may vary due to radionuclide concentrations) Record information on Air Sampler envelope (VYOPF 4533.01).

* 9. Disengage outlet, quick disconnects and remove filter. Secure pump and close valves SRS-23 and SRS-24.

NOTE: Dose rates on filter may be high, use tongs to remove filter to minimize exposure to extremities.

10. Place filter assembly into lead shield pig and place pig in back of vehicle.

11. Install a fresh filter assembly onto panel.

* 12. Return to lab and count silver zeolite cartridge and particulate filter using O.P. 2611 methods or O.P. 3530 Section VI methods, as applicable.

* 13. Report results to the OSC Coordinator (release rate in Ci/sec).
*

C. Gas Sampling

1. Perform Steps 1-3 as outlined in A. above.

2. Close inlet (SRS-23) and outlet (SRS-24) valves.

3. Open bypass (SRS-25) valve.

4. Start pumps, wait for line to purge ∿ 30 sec.

5. Place evacuated vial (14ml gas bottle) on top of hypodermic needle.

* NOTE: Vials can be evacuated in lab prior to
* sampling or by using hand vacuum pump.

6. Turn 3-way sample valve so flow is available to sample vial.

7. Turn 3-way sample valve so flow is secured to sample vial, then secure pump.

8. Close bypass valve (SRS-25).

NOTE: A gas sample can be obtained while drawing an iodine sample, however, the flow rate should be checked.

9. Remove vial and place into a lead pig using tongs.

10. Place pig in back of vehicle and return to lab for analysis.

11. If the dead time on the MCA is >50% when counting the gas vial. Perform serial dilutions until dead time is
* <50%.

II. Reactor Coolant Sampling and Analysis

A. The following procedure assumes the Reactor Building is accessible, otherwise proceed to Section II.B.

1. A dose commitment will be established for this sample prior to it being taken. Dose rates will be monitored during sampling and if it appears the dose commitment will be exceeded, the sampling will be terminated until further evaluation.

2. Samples can be obtained from one of three points depending on what systems are in service. All sample points are at the Reactor Building sample sink. The sample points are:

   a. Reactor Cleanup Inlet
   b. Reactor Recirc Loop A
   c. RHR System

   NOTE: If the sample is to be taken from Reactor Recirc Loop A, the operators will have to open FCV-39 and FCV-40 prior to sampling. If the sample is to be taken from the RHR System, the operators will have to open V10-198A or B prior to sampling. All other sample valves are on the sample panel. *

3. Sample lines must be flushed prior to sampling to insure a representative sample is taken. If the sample lines have not been running, they must be flushed for 10 minutes at a rate of about 500 ml/minute prior to obtaining the sample.

   NOTE: Expect that radiation levels will increase at the sample sink during the sample flushing and sampling. Do not stay at the sample sink to wait for the sample lines to flush. Seek a low radiation area in which to wait.

4. After the sample line is flushed, if a dissolved oxygen analysis is to be run, use a chemet and run the analysis at the sample panel. Obtain about a 50 ml sample for further analysis in the Chem Lab, then secure the sample point.

5. Place the sample bottle in a large plastic bag and maintain the greatest distance possible between you and the sample. Proceed promptly to the Chemistry Lab.

6. Once at the Chem Lab, place the sample behind a shield.

7. If a pH analysis is to be run on the sample, insert the probe into the sample bottle while the bottle is still behind the shield and read the pH.

8. If a chloride analysis is to be run, use O.P. 0630, except use a 1 ml sample volume instead of a 100 ml sample volume and multiply the calculated result by 100 for the answer.

9. If an isotopic analysis is to be run, perform several dilutions on one milliliter of the sample until standard counting techniques can be used.

10. If a boron analysis is to be run, use O.P. 0630, starting with Step g of the "Calibration and Standardization of 0.02N NaOH" Section under the mannitol potentiometric method. Use a sample volume of 1 milliliter. *

* 11. Report all results to the OSC Coordinator.

B. Liquid Post Accident Sampling

NOTE: Obtain portable radio from Security prior to sampling.

1. Prerequisites for Sample Panel Set-Up

   a. All valves are in the closed position.

   b. Valves PAS-17 and PAS-18 (3-way vall valves) are positioned to the left.

   c. Liquid and gas septums are unused and in place. Septum ports are in the STOP position.

   d. Fill the dilution water funnel with the required volume (up to 900 ml) of demineralized water. CAUTION: Do not exceed 900 ml.

   e. Panel has been flushed with demineralized water and purged with argon.

   f. Argon bottle is >500 psi.

* g. Obtain form VYOPF 3530.01 and complete as required.

2. Sample Panel Operation Instruction

   a. Evacuate cylinders B and C and gas septum.

      1) Start vacuum pump.

      2) Open Valves PAS-13, PAS-12, PAS-14, and PAS-15.

      3) Run vacuum pump until approximately 0 psia reads on PI-2.

      4) Close Valves PAS-13, PAS-12, and PAS-14.

      5) Stop vacuum pump.

*
* 6) Check PI-2 to ensure no leaks. Record pressure reading on form VYOPF 3530.01.

* b. Obtain Reactor Coolant sample in cylinder A and cool.

      1) Sample supply from high pressure feed water heater (open valves).

         a) Open Purge Valves PAS-105 and PAS-106 (SW-4 Sol. P-1).

         b) Open Valves PAS-1, PAS-5, PAS-6, and PAS-8 on panel.

c) Throttle Valve PAS-7 on panel to initiate flow, monitor pressure on PI-1.

NOTE: Keep pressure high to avoid flashing the sample.

d) Allow system flow for several minutes to ensure a representative sample.

e) Close Valves PAS-6 and PAS-5 to isolate sample cylinder A, then close Purge Valves 105 and 106 (SW-4 Sol. P-1), PAS-1 and PAS-8.

f) Fill bath tank with cooling water via the bath water funnel.

g) Maintain bath water at approximately room temperature.

2) Sample supply from sensing line taps N2C or N2G (reactor vessel).

a) Open Inboard Sample Valves 102 and 104 (SW-1 Sol. 5-1).

b) Open Outboard Sample Valves 101 and 103 (SW-2 Sol. 5-2).

c) Open Purge Valves 105 and 106 (SW-4 Sol. P-1).

d) Open Valve PAS-2 (for N2C) or Valve PAS-3 for (N2G) and Valves PAS-5, PAS-6, and PAS-8 on panel.

e) Throttle Valve PAS-7 on panel to initial flow, monitor pressure on PI-1.

NOTE: Keep pressure high to avoid flashing the sample.

f) Allow system flow for several minutes to ensure a representative sample.

g) Close Valves PAS-6 and PAS-5 to isolate sample cylinder A, then close Valves 102 and 104 (SW-2), 101 and 103 (SW-1), 105 and 106 (SW-4), PAS-2 or PAS-3 and PAS-8.

h) Fill bath tank with cooling water via bath water funnel.

i) Maintain bath water at approximately room temperature.

c. Gas-strip the liquid sample.

1) Open Valves PAS-10 and PAS-11 and observe pressure change on PI-2. Record pressure reading on form VYOPF 3530.01.
* *

2) Perform a, or b below:

a) If high concentrations of noble gas is assumed present, or if PI-2 shows no vacuum or a positive pressure:

i. Open Valve PAS-16 and crack open Valve PAS-26 to <u>very</u> <u>slowly</u> purge argon gas through the liquid sample.

ii. Bring PI-2 to approximately 64 psia, close Valves PAS-16 and PAS-26.

iii. Re-expand cylinder A and B into cylinder C by opening Valve PAS-12. This will ensure good mixing of the internal volumes and will return the system to approximately one atmosphere, (14.7 psia).

NOTE: If the system is not at 14.7 psia, then add argon until 14.7 psia is achieved.

b) If noble gas concentration is not significant or PI-2 remains in vacuum:

i. Open Valve PAS-16 and crack open Valve PAS-26 to <u>very</u> <u>slowly</u> purge argon gas through the sample.

ii. Bring PI-2 up to one atmosphere (14.7 psia).

iii. Close Valves PAS-26 and PAS-16.

3) Open Valve PAS-14 and extract a gas sample with a syringe at the gas septum.

4) Close Valves PAS-14, PAS-12, PAS-15, PAS-11 and PAS-10.
* *

5) Return to lab with gas sample and analyze for H_2 and O_2 using the Fisher Gas Partitioner.

d. Fill grab sample assembly.

1) Open Valves PAS-16, PAS-19, PAS-20, and PAS-6. This will allow the liquid sample in cylinder A to fill the grab sample assembly without pushing the entire volume of cylinder A out of the panel.

2) Allow approximately 1/2 minute for level in the loop to equalize.

3) Position the grab sample assembly Valves 17 and 18 to the right. This traps approximately 1/2 ml sample between Valves 17 & 18. This also will align the path from the dilution funnel to cylinder D (mixing cylinder).

4) Close Valves PAS-6, PAS-7, PAS-16, PAS-19 and PAS-20.

e. Dilute sample and remove for analysis.

1) Open Valves PAS-21 and PAS-24 and allow a measured amount of dilution water to gravity drain through the grab sample assembly then
* into cylinder D. Record volume of dilution
* water on form VYOPF 3530.01.

2) Allow the dilution water funnel to completely drain.

3) Close Valve PAS-24.

4) Crack open Valve PAS-25 which will blow argon gas into the line and push all the water into cylinder D.

5) Allow the argon gas to bubble through cylinder D to mix the water.

6) Close Valve PAS-21 and pressurize cylinder D with argon to approximately 5 psig on PI-3.

7) Close Valve PAS-25.

8) Open Purge Valves PAS-105 and PAS-106 (SW-4 Sol. P-1).

9) Open Valves PAS-8, PAS-23, PAS-20, and PAS-22. This will allow the diluted sample to flow from cylinder D, through the liquid septum. Observe sample flow at liquid septum/sightglass.

NOTE: If you can't see the inside edge of tygon tubing, then it has water in it.

10) Close Valve PAS-23 to stop sample flow.

11) Open Valve PAS-21 to release any remaining argon overpressure on PI-3.

12) Extract a liquid sample with a syringe at the liquid septum.

13) Place sample in lead shielding and transport to the lab for analysis.

f. Flush system.

NOTE: Prior to flushing the panel, insure that all analyses have been completed (see II.B.2.g).

1) Close Valves PAS-22 and PAS-21.

2) Crack open Valve PAS-25 and repressurize cylinder D to approximately 10 psig on PI-3, close Valve PAS-25.

3) Open Valves PAS-22 and PAS-23 to push the remaining volume out of cylinder D.

4) Close Valves PAS-22 and PAS-23 once no more flow is observed at the sightglass.

5) Refill the dilution water funnel.

6) Open Valves PAS-24 and PAS-21.

7) Allow the flush water in the funnel to gravity drain into cylinder D.

8) Close Valves PAS-24 and PAS-21.

9) Crack open Valve PAS-25 and pressurize cylinder D to 10 psig on PI-3.

10) Close Valve PAS-25.

11) Open Valve PAS-23 and PAS-22 to allow cylinder D to drain. Repeat Steps 9 through 11 as necessary to assure that no liquid remains in cylinder D.

12) Close Valves PAS-22 and PAS-23.

13) Position grab sample Valves PAS-17 and PAS-18 to the left.

* 14) Open outboard sample valves PAS-10 and PAS-103 (SW-2 Sol. S-2) and flush valves PAS-107 and 108 (SW-3 Sol. F-1). *

15) Close Valves PAS-112 and PAS-20.

* 16) Open Valves PAS-110, PAS-111, PAS-2, PAS-3, PAS-5, PAS-6, and PAS-7.

17) After several minutes, close Valves PAS-2, PAS-3, and PAS-111. Then close PAS-107 and PAS-108 (SW-3 Sol. S-F1), PAS-101 and PAS-103 (SW-2 Sol. S-2).

* 18) Open Valves PAS-4, PAS-16, PAS-19 and PAS-20.

19) Close Valve PAS-16 after 1 minute.

20) After several minutes, close Valves PAS-4, PAS-5, PAS-6, and PAS-7.

21) Purge argon through PAS-26 to blow water out of the grab sample assembly (PAS-17 and PAS-18) via Valves PAS-19, PAS-20, and PAS-8.

22) Close Valves PAS-26, PAS-19, PAS-20, and PAS-8.

23) Close remote Valves PAS-105 and PAS-106 (SW-4 Sol. P-1).

24) Change liquid septum port as necessary.

* 25) Open Valves PAS-11, PAS-12, PAS-13, PAS-14 and PAS-15.

26) Start vacuum pump to evacuate cylinder B and C.

27) Remove gas septum port and allow air to enter the evacuated systems for 1 minute as vacuum pump is running.

28) Stop vacuum pump.

29) Insert new gas septum port as necessary.

30) Close Valves PAS-11, PAS-12, PAS-13, PAS-14, and PAS-15.

31) Open Valve PAS-27 to allow bath water to gravity drain.

32) Close valve PAS-27.

* 33) Close PAS-110 and open PAS-112.

g. Chemical analysis

NOTE: Keep samples in or behind lead shielding when performing analyses.

1) Gas samples

a) Hydrogen concentration

i. Inject 1 ml of H_2 gas standard (∿25%) into the Fisher-Hamilton Gas Partitioner (D.P. 2630) and record peak on chart recorder. Repeat several times.

ii. Using shielded syringe, inject 1 ml of gas obtained in Section II.B.2.c into gas partitioner and record results on chart recorder.

iii. Using a ratio known H_2 gas concentration to peak height vs. unknown H_2 gas concentration to peak height, solve for unknown H_2 concentration.

* iv. Complete form VYOPF 3530.01, Section
* III.A.1.

b) Oxygen concentration

NOTE: The Fisher-Hamilton Gas Partitioner is normally set up for hydrogen analysis, when performing oxygen analyses the carrier gas and cell current must be changed (D.P. 2630).

i. Inject 1 ml of a O_2 gas standard (~5%) into the Fisher-Hamilton Gas Partitioner and record the peak height on the chart recorder. Repeat several times.

ii. Using a shielded syringe, inject 1 ml of gas obtained in Section II.B.2.c into gas partitioner and record peak height on chart recorder.

iii. Using a ratio of known O_2 concentration to peak height vs. unknown O_2 gas concentration to peak height, solve for unknown O_2 concentration.

* iv. Complete form VYOPF 3530.01, Section
* III.A.2.

NOTE: If performing both the H_2 and O_2 analyses at the same time, the factors will be the same.

c) Isotopic analysis

i. Obtain 3 ml of sample from gas septum (Sect. II.B.2.c) and inject into a evacuated 14 ml vial.

ii. Count gas vial using steps outlined in Section VI.

* iii. Complete form VYOPF 3530.01, Section
* III.A.3.

2) Liquid samples

NOTE: Record the amount of dilution water added to the sample.

a) Chloride analysis

i. Using the Dionex Ion Chromatograph, initiate a calibration curve for Cl^- using the concentrator column. Use 10 ml. of 25 ppb chloride standard for calibration. Repeat several times.

ii. Using shielded syringe, obtain 10 ml of sample from liquid sample septum and inject into Ion Chromatograph and record results.

iii. Complete form VYOPF 3530.01, Section III.B.1.

b) Boron analysis

i. Peak in the Plasma Spectrometer for Boron and establish calibration curve (D.P. 2630).

ii. Using a shielded syringe, obtain 5 ml of sample from liquid septum and aspirate into plasma.

iii. Complete form VYOPF 3530.01, Section III.B.2.

c) Isotopic analysis

i. Using a shielded syringe, obtain 1 ml of sample into a known geometry container.

ii. Count liquid sample using steps outlined in Section VI.

iii. Complete form VYOPF 3530.01, Section III.B.3.

3) Report all results to the OSC Coordinator.

III. Primary Containment Sampling

A. A dose commitment will be established by the OSC Coordinator for this sample prior to the start of sampling. If it appears the dose commitment will be exceeded, the sampling will be terminated until further evaluation is made.

B. Evacuate two 40 cc sample bombs and place into their lead shields.

C. Valve in the back-up H_2 analyzer per O.P. 2125.

D. Place the No. 1 shield pig on the sample jack and raise the shield up until the sampling bomb has connected to the sampling quick disconnect.

E. Open Valve VG-39 and VG-40 for 5 seconds.

F. Close VG-39 and VG-40, lower the sample shield pig 2 inches and remove sample bomb from the quick disconnect and drop it into the shield. Lower the shield and replace the cover. Place the shield aside as this is only a sample line purge.

G. Place the No. 2 sample shield onto the jack and repeat Step D.

H. Open Valves VG-39 and VG-40 for 5 seconds to take sample.

I. Close VG-39 and VG-40 and remove sample bomb and shield as in Step F.

* J. Take sample shield and sample to the Chemistry lab. Complete
* form VYOPF 3530.02.

K. Using a shielded syringe, take 0.1 cc of the sample gas via the sample hole in the bottom of the sample shield and transfer it into an evacuated off-gas vial. (Other volumes and dilutions may be used depending on the activity of the sample.)

L. Count the sample on the MCA.

M. If H_2 or O_2 analyses are required, use the Fisher-Hamilton
* Paritioner per D.P. 2630. Take sample from sample cylinder.
* DO NOT DILUTE.

* N. Report all results to the OSC Coordinator.

IV. In-Plant Air Sampling and Analysis with MCA Inoperable

A. If it is necessary to do in-plant air sampling with the MCA out of service, accurate iodine results can be achieved using the normal low volume air samplers, then analyzing the samples as follows.

B. Remove the air sampler to an area of low airborne activity and run the sampler for one minute to purge the noble gasses from the charcoal cartridge.

C. Wrap the charcoal cartridge to protect the detector from contamination and count it as follows:

SAM II Operational Procedure:

1. Instrument Preparation:

a. Check instrument, power cord, and detector cable for damage.

b. Connect detector cable and detector, plug cable into front of instrument labled "DETECTOR."

NOTE: Allow 1 1/2 to 2 hours warmup time, if instrument has been "OFF". Instrument should be energized at all times.

c. Place detector into an appropriate shield.

d. Check that front instrument controls are set as indicated on the calibration sticker located on the top of the instrument.

2. Operational Check:

a. Set TIMED - STOP - MAN. switch to MAN. Unit should begin to count.

b. Set TIMED - STOP - MAN switch to TIMED.

c. Set COUNT TIME IN MINUTES switches to 1 and X1.

d. Obtain SAM II check source, place detector directly on top of source.

e. Press Reset - Start switch.

f. After a 1 minute count, the instrument should indicate the number of counts within the range labled on top of the instrument.

3. Sample Counting:

a. With instrument settings remaining as above, perform a background count.

b. Place sample on detector and count.

c. Calculate the iodine-131 concentration as follows:

$$I^{131}\ \mu Ci/cc = \frac{\text{Sample counts (cpm)-Bkg counts (cpm)}}{(E)(Vs)\ (2.22x10^6)}$$

Where:
cpm = count rate from SAM-2
E = counting efficiency (instrument top)
Vs = sample volume in cc
$2.22x10^6$ = cpm/μCi conversion

D. Use of Silver Zeolite Sampler Cartridges

1. If I^{131} concentration calculated in Step C.3 above is greater than or equal to 1×10^{-6} μci/cc I^{131}, then resample and verify results using silver zeolite cartridge (except omit purge step outlined in Step B).

2. Report results to OSC Coordinator and record results in logbook.

* V. Noble gas release rate determination with Stack Gas Monitors Off-Scale

A. If the stack gas monitors are off scale, the release rate can be determined using the Victoreen High Range Monitor (on stack) and the attached Nomogram (Figure 3).

B. Read the dose rate on the Victoreen High Range Monitor in mR/hr.

C. Determine the time since reactor shutdown and stack flow rate (fpm).

D. Using these valves, read the release rate from the Nomogram (Figure 3).

* E. Report results to the SS/PED or OSC Coordinator.

VI. Counting Techniques for Highly Radioactive Samples

NOTE: If sample size or dilutions can be used to permit a sample to be counted by conventional techniques, this should be done. If this is not possible, the following techniques can be used:

A. Use of the MCA at extended distances.

1. Remove the shield top from the small GeLi detector.

2. Suspend the sample above the detector at a distance that will give a dead time of <50% (must be >1 ft.).

3. Measure the distance from the sample to the top of the detector.

4. Count the sample and calculate the activity using a 2" filter paper geometry for efficiencies.

5. Calculate the sample activity as follows:

$$\mu Ci/ml = (\chi)(d^2)(100)$$

where: χ = μCi/ml calculated in 4 above
d = distance in ft measured in 3 above
100 = correction factor.

B. Use of portable instruments.

NOTE: If neither conventional methods or those in VI.A above can be used, a portable gamma survey meter can be used to determine sample activities.

1. If the MCA is available, it can be used to give a qualitative measure of major isotopes. If it is not available, an assumption must be made based on what is known about the sample at the time.

2. Measure the radiation level of the sample at 1 meter.

3. Calculate the sample activity as follows:

$$\mu Ci/ml = \frac{(R/hr\ @\ 1\ meter)(10^6)(A)}{(T)(V_s)}$$

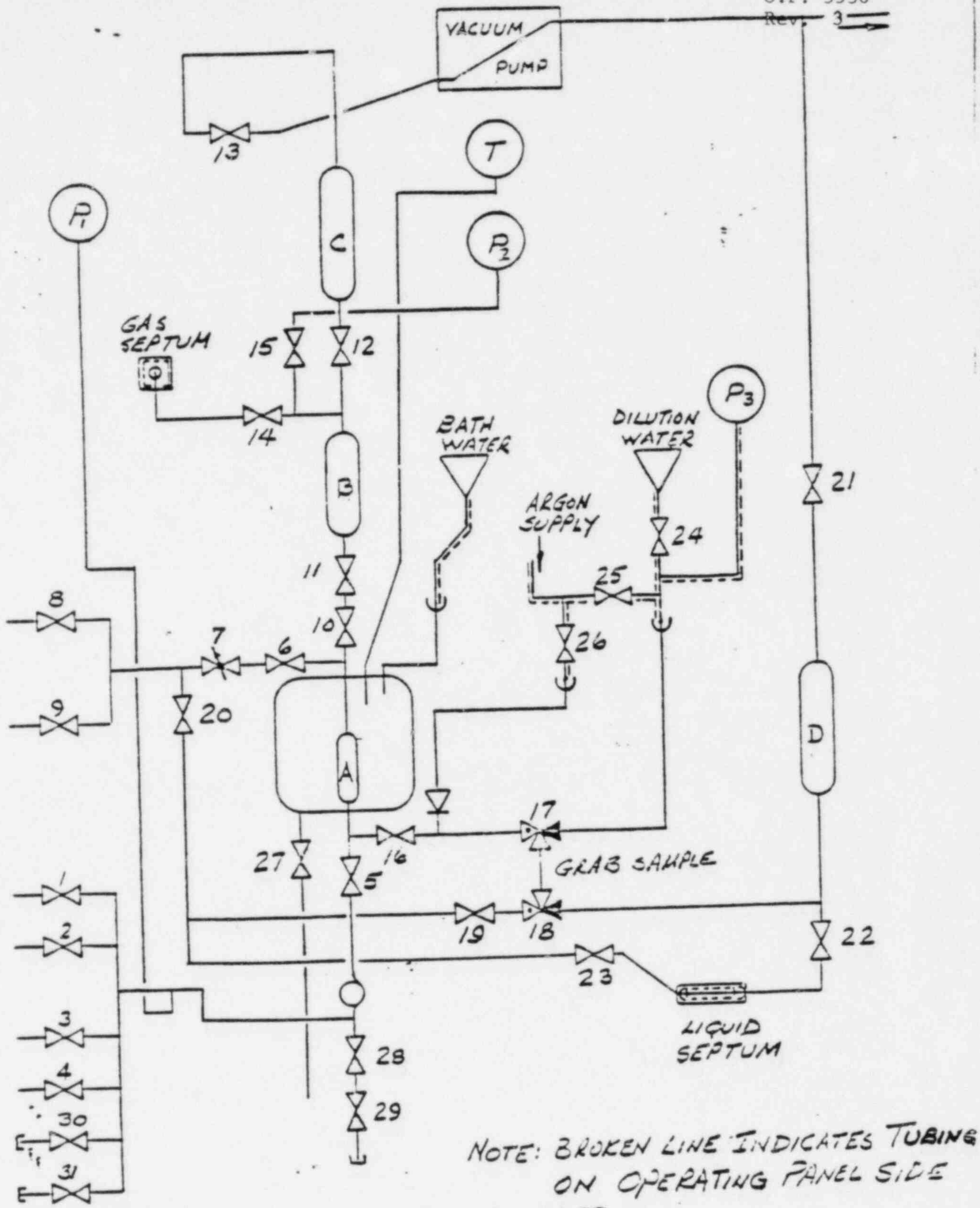
where: A = fraction of total activity due to the isotope.
10^6 = µCi/Ci
V_s = sample volume (milliliters)
T = Γ/10 R/hr @ 1 meter/Ci

From Page 131 Radiation Health Handbook

Value of T for some isotopes are as follows:

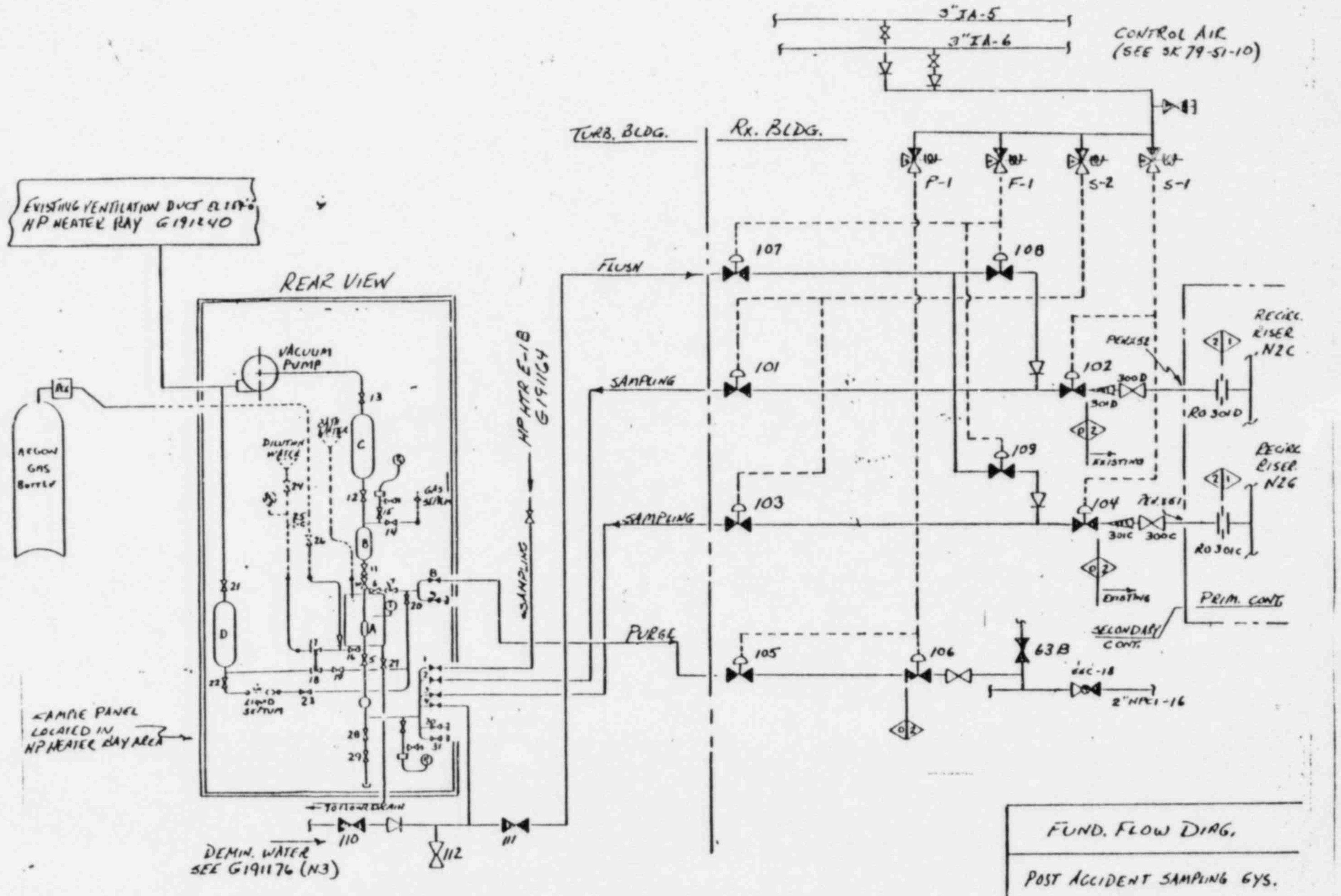
* Cs^{134} = 0.87
* Cs^{137} = 0.33
Co^{60} = 1.32
I^{131} = 0.22
Xe^{133} = 0.10
Kr^{85} = 0.04

SPS/emr



POST ACCIDENT SAMPLER

FIG. 1



FUND. FLOW DIAG.

POST ACCIDENT SAMPLING SYS.

FIG. 2

VERMONT YANKEE
EMERGENCY OFFSITE DOSE RATE NOMOGRAM

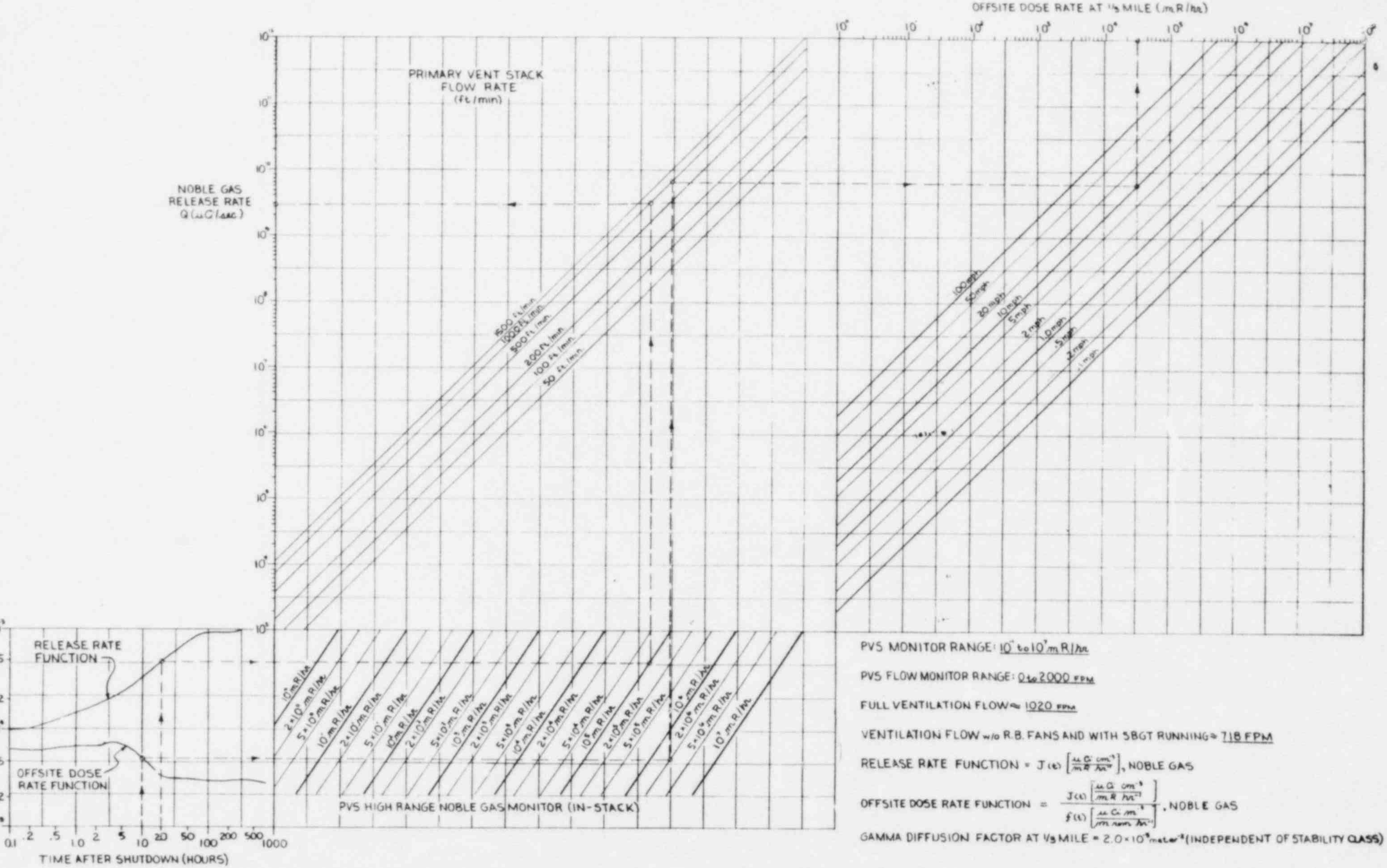


FIGURE 3

POST ACCIDENT SAMPLING DATA/ANALYSIS

Sample Taken on______________, at____________, by_____________.
Date Time Initials

I. Correction Factor for Gas Samples when Diluting with Argon

A. When cylinder 'A' is vented to cylinder 'B' and pressure on PI-2 is <14.7 psi.

1. Record initial pressure on PI-2 (II.B.2.a.6) Pi__________psi
2. Add Argon to bring pressure in cylinder 'B' to 14.7 psi (PI-2) P_f__________psi
3. Calculate correction factor (CF)

$$CF = \frac{P_f}{Pi}$$

CF__________

4. Go to Section III.A and complete form.

B. When sample is vented to Cylinder 'B' and pressure on PI-2 is >14.7 psi.

1. Record initial pressure on PI-2 when 'A' vented to 'B' (II.B.2.a.6) Pi__________psi
2. Add Argon to bring pressure in cylinder 'B' to 64 psi (PI-2) P_f__________psi
3. Vent cylinder 'B' into cylinder 'C' - pressure reading should be ∿14.7 psi. If not, add Argon and bring pressure to 14.7 psi (PI-2)
4. Calculated correction factor (CF)

$$CF = \frac{1300cc}{\left(\frac{Pi}{P_f}\right)\left(300cc\right)}$$

CF__________

5. Go to Section III.A and complete form.

II. Liquid Sample

1. Volume of dilution water Vi__________ml
2. Dilution factor $DF = \frac{Vi}{0.5ml}$ DF__________

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III Post Accident Sampling Analysis

A. Gas Sample Analysis

1. Hydrogen Concentration

a) H_2 conc. from lab analysis (II.B.2.g.1) Hi__________%
b) Gas correction factor (VYOPF 3530.01 IA/B) __________
c) H_2 concentration
H_2 = Hi X CF = [ ] %
d) Chromatograph attached to form __________
Initial

2. Oxygen Concentration

a) O_2 conc. from lab analysis (II.B.2.g.2) Oi__________%
b) Gas correction factor (VYOPF 3530.01 IA/B) __________
c) O_2 concentration
O_2 = Oi X CF [ ] %
d) Chromatograph attached to form __________
Initial

3. Isotopic Analysis

a) Volume of gas sample in 14ml vial
(Sec. II.B.2.c) __________ml
b) Gas correction factor from VYOPF 3530.01
Sec. I A or B. __________
c) Multiply isotopic results by the correction factor in b. above and record these values below. __________
Initial
d) Attach isotopic printout to form. __________
Initial

B. Liquid Sample Analysis

1. Chloride Analysis

a) Concentrator column installed in load port. __________
Initial
b) Vol. of 25 ppb Cl standard injected __________ml
c) Vol. of unknown sample injected (same as in b. above) __________ml
d) Dilution factor from VYOPF 3530.01, Sec. II __________DF
e) Corrected Cl concentration
Cl concentration from Ion Chromatograph X DF [ ] ppb
f) Attach chromatograph to form. __________
Initial

2. Boron Analysis

a) Boron concentration from Plasma Spectrometer ____________ppm

b) Dilution factor from VYOPF 3530.01 Sec. II ____________DF

c) Correct for dilution (Boron Conc.) (Dilution Factor) ____________ppm

d) Attach printout to form ____________ Initial

3. Isotopic Analysis

a) Vol. of original sample Vi____________ml

b) Dilution required to count sample YES/NO____________ (Circle)

1) YES-Original sample diluted to (x)________ml
Correction factor $(C_L) = \frac{x}{Vi}$ ____________C_L

2) NO- $C_L = 1$, continue to Step c.

c) Dilution factor from VYOPF 3530.01 Sec. II ____________DF

d) Multiply isotopic results by the correction factor C_L and DF and records results below: ____________ Initial

e) Attach isotopic printout to form. ____________ Initials

PRIMARY CONTAINMENT DATA/ANALYSIS

Sample Taken on______________, at______________, by______________.
Date Time Initials

1. Isotopic Analysis

a) Vol. of sample transferred to evacuated 14 ml vial. Vi___________cc

b) Dilution required to count sample YES/NO (Circle one)

1) YES- Original sample diluted to X_______cc
Correction factor $C_1 = \frac{x}{Vi}$ ___________C_1

2) NO- C_1 = 1 continue to Step c.

c) Multiply isotopic results by the correction factor C_1 and record results below: ___________ Initials

d) Attach isotopic printout to form. ___________ Initials

2. Hydrogen Concentration

a) Results from Sec. III.M [ ] %

b) Attach chromatograph to form. ___________ Initials

3. Oxygen Concentration

a) Results from Sec. III.M [ ] %

b) Attach chromatograph to form ___________ Initial

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