

BRP EMERGENCY PLAN
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The following spreadsheets are also included on this CD and require MS Excel to perform calculations:

- BRP-ER-8.01 Food and Milk
- BRP-ER 8.01 Water Calculations
- BRP-ER-8.01 Relocation and Recovery

1.0 EMERGENCY CLASSIFICATIONS

NUREG-0654 (Rev. 1), Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants, provides guidance to State and local governments and licensees on developing emergency response plans for nuclear power plant incidents. In NUREG-0654, emergencies are grouped into four classifications which cover the entire spectrum of incident situations. The classification system provides for notification of emergency response organizations and for implementation of certain actions that are appropriate to a specific situation. Provisions are included for upgrading the classification level and the corresponding response if the situation deteriorates or deescalating as the situation improves. The four emergency classifications, in order of increasing severity, are Unusual Event, Alert, Site Area Emergency and General Emergency. A description of the four emergency classifications is contained in Figure 1.1.

The licensee is responsible for classification of the emergency. Specific criteria or conditions known as Emergency Action Levels (EALs) are used to classify incidents into one of the four emergency classifications. EALs set the boundaries of each emergency classification and are based on plant parameters, such as instrument readings or alarms, or radiological conditions such as dose rates.

The appropriate BRP notifications and response activities for each emergency classification are found in Sections 4.0 and 5.0.

FIGURE 1.1

CLASSIFICATION	DESCRIPTION	PURPOSE	RELEASE POTENTIAL
UNUSUAL EVENT	Events are in processor have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated	<ol style="list-style-type: none"> 1) Assure that initial response activities are carried out 2) Provide current information on unusual events. 	No releases of radioactive material requiring offsite response or monitoring are expected unless further degradation of safety systems occurs.
ALERT	Events are in process or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of HOSTILE ACTION.	<ol style="list-style-type: none"> 1) Assure that emergency personnel are readily available to respond if the situation becomes more serious. 2) Perform confirmatory radiation monitoring, if required. 3) Notify federal technical assistance agencies. 4) Provide offsite agencies with current status information 	Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline (PAG) exposure levels.

FIGURE 1.1 (Cont.)

CLASSIFICATION	DESCRIPTION	PURPOSE	RELEASE POTENTIAL
SITE AREA EMERGENCY	Events are in process or have occurred which involve actual or likely major failures of plant functions needed for protection of the public or HOSTILE ACTION that results in intentional damage or malicious acts; (1) toward site personnel or equipment that could lead to the likely failure of or; (2) that prevent effective access to equipment needed for the protection of the public.	<ol style="list-style-type: none"> 1) Assure that response centers are manned. 2) Perform confirmatory radiation monitoring, if required. 3) Request federal technical assistance, if required. 4) Assure that personnel required for evacuation are mobilized. 5) Provide consultation with off-site authorities and current information for public. 	Any releases are not expected to result in exposure levels which exceed EPA Protective Action Guideline exposure levels beyond the site boundary.
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 or HOSTILE ACTION that results in an actual loss of physical control of the facility.	<ol style="list-style-type: none"> 1) Initiate protective actions for the public. 2) Provide continuous assessment of information from licensee and monitoring teams. 3) Request federal technical assistance. 4) Initiate additional measures as indicated by emergency conditions. 5) Provide consultation with off-site authorities and current information for the public. 	Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels offsite for more than the immediate site area.

1.1 INCIDENT OF NATIONAL SIGNIFICANCE

An Incident of National Significance is an actual or potential high-impact event that requires a coordinated and effective response by an appropriate combination of Federal, State, local, tribal, nongovernmental, and/or private-sector entities in order to save lives and minimize damage, and provide the basis for long-term community recovery and mitigation activities. The Secretary of Homeland Security declares Incidents of National Significance (in consultation with other departments and agencies).

For nuclear power plants, an Incident of National Significance can be declared:

1. For a terrorist incident involving a nuclear power plant.
2. For an event classification of General Emergency at a nuclear power plant.

2.0 EMERGENCY FACILITIES AND EQUIPMENT

This section describes the emergency facilities activated in response to incidents at nuclear power plants. Information is included on each facility's function, staffing and emergency equipment. The section also includes information on the emergency monitoring equipment used by BRP field teams, and the laboratory capability for analysis of emergency samples.

2.1 LICENSEE FACILITIES

2.1.1 EMERGENCY OPERATIONS FACILITY (EOF)

The EOF is maintained by the licensee and serves as the central location for coordinating response activities between on-site and off-site agencies. The location and layout of each licensee's EOF is found in the site-specific descriptions in Section 9. The EOF is manned by the licensee at Alert and activated at Site Area Emergency or higher classification.

As the Federal Coordinating Agency for commercial nuclear power plant incidents, NRC will be in charge of the Federal technical response at the EOF. The EOF is also the initial rendezvous location of the DOE Radiological Assistance Program (RAP) team, if Federal technical assistance has been requested.

The function of the BRP staff at the EOF is communication of reactor engineering and radiological information from the licensee to the BRP decision-makers and dose assessment staff at the State Emergency Operations Center (EOC). BRP staff also interface with NRC representatives at the EOF.

Designated BRP staff are dispatched to the EOF at Alert or higher emergency classification. Deployment times for the BRP staff depends on the reactor site and weather conditions. Estimated deployment times are:

<u>Site</u>	<u>From BRP Headquarters</u>	<u>From Regional Offices</u>
Beaver Valley	6 hours	2 hours
Limerick	2 hours	2 hours
Peach Bottom	2 hours	2 hours
Susquehanna Steam	3 hours	3 hours
Three Mile Island	2 hours	2 hours

The EOF contains dedicated telephone lines and fax to the BRP-EOC and the BRP-AC.

2.1.2 TECHNICAL SUPPORT CENTER (TSC)

The TSC is maintained by the licensee and provides support for the Control Room's emergency response efforts, continued evaluation of event classification, assessment of plant status and coordination of emergency response actions.

The TSC for each licensee in Pennsylvania is located at each site.

2.1.3 JOINT INFORMATION CENTER (JIC)

The Joint Information Center is the central location near the incident site for coordination of public information. The licensee activates the JIC at Alert or higher emergency classification.

Detailed information on dissemination of information to the public is described in Emergency Support Function # 15 – External Affairs, of the Commonwealth of Pennsylvania State Emergency Operations Plan.

2.2 STATE FACILITIES

2.2.1 STATE EMERGENCY OPERATIONS CENTER (EOC)

The State EOC is located at the Pennsylvania Emergency Management Agency (PEMA) Headquarters on Interstate Drive north of Harrisburg. The State EOC serves as the location for overall coordination of State response activities and protective action decision-making, prior to the establishment of Federal facilities. The layout of the BRP Cell at the State EOC is shown in Figure 2.1.

The functions of the BRP staff at the EOC are accident assessment, dose assessment (which includes field data collection, and dose projection), interpretation and assessment of utility Protective Action Recommendations (PARs), the development of BRP PARs, conveyance of PARs to PEMA, and general management of BRP response activities. Designated BRP staff report to the State EOC upon its activation at Alert or higher emergency classification.

The BRP-EOC contains the following equipment:

- Computer for Emergency Response Data System (ERDS)
- Computer with dose projection software
- Maps with pre-selected monitoring locations for field sampling
- Dedicated telephone lines to each nuclear power plant and to the BRP-AC, in addition to commercial telephone lines
- Status boards to display reactor status and radiological information
- 800 Mhz radio base station (when available)
- Final Safety Analysis Reports (FSARs) and other reference documents for each nuclear power plant (pre-positioned or brought from BRP Headquarters)
- Fax machines

2.2.2 BRP ASSESSMENT CENTER (BRP-AC)

The BRP Assessment Center is located at the BRP Headquarters. The layout of the Assessment Center is shown in Figure 2.2.

The BRP-AC acts as a back-up facility to the State EOC for BRP functions. It is also used for training. The BRP-AC will be staffed on an exception basis at the discretion of the BRP Radiological Assessment Director. .

FIGURE 2.1

BRP WORK AREA AT STATE EOC

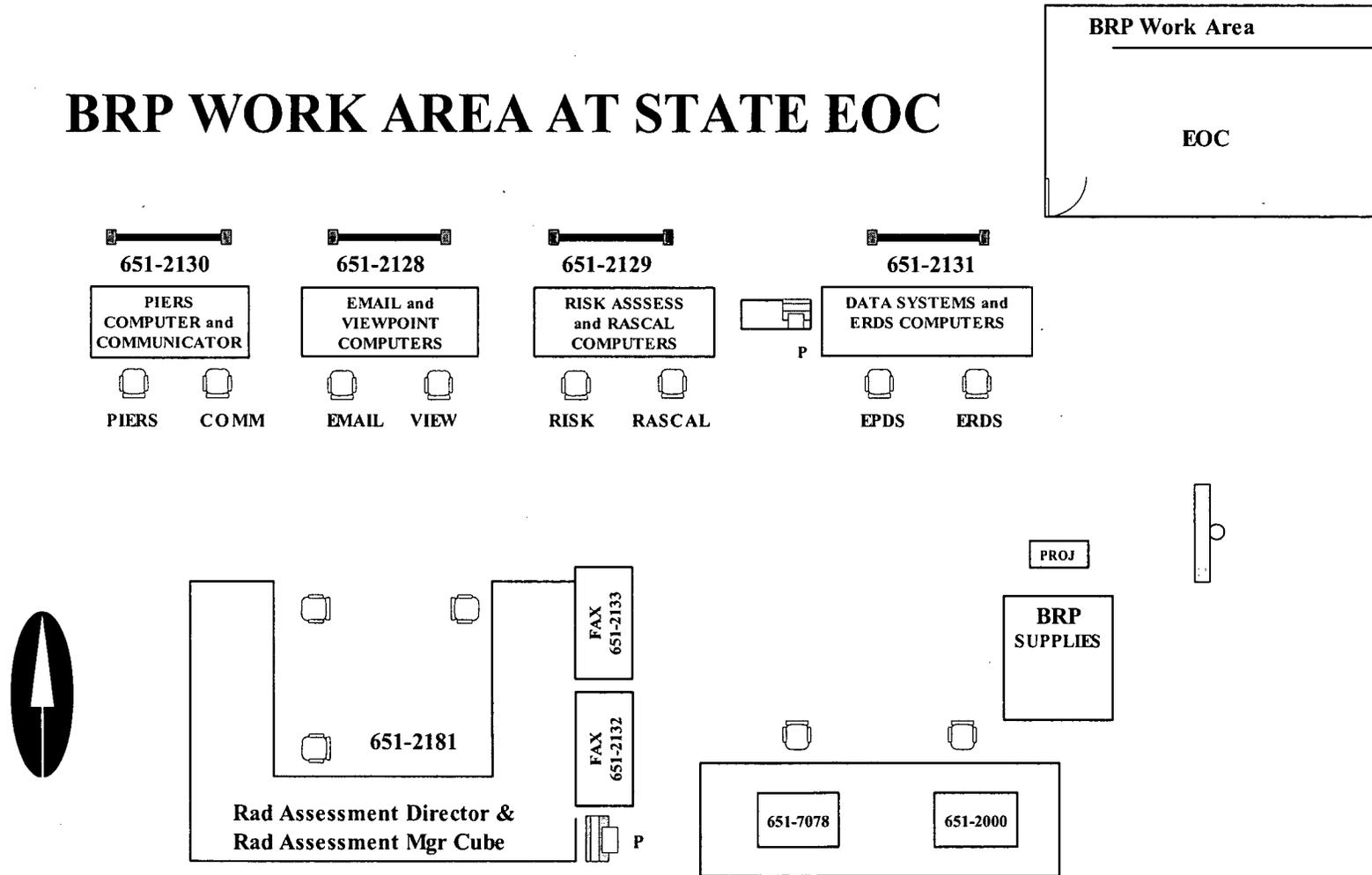
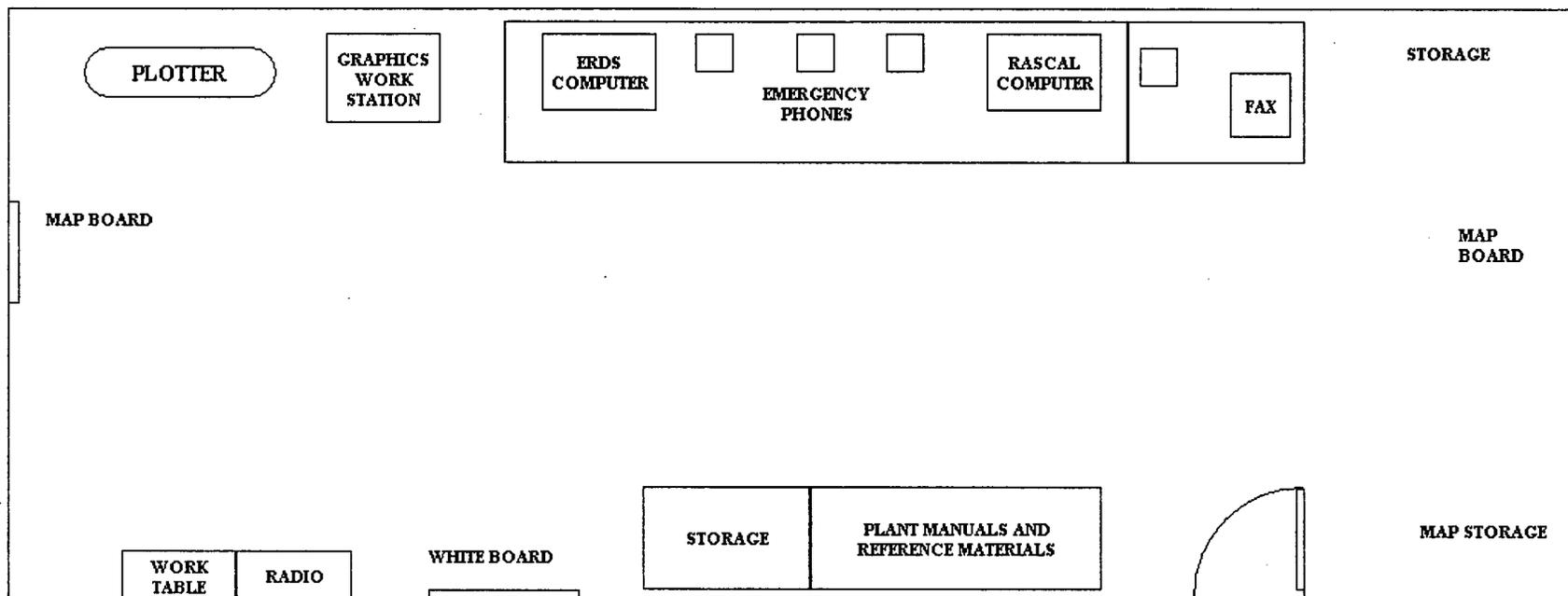


FIGURE 2.2
BRP RADIOLOGICAL ASSESSMENT CENTER



The BRP-AC contains the following emergency equipment:

- Computer for the Emergency Response Data System (ERDS)
- Computer with dose projection software
- Graphics workstation for creating maps for field team control and plume tracking
- Maps with pre-selected monitoring locations for field sampling
- Dedicated telephone lines to each nuclear power plant and the EOC, in addition to commercial telephone lines
- Status boards to display reactor status and radiological information
- Final Safety Analysis Reports (FSARs) and other reference documents for each nuclear power plant
- 800 Mhz Radio base station (when available)
- Fax

2.2.3 DEP RADIATION MEASUREMENTS LABORATORY (RML)

The DEP Bureau of Laboratories, Radiation Measurements Laboratory is located in Harrisburg. RML performs radioanalysis of samples collected as part of the routine environmental monitoring program around each nuclear power plant. RML also performs analysis of emergency samples collected by State and Federal field monitoring teams.

Designated BRP staff are positioned at RML prior to delivery of emergency samples. The function of BRP staff at RML is review and communication of environmental sample data to BRP decision-makers at the EOC and/or Federal Radiological Monitoring & Assessment Center (FRMAC). BRP provides RML with analysis priorities and detection limits, and assists with contamination control procedures.

The major RML instrumentation includes:

- Multichannel analyzers
- Intrinsic germanium detectors (gamma)
- Extended range germanium detector (50% efficiency gamma)
- Low range germanium detector
- Automated thin window proportional counters (alpha and beta-gamma)
- Manual thin window proportional counter with detectors (alpha and beta)
- Liquid scintillation systems (low energy beta and tritium)
- Alpha Spectroscopy Systems

2.3 FEDERAL FACILITIES

2.3.1 NRC HEADQUARTERS OPERATIONS CENTER

The NRC Headquarters Operations Center directs NRC response activities. Early in an incident, the NRC Headquarters Operations Center Staff provide assistance on assessing plant conditions and development of protective action recommendations (PARs).

Additional information on NRC assistance is found in Section 3

2.3.2 FEDERAL RADIOLOGICAL MONITORING & ASSESSMENT CENTER (FRMAC)

The Federal Radiological Monitoring and Assessment Center is established to provide Federal assistance on radiological monitoring and assessment. The FRMAC provides a central location to house the technical resources provided by several different Federal agencies. Federal representation in the FRMAC is approximately 200-300 individuals. DOE is assigned the responsibility to establish and initially manage the FRMAC. The long-term management responsibility for the FRMAC is assigned to EPA. The timeframe for establishment and full operation of the FRMAC in Pennsylvania is normally within 36-48 hours from the time of a request. The typical layout of the FRMAC is shown in Figure 2.3.

The FRMAC will be located in the vicinity of the incident location, but final selection of a site will be determined by the specific emergency conditions and will be coordinated with PEMA at the time of the incident. A potential FRMAC location near each nuclear power plant has been pre-identified by PEMA and is listed in the Pennsylvania Nuclear/Radiological Incident Plan.

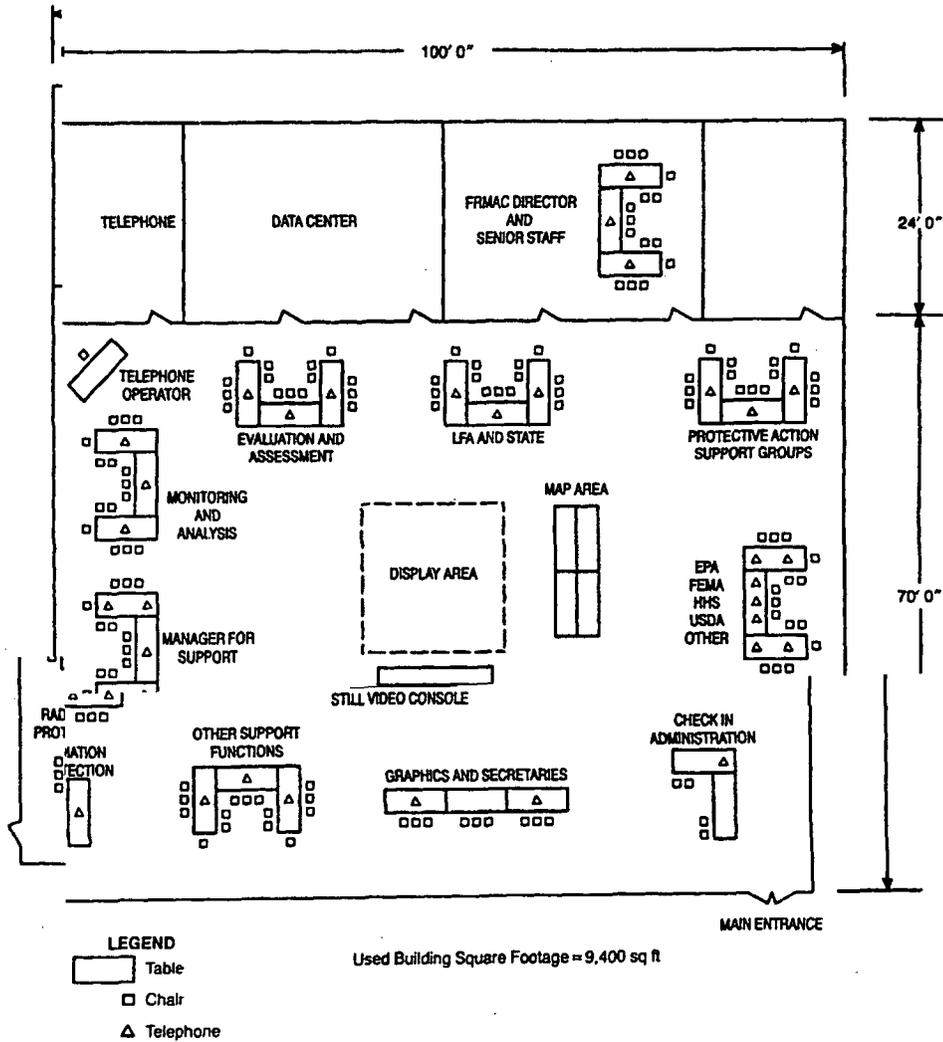
In preparation for establishment of the FRMAC, a DOE Consequence Management Response Team (CMRT) will be deployed. The CMRT functions as an advance element of the FRMAC to establish contact with on-scene responders to coordinate Federal radiological monitoring and assessment activities. Designated BRP staff will meet with the CMRT to provide information on State radiological assessment activities and establish initial State monitoring priorities for the FRMAC. Initial monitoring plans for FRMAC activities are found in Section 6B.

Upon establishment of the FRMAC, designated BRP staff move to the FRMAC and integrate into specific FRMAC functional areas. BRP staff at the FRMAC are responsible for coordinating all radiological assessment activities, in conjunction with Federal representatives. This includes coordinating all State environmental monitoring and field sampling activities from the FRMAC. The organization of BRP staff at the FRMAC and a summary of their responsibilities is found in Section 4.2.

Additional information on Federal technical assistance and FRMAC resources is found in Section 3.

FIGURE 2.3

**GENERIC LAYOUT OF THE
 FEDERAL RADIOLOGICAL MONITORING & ASSESSMENT CENTER (FRMAC)**



2.3.3 JOINT FIELD OFFICE (JFO)

The Joint Field Office (JFO) is a temporary Federal facility established locally to provide a central point for Federal, State, local, and tribal executives with responsibility for incident oversight, direction, and/or assistance to effectively coordinate protection, prevention, preparedness, response and recovery actions. The JFO is established by the Department of Homeland Security (DHS). The JFO combines the traditional functions of the Joint Operations Center (JOC), the FEMA Disaster Field Office (DFO) and the Joint Information Center (JIC) within a single Federal facility.

It is expected that the JFO will be collocated with an existing Emergency Operations Facility (EOF). The organization of BRP staff at the JFO and a summary of their responsibilities is found in Section 4.

2.4 EMERGENCY MONITORING EQUIPMENT AND VEHICLES

2.4.1 BRP PORTABLE FIELD MONITORING EQUIPMENT

BRP field monitoring teams are equipped with portable survey meters, and air sampling and analysis equipment for measuring radioiodine concentrations in air. Field measurement sensitivity for iodine-131 meets $1E-7$ uCi/cc of air, in accordance with NUREG-0654.

Emergency instrumentation is operationally checked prior to use and once each calendar quarter. Emergency equipment is inventoried and checked once each calendar quarter and after each use. All emergency instrumentation is calibrated as required.

Portable Field Monitoring Equipment -- BRP staff at the DEP Regional Offices each have 3 complete sets of field monitoring equipment. Two sets of equipment are operational at all times and one set is held in reserve. One set of equipment is also kept in reserve at BRP Headquarters. The major items of equipment include:

- Portable counter scalers with thin window G-M detectors for I-131 and gross beta-gamma measurement in air sample collection media.
- Air mover for collection of air samples.
- Collection media including silver zeolite and activated charcoal canisters, and air particulate filters.
- Energy compensated GM detector for ambient gamma measurements (closed window) with range of 0-10,000 R/hr, and ambient beta/gamma measurements (open window) with range of 0-5 Rad/hr.

2.4.2 BRP FIELD MONITORING VEHICLES

BRP maintains vehicles for field monitoring activities. These vehicles are designed to provide for rapid response, comprehensive data collection, and continuous data transfer from the field to decision makers.

Dedicated Field Team Response Vehicles -- Each BRP Regional Office has two dedicated field team response vehicles to carry portable field monitoring equipment. BRP Headquarters has one dedicated field team response vehicle to carry portable field monitoring equipment. These dedicated field team response vehicles are equipped with:

- Installed on-board wide range GM detector for gamma measurements (50 uR/hr to 1000 R/hr)
- Satellite uplink capability to transmit the on-board GM detector gamma measurements and GPS location to remote locations, such as the EOC and R3V
- Installed satellite phones
- 800 Mhz radios (when available)

The Dedicated Field Team Response vehicles are pick-up trucks with specially designed pull-out bed platforms to hold field monitoring equipment. They have seating for four personnel, and are equipped with flashing lights and a siren for emergency response activities.

Radiological Rapid Response Vehicle (R3V) – BRP Headquarters has a Radiological Rapid Response Vehicle. This vehicle is designed to conduct radiological monitoring and to serve as a command and control platform. The major radiological monitoring equipment on the R3V include:

- Installed on-board 7 Liter plastic scintillator detector for low range gamma measurements (<10 uR/hr to 25 mR/hr) (Satellite uplink capability)
- Installed on-board wide range proportional detector for gamma measurements (10 uR/hr to 1000 R/hr) (Satellite uplink capability)
- Installed on-board air monitoring system for noble gas, iodine and particulates (Satellite uplink capability)
- Environmental Satellite Probes (4) with wide range proportional detector (10 uR/hr to 1000 R/hr) for gamma measurements. These probes have line of site radio and satellite uplink capability for radiological data and GPS information transfer. These probes are battery powered and can be dropped off in the field. They and can be monitored from remote locations, such as the EOC or R3V.

The major communications equipment on the R3V include:

- Satellite uplink capability to transmit radiological data from the following radiation measurement equipment to remote locations:
 - On-board 7 Liter plastic scintillator
 - On-board wide range proportional detector
 - On-board air monitoring system
 - Environmental Satellite Probes
- GPS unit with data transfer via satellite link
- E-mail capability via satellite link
- Satellite phones
- 800 Mhz radio (when available)
- Commercial television viewing capability via satellite link

The R3V can be used for Field Team Control when necessary.

The R3V is a specially designed truck with an on-board generator for power supply at remote locations. It is also equipped with flashing lights and a siren for emergency response activities.

2.4.3 BRP THERMOLUMINESCENT DOSIMETRY SYSTEM (TLD)

BRP maintains a network of TLDs around each nuclear power plant. Exchange and review of BRP TLDs results is performed by BRP staff.

BRP has National Voluntary Laboratory Accreditation Program (NVLAP) certified contractors in place to perform additional TLD annealing and reading as necessary. BRP maintains a backup system for annealing and reading dosimeters.

3.0 RESPONSIBILITIES AND RESOURCES

This section summarizes the responsibilities of the licensee and designated State and Federal agencies with a major role in assessment and control of radiological emergencies. Also included is a description of the resources available from each agency to assist BRP.

3.1 LICENSEE

3.1.1 Responsibilities

The licensee of the nuclear power plant has the primary responsibility to take actions on-site to limit the consequences of a radiological incident. The licensee is also responsible for keeping off-site authorities informed of the status of the emergency and for recommending specific protective actions to protect the public health and safety.

3.1.2 Resources

NUREG-0654 specifies certain staffing, instrumentation and procedural resources that the licensee must maintain over the life of the facility, including personnel to operate the plant and provide support in radiation protection and engineering.

It is the basic tenet of this plan that the licensee has the best knowledge of the status of their facility in terms of identifying the problem, estimating release rates, predicting offsite doses and forecasting changes in the situation. Consequently, the licensee is in a position to provide timely protective action recommendations to BRP.

The licensee also provides reactor status and radiological information to BRP for independent assessment.

AFTER ESTABLISHMENT OF THE FRMAC, BRP DOES NOT RELY ON THE LICENSEE FOR OFF-SITE MONITORING ASSISTANCE.

3.2 STATE AGENCIES

Following is a summary of State agency responsibilities during radiological emergencies and a description of the resources available to assist BRP.

State agencies with direct interface with BRP are the Pennsylvania Emergency Management Agency, the Department of Environmental Protection, the Department of Agriculture and the Department of Health. BRP requests for assistance are coordinated directly with PEMA and the respective agency's Emergency Preparedness Liaison Officer at the State EOC.

Detailed information on State agency responsibilities is found in the Pennsylvania Nuclear/Radiological Incident Plan.

3.2.1 BUREAU OF RADIATION PROTECTION (BRP)

3.2.1.1 Responsibilities

BRP is the lead State agency with responsibility for technical assessment of radiological incidents and evaluation of off-site consequences. BRP continuously and independently assesses plant conditions and calculates projected doses. BRP recommends appropriate protective actions, through PEMA, to the Governor. BRP coordinates all radiological assessment activities and all technical assistance provided by the Federal government. BRP establishes State monitoring and analysis priorities for FRMAC activities and provides interface with representatives from Federal technical agencies.

3.2.1.2 Resources

BRP has health physics and nuclear engineering staff at BRP Headquarters and at 3 DEP Regional Offices. A general BRP organizational chart is found in Figure 3.1. BRP provides personnel and equipment for field sampling of radioiodines and ambient radiation monitoring. BRP maintains a routine environmental sampling program around each nuclear power plant.

3.2.2 PENNSYLVANIA EMERGENCY MANAGEMENT AGENCY (PEMA)

3.2.2.1 Responsibilities

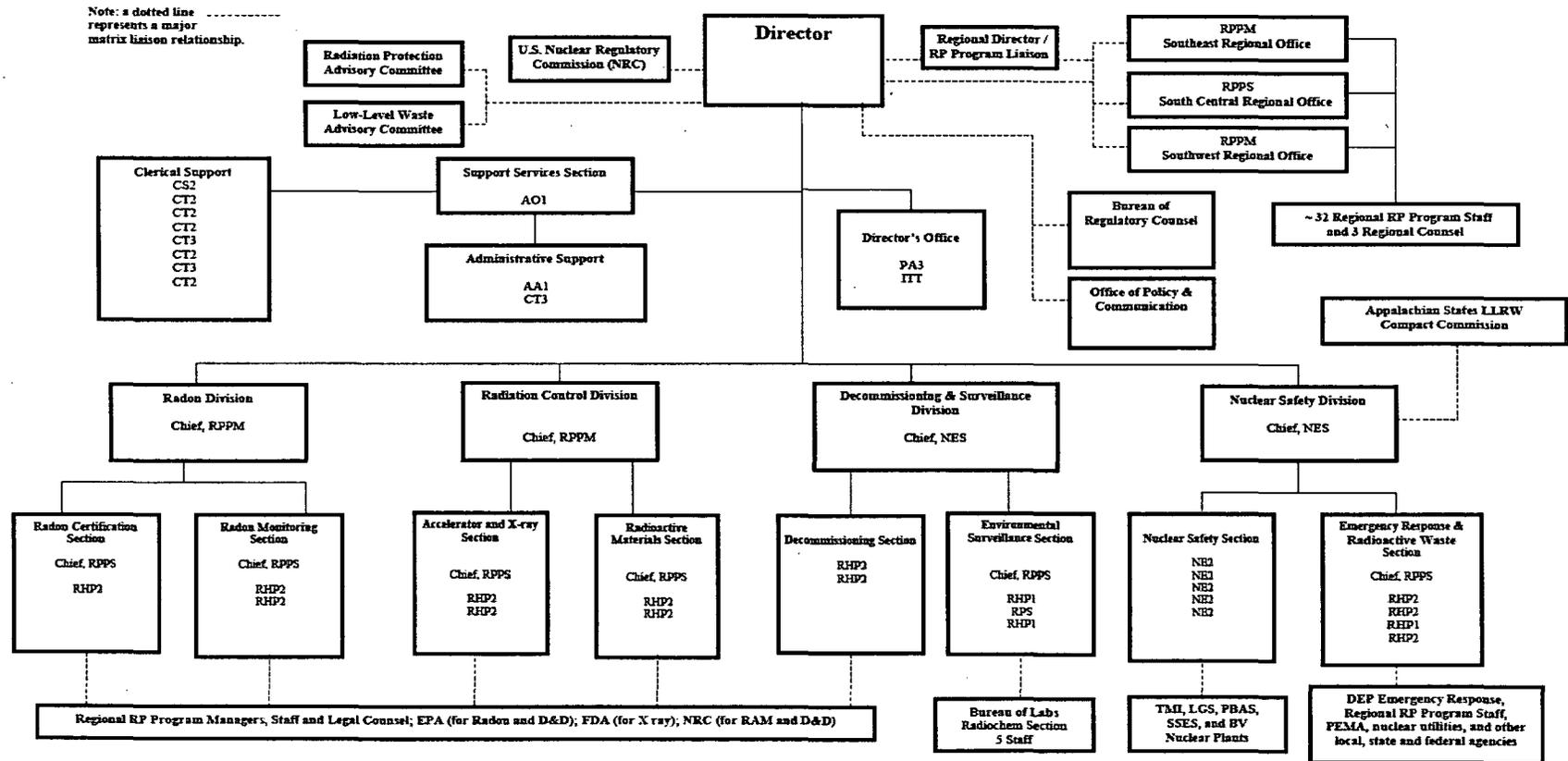
PEMA is the lead agency for direction and coordination of the State response to a radiological emergency. PEMA receives protective action recommendations from BRP and coordinates their implementation. PEMA operates the State EOC and disseminates information and PARs to other State agencies and the Counties. PEMA directs the State Recovery Task Force for managing long-term recovery issues.

3.2.2.2 Resources

PEMA assists BRP in coordinating requests for non-technical assistance with other State agencies and FEMA. PEMA provides logistical support, as requested by BRP, for delivery of samples for laboratory analysis, site selection and establishment of the FRMAC, etc.

FIGURE
 3.1

PA RADIATION PROTECTION PROGRAM



3.2.3 DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP)

3.2.3.1 Responsibilities

DEP is responsible for sampling of surface water, ground water and public water supplies. DEP notifies downstream public water suppliers concerning contamination of water resources.

3.2.3.2 Resources

DEP provides logistical and personnel support such as additional vehicles, radios and drivers for BRP field monitoring teams. DEP provides field sampling teams from the DEP regional offices for collection of water samples. Laboratory analysis of environmental samples is performed by the DEP Bureau of Laboratories, Radiation Measurements Lab. If required, meteorological data and independent assessment is provided by the DEP meteorologist.

3.2.4 DEPARTMENT OF AGRICULTURE (PDA)

3.2.4.1 Responsibilities

The Department of Agriculture is responsible for sampling of milk, and agricultural and food products. PDA provides interface with the agricultural community on the need to take protective actions for the ingestion pathway.

3.2.4.2 Resources

PDA provides field personnel for sampling of agricultural, dairy and food products. PDA maintains dairy herd lists and milk processor/food processor data to use in selecting sampling locations and in the control of contaminated foods.

3.2.5 DEPARTMENT OF HEALTH (DOH)

3.2.5.1 Responsibilities

The PA Department of Health is responsible for directing emergency workers, the public and special populations to take thyroid-blocking agents (potassium iodide), in consultation with BRP.

3.2.5.2 Resources

DOH provides guidance on the use of thyroid-blocking agents (potassium iodide).

3.3 FEDERAL AGENCIES

The National Response Plan (NRP) describes the Federal response to any disaster or emergency situation in which there is a need for Federal assistance, under the authorities provided by the Robert T. Stafford Disaster Relief and Emergency Assistance Act, the Homeland Security Presidential Directive – 5 (HSPD-5) and other Federal laws and directives. The NRP applies to natural disasters such as earthquakes and hurricanes, or technological emergencies involving radiological or hazardous material releases. The purpose of the NRP is to facilitate Federal assistance to support State efforts to save lives, and protect public health, safety and property. The resources of the Federal agencies are grouped into Emergency Support Function (ESF) Annexes, according to the type of assistance available. The ESF Annexes serve as the primary mechanism through which Federal assistance is provided, based on State-identified needs and priorities.

The Nuclear/Radiological Incident Annex to the NRP is used by Federal agencies in responding to peacetime radiological emergencies, such as accidents at nuclear power plants or radioactive material transportation accidents. The Nuclear/Radiological Incident Annex specifies the authorities and responsibilities of each Federal agency that has a significant role in such emergencies, and outlines the Federal assistance, both technical and non-technical, provided to support State and local governments. Under the Nuclear/Radiological Incident Annex, the Federal Coordinating Agency with ownership or regulatory authority for the affected facility or released material will manage the federal response actions on-site. For a radiological accident at a commercial nuclear power plant, the NRC is the designated Federal Coordinating Agency.

For an event that is an actual or potential Incident of National Significance, the Department of Homeland Security (DHS) is responsible for overall coordination of operations. For Incidents of National Significance that are Presidentially declared disasters or emergencies, Federal support to States is delivered in accordance with relevant provisions of the Stafford Act. (Note that while all Presidentially declared disasters and emergencies under the Stafford Act are considered Incidents of National Significance, not all Incidents of National Significance necessarily result in disaster or emergency declarations under the Stafford Act.)

BRP depends upon the Federal technical resources available under the NRP primarily to support and supplement monitoring and assessment activities for 24-hour operations. Initial BRP requests for Federal technical assistance are coordinated through DOE-Brookhaven, prior to arrival of the Consequence Management Response Team (CMRT) and establishment of the FRMAC.

The BRP Radiological Assessment Director and the Radiological Assessment Manager are authorized to request Federal technical assistance, and to delegate that authority. Federal assistance is requested at General Emergency, or earlier at the discretion of the BRP Radiological Assessment Director or the Radiological Assessment Manager. **BRP DOES NOT REQUIRE APPROVAL FROM PEMA TO INITIATE REQUESTS FOR FEDERAL TECHNICAL ASSISTANCE, BUT WILL KEEP PEMA INFORMED OF THE STATUS OF ANY REQUESTS.**

Following is a summary of Federal agency responsibilities during radiological emergencies and a description of the resources available to assist BRP.

3.3.1 DEPARTMENT OF HOMELAND SECURITY (DHS)

3.3.1.1 Responsibilities

Under the NRP, DHS is responsible for overall coordination of a multi-agency Federal response to an Incident of National Significance. For an Incident of National Significance, DHS coordinates State requests for Federal assistance, identifying which Federal agency can best address specific needs. The Federal Emergency Management Agency (FEMA) is part of DHS. FEMA is the primary State agency to interface with DHS. Any BRP requests for non-technical assistance from DHS are coordinated through FEMA.

3.3.1.2 Resources

DHS establishes and operates the Joint Field Office (JFO). Additional information on establishment of the JFO is found in Section 2. DHS also serves on the Advisory Team for Environment, Food and Health.

3.3.2 NUCLEAR REGULATORY COMMISSION (NRC)

3.3.2.1 Responsibilities

As the Federal Coordinating Agency for incidents at nuclear power plants, NRC is responsible for coordinating the Federal technical response for the emergency. The NRC will monitor, assess and, if necessary, direct the licensee to take actions to protect the health and safety of the public. The principal role of the NRC is to assist BRP in interpretation and analysis of technical information as a basis for making protective action decisions. For incidents at a nuclear power plant that are of lesser severity than an Incident of National Significance, the NRC leads the Federal response.

THE NRC SHOULD DISCUSS ALL PROTECTIVE ACTION RECOMMENDATIONS WITH BRP BEFORE GIVING THEM TO THE GOVERNOR.

3.3.2.2 Resources

Emergency Response Data System (ERDS) - The Emergency Response Data System is a non-interactive data acquisition system linking NRC computers with the licensee computers at all nuclear power plants. Data is retransmitted from NRC to a remote terminal location at the BRP-AC or the BRP cell at the State EOC, allowing BRP staff to view certain reactor parameters such as temperatures, pressures, radiation levels and meteorology. Depending on the situation, a custom menu of specific parameters can be displayed for review or graphing. The data is used by BRP staff to assist in accident assessment. BRP access to the system is subject to the terms of a Memorandum of Understanding with NRC. During emergencies, ERDS is activated by the licensee at Alert or higher emergency classification. If requested, NRC also provides a liaison at the NRC Headquarters Operations Center to assist BRP in ERDS operation.

State Liaison Team - Based at the NRC Headquarters Operations Center, the State Liaison Team is composed of a Team Director, a Protective Measures State Liaison and a Reactor Safety State Liaison. The State Liaison Team is available to provide information on protective actions, dose projections or operational data for use in the decision-making process. This assistance is offered to BRP and State decision makers at NRC Initial Activation (Site Area or General Emergency). In addition, the NRC Region I Government Liaison establishes contact with BRP early in the emergency to offer assistance and provide a liaison at the State EOC.

3.3.3 DEPARTMENT OF ENERGY (DOE)

3.3.3.1 Responsibilities

DOE is responsible for coordinating offsite radiological monitoring and assessment activities during the initial phases of the emergency, as outlined in the NRP. DOE establishes and initially manages the FRMAC, which houses the technical resources provided by several different Federal agencies. DOE conducts environmental monitoring, and compiles and preserves the offsite radiological data from all participating agencies. A quality assurance program for measurements among all offsite monitoring parties is also conducted to ensure the validity of the monitoring data. The results of environmental monitoring are provided to the State and Federal Coordinating Agency, along with an appropriate interpretation of the data.

3.3.3.2 Resources

DOE resources include technical personnel and equipment to establish and support FRMAC operations. An organizational chart of the FRMAC is found in Figure 3.2. Additional information on establishment of the FRMAC is found in Section 2.3.2. Other special DOE resources are discussed below.

Radiological Assistance Program (RAP) Teams - The Radiological Assistance Program teams are small, first-response groups of trained and equipped radiation protection specialists deployed from DOE regional offices to perform off-site field monitoring and assessments. RAP teams also coordinate requests for other DOE assets, such as AMS and ARAC, prior to the establishment of the FRMAC. For Pennsylvania, RAP teams are deployed from Brookhaven National Laboratory in Upton, Long Island, New York.

Response times for monitoring teams to arrive at any of the 4 reactors in eastern Pennsylvania is estimated to be 6 hours via helicopter and 9 hours by truck. For the Beaver Valley Power Station near Pittsburgh, response times are 8 hours by air and 14 hours by truck.

Consequence Management Response Team (CMRT) – The Consequence Management Response Team (CMRT) provides for rapid initial response capability. The CMRT is deployed in two phases, Phase I and Phase II. Phase I is a small initial team (about 16 members) with expertise in radiation monitoring, sampling, analysis, assessment, health and safety, and support and logistics functions. The CMRT Phase I members meet with state and local emergency responders to identify the status and magnitude of the incident, determine FRMAC site-selection and logistic requirements, and initiate DOE radiological monitoring and assessment activities. This initial meeting provides the basis to establish the arrival of the Phase II team, which augments DOE capabilities. The CMRT functions as an advance element of the FRMAC to establish contact with on-scene responders to coordinate Federal radiological monitoring and assessment activities. Prior to the establishment of the FRMAC, Federal first responders coordinate radiological monitoring and assessment data with the CMRT. The CMRT is deployed from the National Nuclear Security Administration Nevada Site Office.

Response time for the CMRT Phase I to arrive by air at a site in Pennsylvania is about 12 hours.

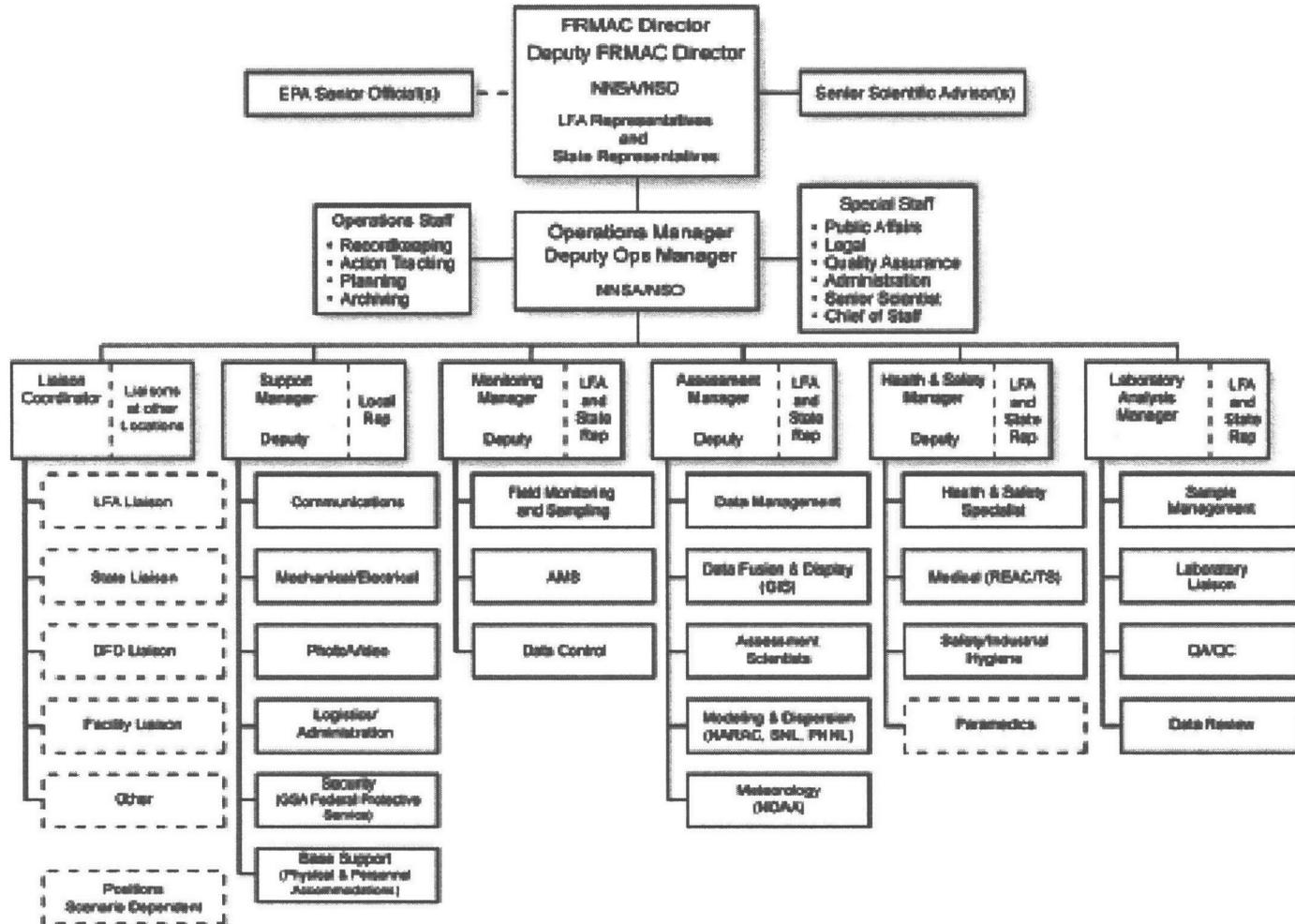
Aerial Measuring System (AMS) - The Aerial Measuring System is used to track and map radioactive plumes and perform airborne air sampling. AMS also provides an overflight capability of the affected area to determine ground concentrations of radioisotopes. Both fixed-wing aircraft and helicopters are used for these tasks.

Several aerial surveys are conducted. The order and priority of the surveys is determined by whether atmospheric releases are ongoing or terminated. The first survey is performed by fixed-wing aircraft in a serpentine pattern to quickly cover the deposition area. Initial survey results identify the boundaries of measurable contamination, and the major isotopes and levels of contamination.

Maps are produced for decision-makers showing the deposition footprint and designating contours of exposure rate and isotope concentrations. Also, maps are produced displaying projected dose contours. Additional surveys are used to refine the maps.

Deployment of AMS will be coordinated through DOE-Brookhaven, prior to arrival of the Consequence Management Response Team and establishment of the FRMAC. The AMS is deployed from Andrews Air Force Base in Washington, D.C., and Nellis Air Force Base in Las Vegas, Nevada. Deployment times are approximately 4 hours from Washington, D.C. and 12 hours from Las Vegas.

Figure 3.2



National Atmospheric Release Advisory Capability (NARAC) - The National Atmospheric Release Advisory Capability at Lawrence Livermore National Laboratory is a real-time computer model used to project offsite doses resulting from a release of radiation to the environment. NARAC's products include contour plots of air concentration, airborne dose, ground deposition or ground exposure dose overlaid on a map of the accident area. Predictions are based on available source term information, or normalized X/Q calculations if source term information is initially unknown.

After initial products are generated, NARAC predictions are updated hourly or more often to account for changing accident or meteorological conditions. NARAC predictions are also updated, as needed, based on actual ground deposition measurements made by field monitoring teams.

NARAC products can be used for assessing downwind areas receiving significant dose and deposition, and to aid in deploying field teams and developing AMS survey plans. NARAC products are also used to compare with BRP and licensee dose projections. NARAC services are coordinated through DOE-Brookhaven, prior to arrival of the Consequence Management Response Team and establishment of the FRMAC.

Initial NARAC products can be available within 1-2 hours of notification of a radioactive release. NARAC products are transmitted via fax or established computer-to-computer links to DOE at the incident site and/or to other locations, as requested by BRP.

Geographic Information System (GIS) - The Geographic Information System is a computer-based mapping system developed for each commercial nuclear power plant. The GIS contains information on areas within the 50-mile EPZ such as population density, major roads and evacuation routes, land use, political boundaries, etc. The GIS is used in conjunction with a Global Positioning System (GPS) which integrates actual measurements from field sampling teams to latitude/longitude coordinates and enters them into the GIS. GIS data are organized to generate maps displaying selected information or to produce standardized maps for response personnel.

Radiation Emergency Assistance Center/Training Site (REAC/TS) - The Radiation Emergency Assistance Center/Training Site provides medical health physicists and radiation medicine specialists for advice and assistance on the treatment of all types of radiation exposure incidents. REAC/TS is based at Oak Ridge National Laboratory.

3.3.4 ENVIRONMENTAL PROTECTION AGENCY (EPA)

3.3.4.1 Responsibilities

The EPA responsibilities are to provide staff and material resources to support FRMAC operations during the initial response. EPA will assume the long-term management of the FRMAC from DOE at a mutually agreed on time. EPA assists in development of long-term exposure and relocation options for the public and a long-term environmental monitoring program.

3.3.4.2 Resources

EPA resources include field team personnel and sample analysis capability, through mobile and fixed laboratory facilities. EPA provides interpretation and guidance through the Advisory Team for Environment, Food and Health on their PAGs.

3.3.5 U.S. DEPARTMENT OF AGRICULTURE (USDA)

3.3.5.1 Responsibilities

USDA is responsible for food safety and inspection of meat, poultry and egg products.

3.3.5.2 Resources

USDA provides interpretation and guidance through the Advisory Team for Environment, Food and Health on their PAGs and will assist the State in developing a recovery plan and PARs for the ingestion exposure pathway. USDA also provides supplementary personnel to assist in sample collection.

3.3.6 DEPARTMENT OF HEALTH AND HUMAN SERVICES (HHS)

3.3.6.1 Responsibilities

HHS is responsible for food safety and drug regulation through the Food and Drug Administration (FDA), and disease control and prevention through the Centers for Disease Control and Prevention (CDC).

3.3.6.2 Resources

HHS provides interpretation and guidance through the Advisory Team for Environment, Food and Health on their PAGs and will assist the State in developing a recovery plan and PARs for the ingestion exposure pathway.

3.3.7 INTERAGENCY GROUPS

Advisory Team for Environment, Food and Health (Advisory Team) – The Advisory Team for Environment, Food and Health is composed of representatives from DHS, EPA, USDA, and HHS. The Advisory Team provides interpretation and guidance, and develops coordinated advice and recommendations for Federal, State, and local officials concerning Protective Action Guides (PAGs), environmental, food health, and animal health matters. The Advisory Team also assists the State in developing Protective Action Recommendations (PARs) using data and assessment from the FRMAC. The Advisory Team will be located with the FRMAC.

Interagency Modeling and Atmospheric Assessment Center (IMAAC) – The Interagency Modeling and Atmospheric Assessment Center is responsible for production, coordination, and dissemination of consequence predictions for an airborne radiological

release. The IMAAC generates the single Federal prediction of atmospheric dispersions and their consequences utilizing the best available resources from the Federal Government.

3.4 OTHER AGENCIES

3.4.1 COUNTY AGENCIES

BRP does not interface directly with County agencies. Information and/or PARs are disseminated to the Counties by PEMA.

3.4.2 NEIGHBORING STATES

BRP does not rely on neighboring states for support. BRP establishes contact with neighboring states radiation protection programs within the 10-mile and 50-mile Emergency Planning Zones (EPZs) for exchange of information and coordination of protective actions. The appropriate neighboring states are found in the site-specific description for each nuclear power plant.

Written agreements for neighboring states within the 10-mile EPZ for each nuclear power plant are found in the site-specific descriptions.

4.0 EMERGENCY ORGANIZATION

This section describes the organization of the BRP in managing the initial response to incidents at nuclear power plants, and summarizes the responsibilities of BRP emergency positions. Response is discussed in two phases, Initial Activation and Full Federal Activation.

The BRP organization for long-term management of recovery activities is discussed in Section 7.

4.1 INITIAL ACTIVATION

4.1.1 ORGANIZATION

Initial Activation applies at Alert or higher emergency classification. During Initial Activation, BRP staff are organized to coordinate all radiological assessment activities and protective action decision-making from the State EOC.

At Initial Activation, BRP staff are positioned according to the emergency organizational chart shown in Figure 4.1. BRP staff report to the State EOC, the licensee TSC and EOF, and the DEP Radiation Measurements Laboratory. Field monitoring teams are mobilized at the appropriate regional office and are dispatched, as required.

Three key supervisory positions are required:

1. Radiological Assessment Director
2. Technical Assessment Manager
3. Radiological Assessment Manager

The Radiological Assessment Director is responsible for directing all Bureau response activities. The Technical Assessment Manager directs all BRP activities at the licensee's TSC and EOF. The Radiological Assessment Manager directs all BRP activities at the State EOC. A listing of the primary designated individuals to fill each BRP emergency position is found in Figure 4.2. A brief functional description of each BRP emergency position is found in Section 4.1.2.

If BRP cannot fill all of the emergency positions, they will be filled in order of priority listed in Figure 4.2. Also, some individuals may fill combined positions if the situation demands. If required, administrative and technical assistance to supplement BRP staff will be secured through DEP management.

AT THE DISCRETION OF THE RADILOGICAL ASSESSMENT DIRECTOR, THE BRP EMERGENCY ORGANIZATION MAY BE MODIFIED.

FIGURE 4.1
 BRP EMERGENCY ORGANIZATION
 (Initial Activation)

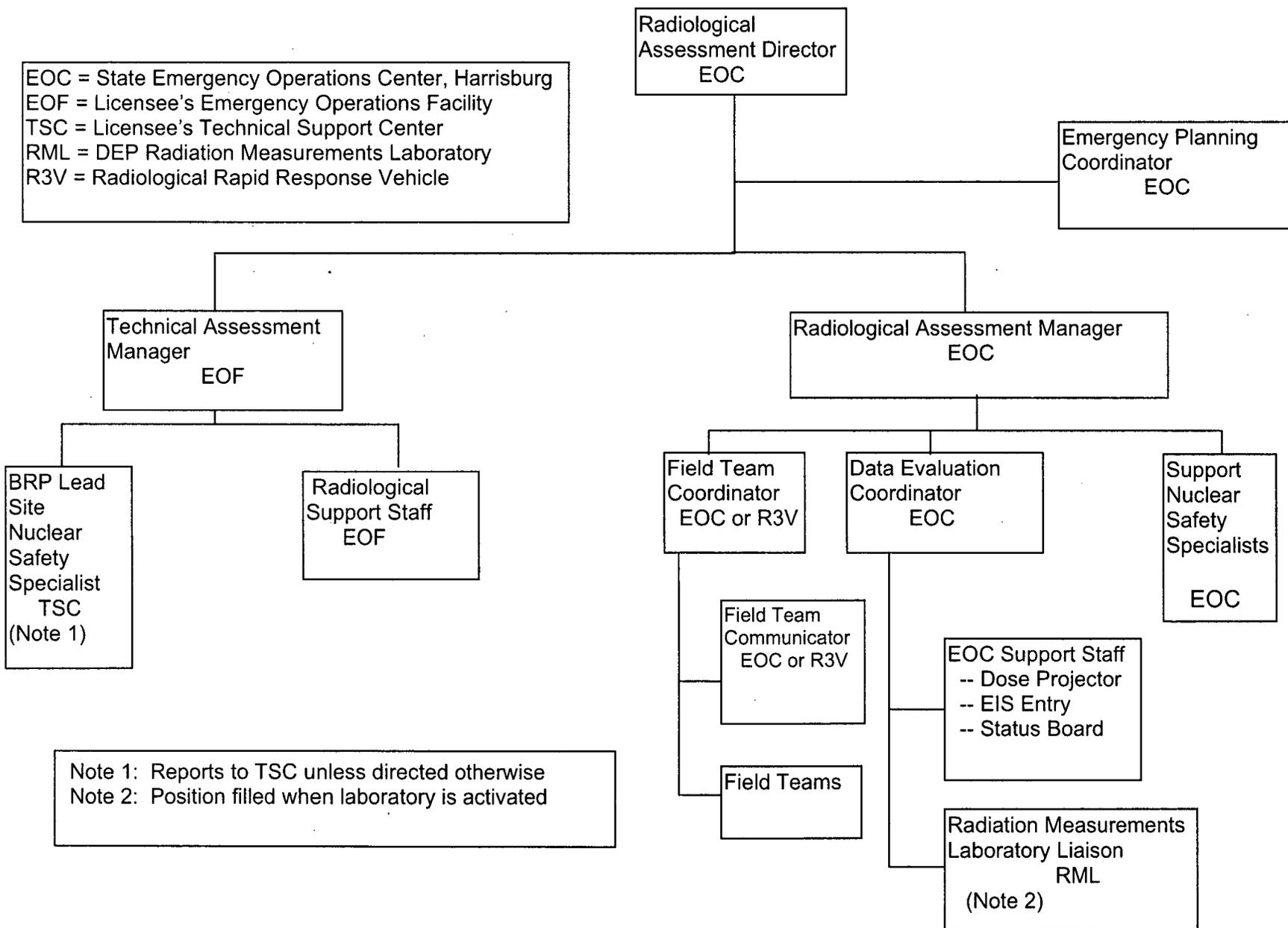


FIGURE 4.2

Primary Personnel Assignments for Initial Activation

Radiological Assessment Director-----	Bureau Director
Technical Assessment Manager -----	Chief, Nuclear Safety Division
Radiological Assessment Manager -----	BRP- CO RPPS or RPPM
Emergency Planning Coordinator -----	Chief, Emergency Response Section
Lead Site Nuclear Safety Specialist-----	Assigned Nuclear Safety Specialist
EOC Support Nuclear Safety Specialists -----	Nuclear Safety Specialists
EOF Radiological Support Staff (2) -----	Regional Health Physicist BRP-CO Health Physicist
Field Team Coordinator -----	Regional Health Physicist BRP-CO Health Physicist
Data Evaluation Coordinator -----	BRP-CO Health Physicist
Field Team Communicator-----	Regional Health Physicist BRP-CO Health Physicist
EOC Support Staff -----	BRP-CO Health Physicists BRP-CO Clerical Staff
Field Monitoring Teams -----	Regional Health Physicists BRP-CO Health Physicists
Radiation Measurements Laboratory Liaison -----	Health Physicist, Environmental Surveillance Section

All other support positions will be filled from remaining BRP technical staff.

If BRP cannot fill all of the emergency positions, they will be filled in order of priority listed in Figure 4.1. Also, some individuals may fill combined positions if the situation demands. If required, administrative and technical assistance to supplement BRP staff will be secured through DEP management.

4.1.2 FUNCTIONAL DESCRIPTIONS

Following are brief functional descriptions of key BRP positions during Initial Activation. The most probable location for these positions is shown in parentheses.

Radiological Assessment Director (EOC)

Directs all BRP response activities. Consults with Technical Assessment Manager and Radiological Assessment Manager on the need for PARs. Makes PARs to the Governor, or his designee, in conjunction with PEMA. Acts as primary spokesperson for BRP response activities. In the absence of the Radiological Assessment Director, the Radiological Assessment Manager will perform the duties of the Radiological Assessment Director. At Full Federal Activation, moves to the JFO.

Technical Assessment Manager (EOF)

Directs all BRP activities at the licensee's TSC and EOF. Provides independent assessment of plant status. Coordinates transmittal of plant status and current radiological data from TSC and EOF to the State EOC. Consults with Radiological Assessment Director and Radiological Assessment Manager on the need for PARs. Acts as BRP liaison with NRC and licensee representatives at the EOF. In the absence of the Technical Assessment Manager, the senior BRP representative at the EOF will perform the duties of the Technical Assessment Manager.

Radiological Assessment Manager (EOC)

Directs all BRP activities at the State EOC. Advises Radiological Assessment Director on PAGs. Evaluates all radiological data and dose projections, and assists in formulation of PARs. Upon arrival of the DOE Consequence Management Response Team, coordinates with DOE officials on establishing State monitoring and analysis needs and priorities. In the absence of the Radiological Assessment Manager, the Data Evaluation Coordinator will perform the duties of the Radiological Assessment Manager. At Full Federal Activation, moves to the FRMAC as lead State representative.

Emergency Planning Coordinator (EOC)

Ensures compliance with BRP Emergency Plan. Advises and assists BRP staff on procedures, methodologies and concepts of operation. Assists the Radiological Assessment Director and Radiological Assessment Manager as necessary. Ensures adequate communications, and administrative and logistical support. Ensures documentation of all BRP response activities and archives all records. Upon arrival of the DOE Consequence Management Response Team, assists Radiological Assessment Manager in coordinating with DOE officials and establishment of State needs and priorities. At Full Federal Activation, moves to the FRMAC, and represents BRP on the Advisory Team on Environment, Food and Health.

Lead Site Nuclear Safety Specialist (TSC)

Maintains detailed familiarity with specific assigned plant. Communicates with Technical Assessment Manager at the EOF on plant status and mitigation actions underway or planned.

Support Nuclear Safety Specialist (1) (EOC)

Receives plant status information from EOF. Ensures accurate technical data flow between EOF and EOC. Provides nuclear safety support to Radiological Assessment Director and Radiological Assessment Manager at the EOC. Operates Emergency Response Data System (ERDS) and provides nuclear safety support by researching FSARs, etc.

EOF Radiological Support Staff (EOF)

Reports to the licensee EOF upon its activation. Performs duties as assigned by the Technical Assessment Manager. Coordinates exchange of radiological data and information between licensee and BRP. Communicates radiological data updates to the BRP Staff at the State EOC. At Full Federal Activation, moves to the FRMAC and represents BRP in the Assessment Group.

Field Team Coordinator (EOC or R3V)

Mobilizes field teams and provides briefing prior to deployment. Directs BRP field monitoring teams. Reports field team data to the Radiological Assessment Manager and EOF. Tracks field team exposures and advises team members on radiation safety issues. Performs additional duties as assigned by the Radiological Assessment Manager.

Data Evaluation Coordinator (EOC)

Maintains a record of all radiological data received from the Field Team Coordinator, EOF Radiological Support Staff, and Radiation Measurements Lab Liaison. Directs BRP dose projection activities. Reports dose projections to the Radiological Assessment Manager and EOF. Notifies the Radiological Assessment Manager immediately of any data or projections in excess of PAGs. Directs support staff at the EOC and provides input on BRP activities to the EOC Emergency Information System (EIS). In the absence of the Radiological Assessment Manager, the Data Evaluation Coordinator will perform the duties of the Radiological Assessment Manager. Performs additional duties as assigned by the Radiological Assessment Manager.

Field Team Communicator (2) (EOC or R3V)

Communicates with BRP field monitoring teams via telephones (satellite or cell phones) or 800 Mhz radio (when available). Records field team data and dosimeter readings. Performs duties as assigned by the Field Team Coordinator.

EOC Support Staff (EOC)

Perform dose projections, PIERS data entry, and status board record keeping, as directed by the Data Evaluation Coordinator.

Field Monitoring Teams

Perform ambient beta/gamma radiation measurements. Collect air samples and perform field analysis for radioiodine and particulates, as directed by the Field Team Coordinator. Label and retain samples for laboratory analysis. At Full Federal Activation, provide health physics support, as assigned by the Radiological Assessment Manager.

Radiation Measurements Laboratory Liaison (RML)

Receives all data from environmental samples analyzed by the DEP Radiation Measurements Laboratory. Reports data to the Data Evaluation Coordinator at the EOC. Advises RML on analysis priorities and detection limits, as determined by the Radiological Assessment Manager. Assists RML with contamination control procedures. Performs duties as assigned by the Data Evaluation Coordinator.

4.2 FULL FEDERAL ACTIVATION

4.2.1 ORGANIZATION

Federal Activation applies after establishment of the Federal Radiological Monitoring and Assessment Center (FRMAC) and the Joint Field Office (JFO). During Full Federal Activation, BRP staff are organized to coordinate all State radiological assessment and field sampling activities from the FRMAC. All protective action decision-making is coordinated from the JFO.

At Full Federal Activation, BRP staff are positioned according to the emergency organizational chart shown in Figure 4.3. The Radiological Assessment Manager and support staff move to the FRMAC and integrate into specific functional areas. The Radiological Assessment Director and support staff move to the JFO. The Technical Assessment Manager remains at the EOF to interface with NRC and licensee representatives. A listing of the primary designated individuals to fill each BRP emergency position is found in Figure 4.4. A brief functional description of each BRP emergency position is found in Section 4.2.2.

FIGURE 4.3

BRP EMERGENCY ORGANIZATION
(Full Federal Activation)

JFO - Joint Field Office

EOF - Licensee's Emergency Operations Facility

TSC - Licensee's Technical Support Center

RML - DEP Radiation Measurements Laboratory, Harrisburg

FRMAC - Federal Radiological Monitoring and Assessment Center

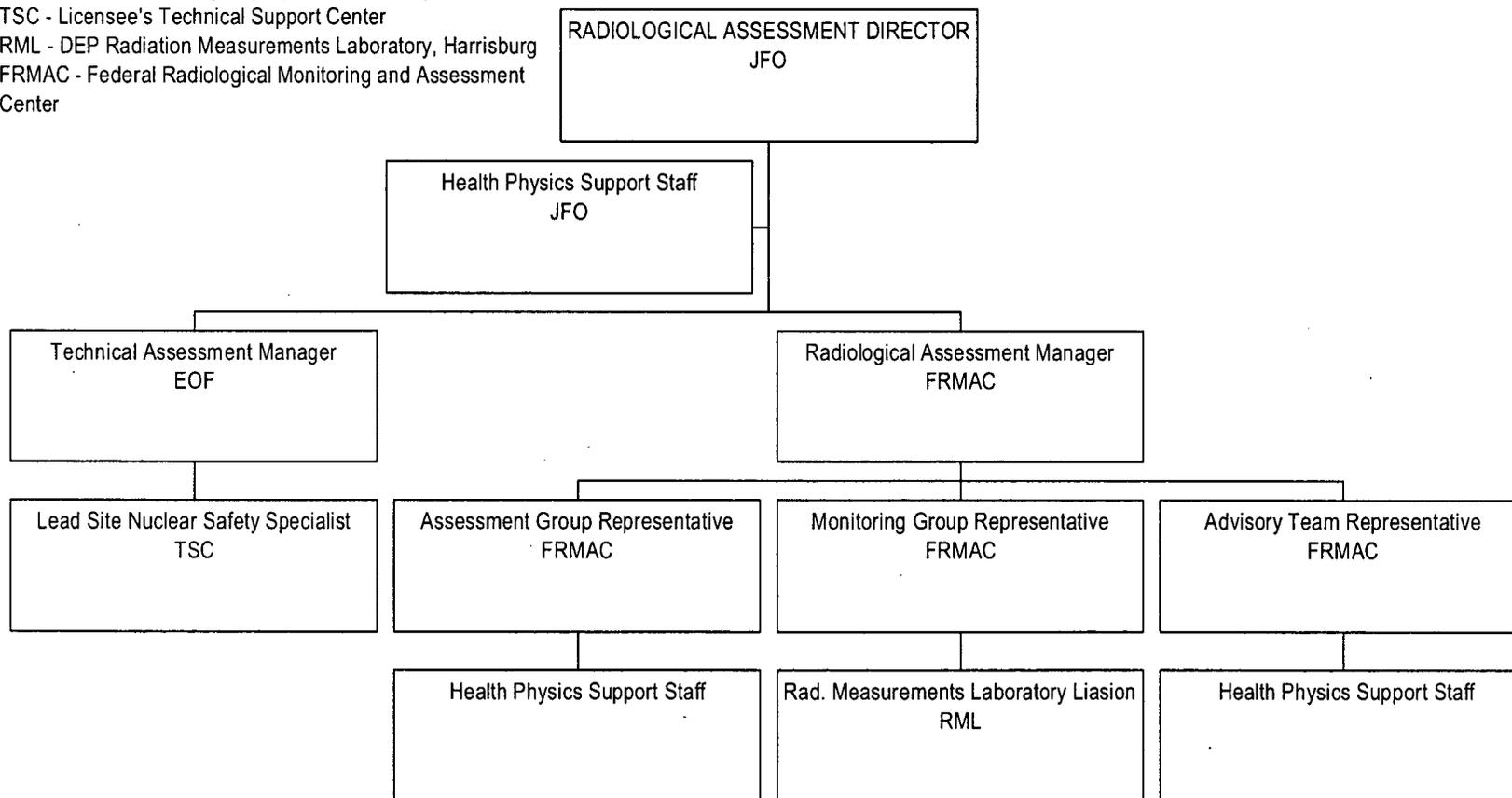


FIGURE 4.4

Primary Personnel Assignments for Full Federal Activation

Radiological Assessment Director -----Bureau Director
Technical Assessment Manager -----Chief, Nuclear Safety Division
Radiological Assessment Manager-----BRP-CO RPPS or RPPM
Lead Site Nuclear Safety Specialist -----Assigned Nuclear Safety Specialist
Advisory Team Representative -----Chief, Emergency Response Section
Monitoring Group Representative -----Regional Health Physicist
Assessment Group Representative -----Regional or BRP-CO Health Physicist
(EOF Radiological Support)

Radiation Measurements Laboratory -----Chief, Environmental
Liaison Surveillance Section

All other support positions will be filled from remaining BRP technical staff.

If BRP cannot fill all of the emergency positions, they will be filled in order of priority listed in Figure 4.3. Also, some individuals may fill combined positions if the situation demands. If required, administrative and technical assistance to supplement BRP staff will be secured through DEP management.

4.2.2 FUNCTIONAL DESCRIPTIONS

Following are brief functional descriptions of key BRP positions during Full Federal Activation. The most probable location of the position is shown in parentheses.

Radiological Assessment Director (JFO)

Directs all BRP response activities. Consults with Technical Assessment Manager and Radiological Assessment Manager on appropriate PARs. Consolidates technical input into State protective action decisions. Provides interface between State decision-makers, NRC Director of Site Operations and JFO staff. Participates, as required, on State Recovery Task Force. Acts as primary spokesperson for BRP response activities.

Technical Assessment Manager (EOF)

Directs all BRP activities at the licensee's TSC and EOF. Provides independent assessment of plant status. Coordinates transmittal of plant status and current radiological data from TSC and EOF to the State EOC. Consults with Radiological Assessment Director and Radiological Assessment Manager on the need for PARs. Acts as BRP liaison with NRC and licensee representatives at the EOF.

Lead Site Nuclear Safety Specialist (TSC)

Maintains detailed familiarity with specific assigned plant. Assists Technical Assessment Manager with technical assessment and liaison responsibilities.

Radiological Assessment Manager (FRMAC)

Acts as lead State representative at the FRMAC. Establishes State radiological monitoring and assessment needs and priorities for the FRMAC. Interfaces with FRMAC Director and NRC Protective Measures Coordinator. Evaluates all radiological data and assessments. Advises Radiological Assessment Director on appropriate PARs and status of FRMAC activities. Directs BRP staff at the FRMAC.

Advisory Team Representative (FRMAC)

Assists Radiological Assessment Manager with assessment and liaison responsibilities. Interfaces with Advisory Team on Environment, Food and Health in developing protective action positions. Interfaces with FRMAC Liaison Coordinator and Support Manager to track the status of State requests and respond to FRMAC requests for information/assistance from the State. Performs duties as assigned by the Radiological Assessment Manager.

Monitoring Group Representative (FRMAC)

Acts as BRP representative in the FRMAC Monitoring Group. Responsible for integrating all State field sampling and analysis activities into FRMAC operations. Receives BRP environmental sample and TLD results from RML Liaison for input into FRMAC database. Coordinates with FRMAC Monitoring Manager and Assessment Manager on development of both near-term and long-term environmental monitoring plans, as directed by the Radiological Assessment Manager. Performs duties as assigned by the Radiological Assessment Manager.

Assessment Group Representative (FRMAC)

Acts as BRP representative in the FRMAC Assessment Group. Responsible for review of Assessment Group work products, including environmental data reports, dose assessment reports, mapping of deposition pattern, etc. Provides State generated data and dose projections for input to FRMAC database. Coordinates data formatting and summary reports needed by State decision-makers. Performs duties as assigned by the Radiological Assessment Manager.

Radiation Measurements Laboratory Liaison (RML)

Receives data from all environmental samples analyzed by the DEP Radiation Measurements Laboratory and TLDs analyzed by the BRP Environmental Surveillance Section. Reports data to the BRP Monitoring Group Representative at the FRMAC. Advises Radiation Measurements Laboratory on contamination control procedures. Performs duties as assigned by the BRP Monitoring and Analysis Coordinator.

5.0 NOTIFICATION AND COMMUNICATIONS

Notification and mobilization of appropriate BRP personnel is based on the emergency classification. This section describes the initial notification and activation process (Initial Activation is at Alert or higher classification). Also included is a summary of the BRP communications network, designed to ensure timely and efficient information flow between BRP and other response organizations

5.1 NOTIFICATIONS AND ACTIVATIONS

Initial notification of any emergency situation is made from the licensee to PEMA to BRP. The agencies to be notified directly by the licensee include:

- Risk County Emergency Management Agency (s)
- PEMA

For any emergency classification event (Unusual event or higher), the notification is made within 15 minutes of recognition of the emergency condition.

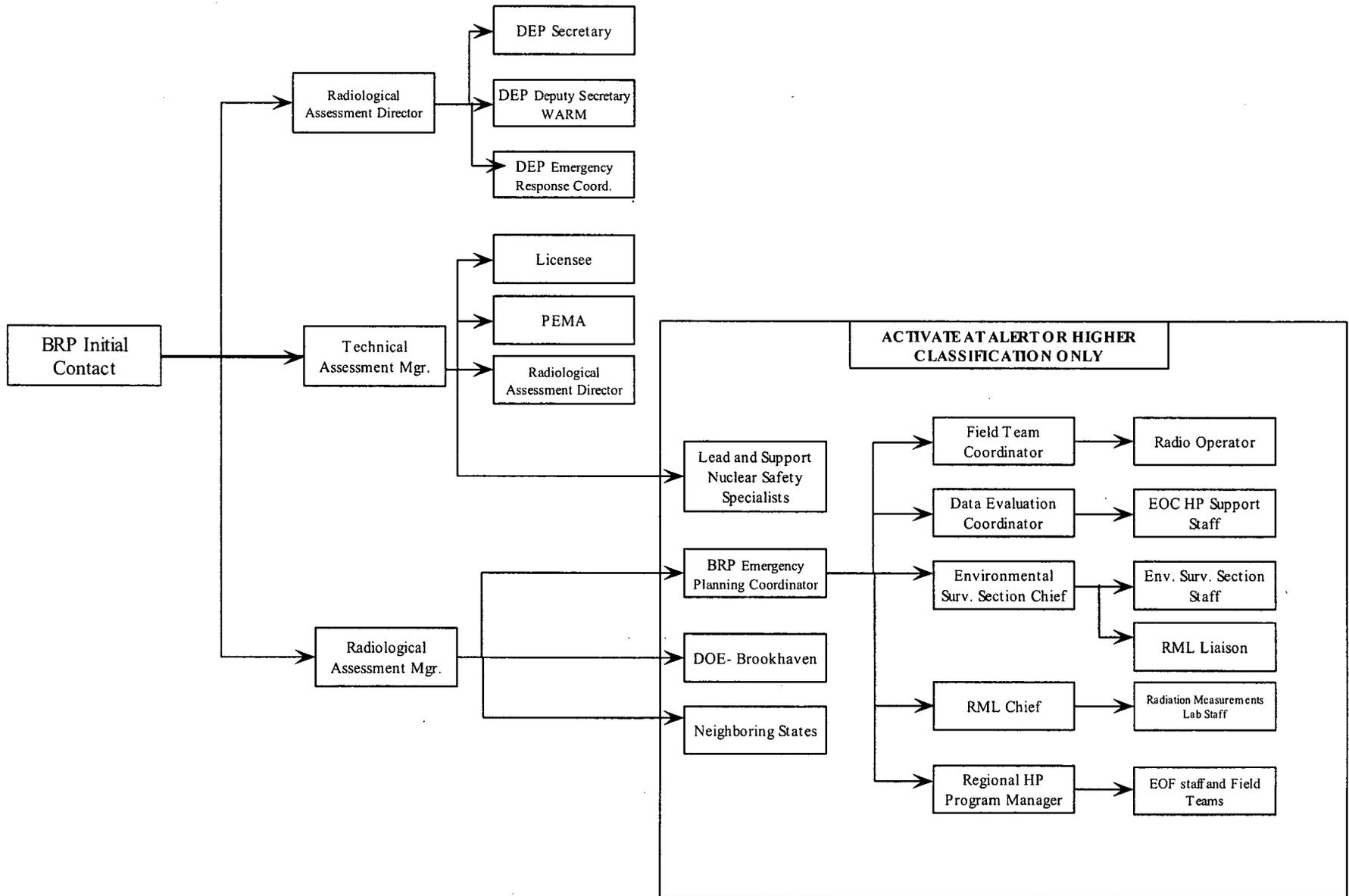
Upon notification from PEMA, BRP will contact the licensee for preliminary assessment and protective action recommendations. The purpose of this first contact between BRP and the licensee is to verify that an emergency situation exists and to determine the need for immediate protective actions to protect the public within the first few hours. The loop is closed when BRP recontacts PEMA with appropriate information and/or protective action recommendations.

PEMA maintains a roster of BRP staff designated as Emergency Preparedness Liaison Officers (EPLOs) who will be the initial contacts. Upon notification from PEMA, the initial BRP contact begins a callout cascade, with each individual in sequence having specific notification responsibilities. The notification and callout is performed in accordance with BRP-ER-5.01, "Initial Notification and Activation" procedure.

The BRP callout cascade is completed as shown in Figure 5.1. Notifications at Initial Activation include the Department of Energy at Brookhaven National Laboratory. DOE - Brookhaven is the BRP contact point for Federal technical assistance. At Initial Activation, BRP will also establish contact with neighboring states' radiation protection programs within the plume and ingestion EPZs. The appropriate neighboring states are found in the site-specific description for each nuclear plant.

Notification procedures for Initial Notifications and Activation, and Change in Emergency Classification are found in the BRP Implementing Procedures.

FIGURE 5.1
BRP Initial Notification and Activation Cascade



5.1 NOTIFICATION OF CHANGE IN EMERGENCY CLASSIFICATION

Changes in emergency classification, either escalation or de-escalation, originate with the licensee.

Specific notification procedures for a change in emergency classification are found in BRP Implementing Procedure BRP-ER-5.02, "Notification Procedure for Change in Classification".

5.2 COMMUNICATIONS

Emergency communications systems are designed to ensure the reliable and timely flow of information. Reliability is provided through redundancy, alternate communications methods and dedicated communications equipment.

The BRP emergency communications equipment consists of commercial telephone, dedicated telephone, radio and fax. Figure 5.2 shows the communications links between BRP and other agencies during radiological emergencies.

5.2.1 COMMERCIAL TELEPHONE

BRP is linked by commercial telephone to various agencies as listed below:

- Licensee (via dedicated lines)
- PEMA
- DEP
- Other State Agencies
- DOE - Brookhaven
- NRC and other Federal Agencies
- Neighboring States

5.2.2 DEDICATED TELEPHONE

BRP is linked to each nuclear power plant by dedicated telephone lines located in the BRP-EOC and BRP-AC. Directions for use of the dedicated telephone systems are found in the BRP Emergency Telephone Directory.

5.2.3 RADIO – 800 Mhz (when available)

BRP uses the 800 Mhz radio network (when available) during radiological emergencies for mobile communications and as a backup for satellite and cellphone communications. Base stations are located in the BRP-EOC, BRP-AC, DEP Headquarters, and the six DEP Regional Offices. The 800 Mhz radio system provides state-wide coverage.

BRP Field Monitoring Vehicles (Dedicated Field Team Response Vehicles and Radiological Rapid Response Vehicle (R3V)) are equipped with 800 Mhz radios.

Vehicles in the DEP Emergency Response Program are also equipped with 800 Mhz radios.

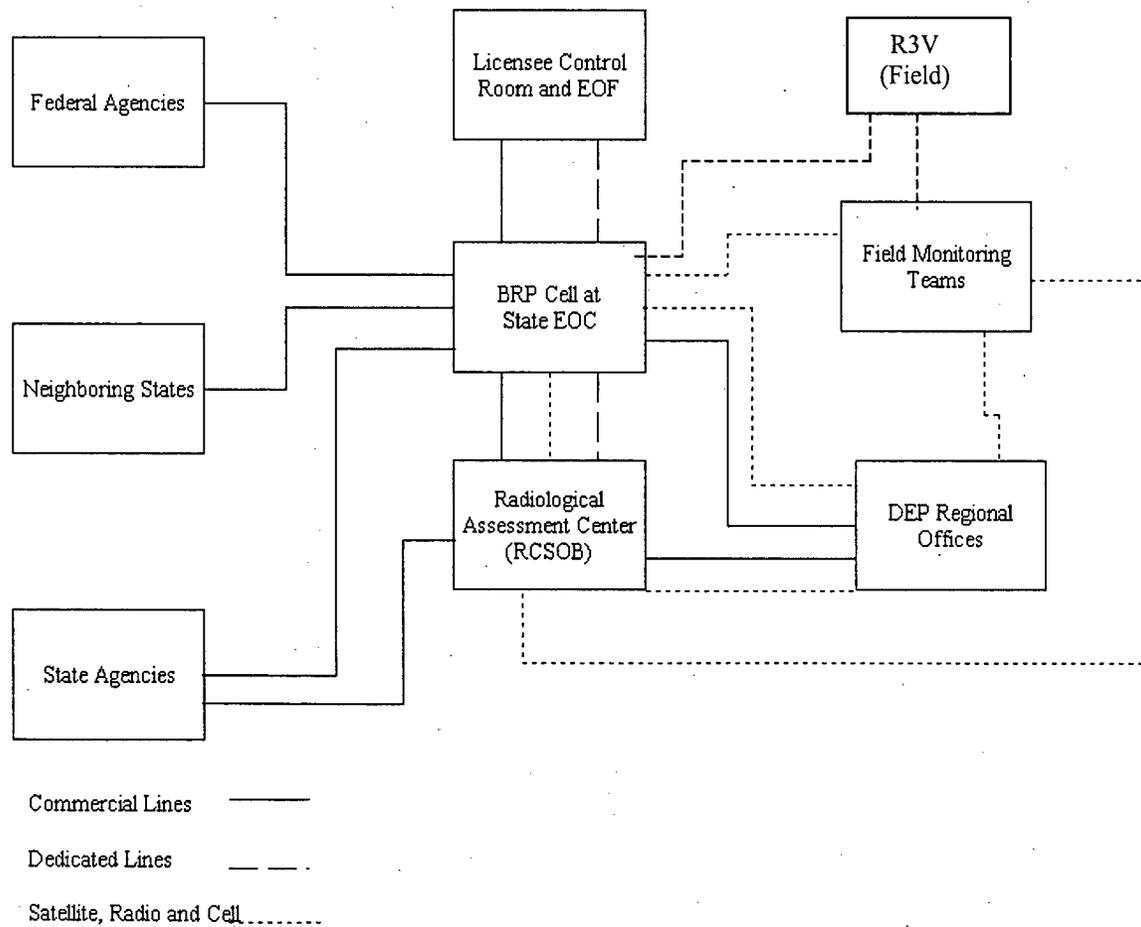
5.2.4 SATELLITE AND/OR CELLULAR PHONES

BRP uses satellite phones as the normal primary means for communicating with the BRP Field Teams. Cellular phones are the normal backup means. Communication methods may be modified as necessary.

5.2.5 FAX

BRP has a fax machine at the BRP-EOC and BRP-AC. BRP staff also have access to a fax machine at each licensee's EOF.

FIGURE 5.2
EMERGENCY COMMUNICATIONS NETWORK



INITIAL NOTIFICATION AND ACTIVATION PROCEDURE FOR BRP PERSONNEL

PURPOSE:

This procedure describes the Initial Notification and Activation of BRP personnel.
(BRP PERSONNEL ARE ACTIVATED AT ALERT OR HIGHER CLASSIFICATION).

AT THE DISCRETION OF THE RADIOLOGICAL ASSESSMENT DIRECTOR, THE BRP EMERGENCY ORGANIZATION MAY BE MODIFIED AS APPROPRIATE.

REFERENCES:

1. A list of BRP Emergency Positions Assignments is found in Attachment 2.
2. Telephone numbers for notification are found in the BRP Emergency Plan (Section 5A).

NOTIFICATIONS:

INITIAL NOTIFICATION OF ANY EMERGENCY SITUATION IS FROM THE LICENSEE TO PEMA TO BRP.

1. Upon notification from PEMA, the BRP Initial Contact will:
 - 1.1 Obtain the information shown on Attachment 1.
 - 1.2 Notify the Technical Assessment Manager (or Lead Site Nuclear Safety Specialist) and provide the information from Attachment 1.
 - 1.3 Notify the Radiological Assessment Director and provide the information from Attachment 1.
 - 1.4 Notify the Radiological Assessment Manager and provide the information from Attachment 1.
 - 1.5 If event is Alert or higher classification assume assigned emergency position and perform any additional required notifications.

2. Upon notification from the BRP Initial Contact, the Radiological Assessment Director will:
 - 2.1 Notify the following individuals of the situation and provide a summary of the situation:
 - ___ DEP Secretary
 - ___ DEP Deputy Secretary for Waste, Air, and Radiation Management
 - ___ DEP Emergency Response Director
 - 2.2 Call the Technical Assessment Manager and/or the Radiological Assessment Manager for consultation, if required.
 - 2.2 If event is Alert or higher classification report to the EOC.
3. Upon notification from the BRP Initial Contact, the Technical Assessment Manager will:
 - 3.1 Contact the licensee to verify the incident and obtain information for technical assessment and potential for escalation.
 - 3.2 Re-contact PEMA and provide a summary of the situation:
 - 3.3 Contact the Radiological Assessment Director and provide summary of data from licensee.
 - 3.4 If event is Alert or higher classification:
 - Contact Lead Site Nuclear Safety Specialist and additional Nuclear Safety Specialists Support Staff.
 - Remain in contact with the licensee until BRP staff at the EOC have established communications with the licensee.
 - Report to the EOF.
 - 3.5 If event is an Unusual Event classification:
 - Remain in contact with the licensee, as necessary, until termination or escalation of the event.
4. If event is Alert or Higher Notification the Radiological Assessment Manager will:
 - 4.1 Notify the following individuals and provide a summary of the situation:
 - ___ BRP Emergency Planning Coordinator
 - ___ DOE - Brookhaven
 - ___ Neighboring States Radiation Protection Programs

- 4.2 Report to the EOC.
5. Upon notification from the Radiological Assessment Manager, the BRP Emergency Planning Coordinator will:
- 5.1 Notify the following individuals and provide a summary of the situation:
- ___ Field Team Coordinator
 - ___ Data Evaluation Coordinator
 - ___ Environmental Surveillance Section Chief
 - ___ Radiation Measurements Laboratory Chief
 - ___ Appropriate Regional HP Program Manager(s) for EOF Radiological Support Staff and Field Team Deployment
- 5.2 Report to the EOC.
6. Upon notification from the Emergency Planning Coordinator, the Appropriate Regional HP Manager(s) will:
- 6.1 Notify the Regional Field Teams and provide a summary of the situation:
- 6.2 Coordinate the deployment of field teams.
- 6.3 Provide support staff to the EOF that will report to the Technical Assessment Manager.
- Note: At the discretion of the Incident Manager a CO Health Physicist may also be dispatched to the EOF.
7. Upon notification from the Emergency Planning Coordinator, the Field Team Coordinator will:
- 7.1 Notify the following individuals and provide a summary of the situation:
- ___ Field Team Communicators
- 7.2 Report to the EOC or R3V, as directed.

8. Upon notification from the Emergency Planning Coordinator, the Data Evaluation Coordinator will:
 - 8.1 Notify the following individuals and provide a summary of the situation:
____ EOC HP Support Staff
 - 8.2 Report to the EOC.
9. Upon notification from the Emergency Planning Coordinator, the Environmental Surveillance Section Chief or designee will:
 - 9.1 Notify the following individuals and provide a summary of the situation:
____ Environmental Surveillance Section Staff
____ Radiation Measurements Laboratory Liaison
 - 9.2 Report to the EOC.
10. Upon notification from the Emergency Planning Coordinator, the Radiation Measurements Lab Chief or designee will:
 - 10.1 Notify the following individuals and provide a summary of the situation:
____ Radiation Measurements Lab Staff
 - 10.2 Report to the Radiation Measurements Lab.

ESCALATION OR TERMINATION:

1. Upon a change in classification by the licensee, go to BRP-ER-5.02 Notification Procedure Change In Classification
2. Upon TERMINATION by the licensee, the Technical Assessment Manager will notify the following individuals and close out the event:
 - ___ Radiological Assessment Director
 - ___ Radiological Assessment Manager
3. Upon TERMINATION by the licensee, the Radiological Assessment Director will notify the following individuals and close out the event:
 - ___ DEP Secretary
 - ___ DEP Deputy Secretary for Waste, Air and Radiation Management
 - ___ DEP Emergency Response Director
3. Give records of the event to the Emergency Response Section Chief.

HP Regional Program Managers: John Maher
SC Region

Terry Derstine
SE Region

Jim Yusko
SW Region

EOF Radiological Staff:

Beaver Valley: SW Region staff

Limerick: SE Region staff

Peach Bottom: SE Region staff

Susquehanna: SC Region staff / CO staff

Three Mile Island: SE Region staff

Data Evaluation Coordinator/
EOC Staff:

Jim Barnhart	Mike Pyles
Ron Hamm	Ray Urciuolo
Kelley Oberdick	Stephen Williams
Bob Lewis	Jeff Whitehead
Dennis Gallagher	C. Smalls
Bill Wagner	Matt Shields
Bryan Werner	G. Simonetti
Scott Wilson	Joe Melnic
Carol Llewellyn	

Field Team Coordinator/
Field Team Communicator

Tonda Lewis	Chris Ott
Sherry McLain	John Chipppo

Field Teams:

Beaver Valley: Southwest Regional Office

Limerick/Susquehanna: Southeast Regional Office

Peach Bottom/TMI: Southcentral Regional Office

NOTE: These assignments may be changed as necessary to meet incident response requirements.

NOTIFICATION PROCEDURE FOR CHANGE IN CLASSIFICATION

PURPOSE:

This procedure describes the notifications to be made for a **CHANGE IN CLASSIFICATION** (escalation or de-escalation).

REFERENCES:

1. Telephone numbers for notification are found in the BRP Emergency Plan (Section 5A).

NOTIFICATIONS:

NOTIFICATIONS OF CHANGE IN CLASSIFICATION ARE FROM THE LICENSEE TO PEMA TO BRP.

1. Upon notification from PEMA, the BRP EOC STAFF will notify the following individuals:

- ___ BRP EOF Staff
- ___ DEP Secretary
- ___ DEP Deputy Secretary for Waste, Air and Radiation Management
- ___ Neighboring States Radiation Protection Programs
- ___ DOE - Brookhaven
- ___ BRP Radiation Measurements Laboratory Liaison

2. The BRP Field Team Coordinator will notify the following individuals:

- ___ BRP Field Teams

INITIAL NOTIFICATION PROCEDURE FOR RADIOLOGICAL INCIDENTS

PURPOSE:

This procedure describes the initial notification of BRP/DEP personnel for Non – Nuclear Plant Radiological Incidents

REFERENCES:

1. Telephone numbers for notification are found in BRP-ER-5A, “BRP Emergency Telephone Directory”

NOTIFICATIONS:

The BRP Bureau Director is notified of all incidents and will determine if additional notifications are necessary.

A. INITIAL NOTIFICATION OF THE RADIOLOGICAL INCIDENT IS FROM PEMA TO BRP.

1. Upon notification from PEMA, the BRP Initial Contact will:
 - 1.1 Receive the information shown on Attachment 1.
 - 1.2 Notify the BRP Bureau Director and brief using the information from Attachment 1.
 - 1.3 Notify the RC Division Chief and the EP Section Chief
2. Upon notification from the BRP Initial Contact, the Bureau Director will:
 - 2.1 Notify the DEP Deputy Secretary for Waste, Air and Radiation Management
 - 2.2 Notify the appropriate BRP Regional Manager
3. Upon notification from the BRP Initial Contact, the RC Division Chief will:
 - 3.1 Call the BRP Bureau Director for additional instructions and information

4. Upon notification from the BRP Initial Contact, the BRP EP Section Chief will:
 - 4.1 Notify the DEP Emergency Response Director
 - 4.2 Contact the BRP Bureau Director for additional instructions.

B. INITIAL NOTIFICATION OF THE RADIOLOGICAL INCIDENT IS FROM THE INCIDENT LOCATION TO BRP.

1. Upon notification from the incident location, the BRP Initial Contact will:
 - 1.1 Receive the information shown on Attachment 1.
 - 1.2 Using the information from Attachment 1

Notify the BRP Bureau Director.
Notify the RC Division Chief and the EP Section Chief
Notify PEMA
2. Upon notification from the BRP Initial Contact, the Bureau Director will:
 - 2.1 Notify the DEP Deputy Secretary for Waste, Air and Radiation Management
 - 2.2 Notify the appropriate BRP Regional Manager
3. Upon notification from the BRP Initial Contact, the RC Division Chief will:
 - 3.1 Call the BRP Bureau Director for additional instructions and information
4. Upon notification from the BRP Initial Contact, the BRP EP Section Chief will:
 - 4.1 Notify the DEP Emergency Response Director
 - 4.2 Contact the BRP Bureau Director for additional instructions.

C. INITIAL NOTIFICATION OF THE RADIOLOGICAL INCIDENT IS FROM WITHIN DEP TO BRP.

1. Upon notification from the DEP program, the BRP Initial Contact will:
 - 1.1 Receive the information shown on Attachment 1.
 - 1.3 Using the information from Attachment 1

Notify the Bureau Director.
Notify the RC Division Chief and the EP Section Chief
Notify PEMA
2. Upon notification from the BRP Initial Contact, the Bureau Director will:
 - 2.1 Notify the DEP Deputy Secretary for Waste, Air and Radiation Management
 - 2.2 Notify the appropriate BRP Regional Manager
3. Upon notification from the BRP Initial Contact, the RC Division Chief will:
 - 3.1 Call the BRP Bureau Director for additional instructions and information
4. Upon notification from the BRP Initial Contact, the BRP EP Section Chief will:
 - 4.1 Notify the DEP Emergency Response Director
 - 4.2 Contact the BRP Bureau Director for additional instructions.

ATTACHMENT 1
Notification of Radiological Incident
EMERGENCY NOTIFICATION REPORT

1. This is: _____ at _____
My phone number is: _____ the time is _____

2. Origin of Call:

- | | |
|---|--|
| <input type="checkbox"/> County EMA | <input type="checkbox"/> County 911 |
| <input type="checkbox"/> Responsible Party | <input type="checkbox"/> DEP Emergency Response Team |
| <input type="checkbox"/> DEP Bureau of Radiation Protection | <input type="checkbox"/> Citizen |

Contact Name: _____ Phone Number: _____
Time: _____ Date: _____ (To be used by DEP/BRP for call back)
Responsible Party _____ Address _____
Phone Number _____

3. Brief Description of the Event:

Radiological Information (Radioactive material, amount of Radioactivity, Dose Rate, releases, etc.)

4. Type of Incident: (Check & Annotate where necessary)

Transportation Fixed Facility Other _____
Location of Incident: County _____ Municipality _____
Address of Incident: _____

5. Additional Information: (Circle Where Applicable)

Emergency Response Guide Used from NAERG 2004 (162, 163, 164, 165, 166)

Injuries Involved	Yes/No or N/A
Shipping Papers Accessible	Yes/No or N/A
Shipper Notified	Yes/No or N/A
Packaging Compromised	Yes/No or N/A
Waterway(s) Affected	Yes/No or N/A
Secondary Hazards*	Yes/No or N/A

*If yes note here _____

BRP EMERGENCY TELEPHONE DIRECTORY

REVISION X: 99/00

BUREAU OF RADIATION PROTECTION

NOTE: Phone numbers not prefixed by an area code are in the (717) area code and are local calls from Harrisburg. DO NOT GIVE HOME PHONE NUMBERS TO THE PUBLIC!

EXAMPLE ONLY

UPDATED PHONE LISTS WILL BE ISSUED EACH QUARTER

<u>BRP EPLO's</u>	<u>OFFICE</u>	<u>HOME</u>	<u>PAGER</u>	<u>CELL</u>
Allard, David	787-2480	999-9999	877-831-6550	
Janati, Rich	787-2147	999-9999	888-608-9280	
Maiers, Robert	783-8979	999-9999	888-608-8460	
Vyenielo, Martin	783-6003	999-9999	888-991-0206	

<u>NUCLEAR SAFETY</u>	<u>OFFICE</u>	<u>HOME</u>	<u>PAGER</u>	<u>CELL</u>
Barnhart, James	772-0178		877-790-9376	
Dyckman, Dennis	783-4546		877-204-7560	
Murphy, Michael	783-9734		877-899-6563	
Ney, David	783-9492		877-899-6561	
Ryan, Larry	412-442-5881		877-790-9373	

6.0 ACCIDENT ASSESSMENT

Accident assessment is the process used for the identification and evaluation of actual or potential offsite consequences of an incident. This section discusses the assessment techniques used by BRP to evaluate the need for protective actions for off-site areas.

6.1 INFORMATION TRANSFER

During a nuclear power station incident, several methods of information transfer are used in accident assessment, depending of the classification and time since onset. These are commercial telephone, dedicated telephone, satellite phones, cellular phones, 800 Mhz radio (when available), e-mail, computer displays of plant information, and onsite evaluation.

At Unusual Event, commercial or dedicated telephone is used to verify the message and to discuss aspects of the incident with the licensee, as necessary.

For initial assessment at Alert or higher emergency classification, commercial or dedicated telephone is used to communicate information between the BRP-EOC and the licensee. In addition, BRP nuclear engineering and health physics staff are positioned at the licensee's EOF to communicate information resulting from the independent assessment of plant conditions and from face to face discussions with the licensee. Telephone contact between BRP and the licensee is retained until arrival and briefing of the BRP staff at the EOF.

Information from BRP field monitoring teams is reported via satellite phone, cellular phone, 800 Mhz radio (when available), or e-mail to the BRP-EOC. The data is also communicated to the BRP staff at the EOF for comparison with licensee field monitoring team results.

6.1.1 COMPUTER DISPLAYS OF PLANT INFORMATION

Two computer displays of plant information are available to BRP. These are the NRC's Emergency Response Data System (ERDS), and Licensee Plant Data Systems. These displays can be monitored by BRP at computer terminals at the State EOC and the BRP-AC.

ERDS AND LICENSEE PLANT DATA SYSTEMS POLICY: ERDS AND LICENSEE PLANT DATA SYSTEMS ARE USED SOLELY AS A MEANS OF GATHERING INFORMATION ON PLANT PARAMETERS WHILE ELIMINATING THE BURDEN OF VOICE INQUIRY AND RESPONSE, AND THE CONSEQUENCES OF TRANSCRIPTION ERRORS. PROTECTIVE ACTION RECOMMENDATIONS (PARS) BASED ON DEDUCTIONS FROM ERDS OR LICENSEE PLANT DATA SYSTEMS SHALL BE VALIDATED WITH THE LICENSEE BEFORE CONVEYANCE TO PEMA.

6.1.1.1 Emergency Response Data System (ERDS)

The Emergency Response Data System is operated by the NRC. ERDS is accessed by modem, and displayed on terminals with special ERDS software installed. ERDS is designed to collect plant performance and environmental data from nuclear reactor sites

and then display that data to ERDS users. Plant parameters such as temperatures, pressures, radiation levels, and environmental parameters such as wind speed and direction are displayed in tabular and graphic formats. ERDS becomes available at Alert or higher classification. All five nuclear power plant sites in Pennsylvania (BVPS, SSES, TMI, PBAPS, and LGS) display data on ERDS.

6.1.1.2 Licensee Plant Data Systems

Several nuclear power plants in Pennsylvania also provide information to BRP through Licensee Plant Data Systems. Currently Licensee Plant Data Systems are available for: TMI, PBAPS and LGS. These Licensee Plant Data Systems are internet based, high speed data transfer systems. They provide plant parameters such as temperatures, pressures, and radiation levels, and environmental parameters such as wind speed and direction in tabular and graphic format. They also provide diagrams of plant systems, and dose projection basis information. The Licensee Plant Data Systems are always available, even when no emergency has been declared at a nuclear power plant.

Expansion of this system to include SSES and BVPS is expected in the future.

6.2 ASSESSMENT TECHNIQUES

Identification of the occurrence of an incident is the responsibility of the licensee. The licensee has the best knowledge of reactor behavior, system parameters and available options for consequence mitigation. Upon recognition of an emergency condition, the licensee will classify the incident using established Emergency Action Levels (EALs). The EALs are based on off normal criteria in the plant itself or in its environment. BRP uses information provided by the licensee and independent assessments from BRP nuclear engineering and health physics staff to evaluate the need for protective actions for offsite areas. If available, dose projections and actual field team measurements are also considered.

DOSE PROJECTIONS AND FIELD MEASUREMENTS ARE NOT AN ABSOLUTE REQUIREMENT IN THE DEVELOPMENT OF PROTECTIVE ACTIONS.

At declaration of General Emergency, the licensee is required by NRC to furnish a Protective Action Recommendation (PAR) to offsite agencies. BRP may accept the PAR provided by the licensee, or make a more restrictive or less restrictive PAR. A PAR may also be made by BRP, based on plant conditions, at classifications less severe than General Emergency.

The NRC staff at the Region I Office at King-of-Prussia, and the Headquarters Operations Center are available to BRP for backup accident assessment and general consultation.

Accident assessment is also supported by the technical resources available through the NRP, including establishment of the Federal Radiological Monitoring and Assessment Center (FRMAC). The FRMAC operates to support the State through specific requests from BRP. These are expressed in terms of missions and objectives.

6.2.1 ENGINEERING ASSESSMENT

Nuclear power stations are designed, constructed and operated to isolate large inventories of radioactive material from the environment. **Three major barriers operate to maintain this isolation. These include the fuel matrix and cladding, the reactor coolant system, and the containment structure(s).** The integrity of these barriers is maintained by control of core reactivity and the availability of an adequate heat sink. For a PAR to be clearly indicated, two out of the three barriers to the environment must be lost, with a potential for, or actual loss of the third barrier.

The first major consideration in assessment of off normal conditions focuses on the ability to achieve plant shutdown (trip) when called for by automatic systems, or when procedures call for a manual shutdown. Failure to trip continues heat production.

The second major consideration is the availability of adequate core cooling to prevent cladding failure and melting of the fuel matrix. Loss of adequate cooling, such as a substantial leak in the reactor coolant system, can be a facet of the initiating event. The outcome will depend on a continuing ability to deliver adequate makeup to compensate for coolant loss.

A third consideration is maintaining the integrity of the containment structure, including physical isolation of containment penetrations. Containment pressure generated during some accidents due to inadequate heat removal may threaten the integrity of the structure. Systems designed specifically for pressure reduction must function as needed.

Assurance of power for the operation of required safety-related equipment is another major consideration. Much of the plant's safety-related equipment depends on the availability of offsite power during an incident involving reactor trip. If offsite AC power is lost for any reason during such an incident, the operation of safety-related equipment will depend on the plant's diesel generators or backup batteries.

The ability of a nuclear power plant to operate safely can also be compromised by hostile action directed against the facility. Hostile action can result in life threatening risk to site personnel, damage to equipment, loss of access to equipment needed for protection of the public, or actual loss of physical control of the facility. Hostile action against a nuclear power plant can result in emergency classifications from Alert to General Emergency, depending on the nature and severity of the hostile action. For an event involving hostile action against a nuclear power plant, discussions with law enforcement personnel will have a key role in BRP's assessment of the event.

6.2.2 DOSE PROJECTION

A dose projection is a calculated estimation of the radiation dose expected to be delivered to offsite populations if action is not taken to avoid the projected dose. Dose projections apply only to future doses and do not include any dose received before the dose projection is made. Dose projections are compared with recommended Protective Action Guides (PAGs) to provide guidance for Protective Action Recommendations (PARs). The recommended PAGs are discussed in BRP-ER-7.0.

Dose projections used by BRP in the assessment process can include projections actually generated by BRP using input parameters from the licensee, and projections made by the licensee or Federal agencies.

Dose projections are not an absolute requirement in the development of PARs. Certain accident sequences can make it very apparent that protective actions will be required and nothing will be gained by calculating the projected dose. Certain accident sequences, combined with other considerations, may also lead to the making of precautionary PARs, with or without a dose projection or comparison with a PAG.

For purposes of dose assessment and dose projection calculations, this plan uses conversion values listed in the appropriate tables provided in the US EPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents (EPA 400-R-92-001), unless otherwise indicated.

6.2.2.1 Dose Projection Modeling

Dose projections have specific starting times and finite durations.

Dose projections can be based on calculations using a known mix of nuclides released from the plant, combined with meteorological conditions. Projections may also be based on contingency calculations which use theoretical release rates resulting from anticipated reactor conditions, or from unmonitored pathways.

Dose projections can also be made using field monitoring team data, corrected for time and location within the plume. However, field monitoring team data cannot stand alone as a means of dose projection or as the basis for making a Protective Action Recommendation (PAR).

Early in the incident the licensee uses hand calculations for dose projection. Once the EOF becomes operational, the licensee uses advanced computer-based dose models which include site-specific terrain features and meteorological parameters. These advanced projection methods are available in minutes to hours following EOF activation.

Dose projections made by BRP may use hand calculations, or computer-based modeling. The BRP hand calculation methods are found in later in this section. The computer model used by BRP is the Radiological Assessment System for Consequence Analysis (RASCAL), provided by NRC. Projections using RASCAL are available in minutes to hours following notification of an incident.

NRC also performs dose projections using RASCAL, which are available in minutes to hours following notification of an incident.

In addition, DOE can make available the National Atmospheric Release Advisory Capability (NARAC). This system is available in minutes to hours following BRP request through DOE - Brookhaven. Detailed information on NARAC is found in BRP-ER-3.0, Section 3.3.3.2.

Also, for an event that is an Incident of National Significance, the resources of the Interagency Modeling and Assessment Center (IMAAC) become available. IMAAC is responsible for production, coordination, and dissemination of consequence predictions for an airborne hazardous material release. IMAAC generates a single Federal prediction of atmospheric dispersions and their consequence utilizing the best available resources from the Federal Government.

These dose projection models usually tend to overestimate the actual dose delivered, due to inherent conservative assumptions in the models.

6.3 RADIATION MEASUREMENTS

Radiation measurements are used during reactor incidents to determine and assess the total effective dose equivalent to the general population. Pathways known to be most capable of delivering dose to man include plume immersion and inhalation, deposited surface contamination and ingestion.

Actual radiation measurements are used to verify dose projections for various pathways, if circumstances permit.

6.3.1 FIELD MONITORING TEAM MEASUREMENTS

The objective of field monitoring teams is the collection of data to determine whether offsite conditions are consistent with what is expected from the existing plant conditions or dose projections. Measurements in the plume path are made by both BRP field monitoring teams and licensee field monitoring teams. Depending on plume duration, these may be augmented by DOE RAP teams. Measurements consist of ambient beta/gamma exposure rates, and air sampling and analysis for airborne radioiodines and particulates.

The BRP field monitoring teams are directed to either pre-identified monitoring locations or to begin monitoring at a specific dose rate and then report location using a Global Positioning System (GPS). The fixed monitoring locations are identified on maps located in the BRP-EOC, BRP-AC and R3V. The GPS positions may be tracked using computer software at the BRP-EOC, BRP-AC and R3V.

Licensee field monitoring teams are generally operated on a free ranging basis, since team members and their base coordinator are familiar with the site environs.

6.3.1.1 Field Monitoring Team Direction

BRP field monitoring teams are directed by a BRP Field Team Coordinator. The BRP Field Team Coordinator is stationed:

- a. At the State EOC, or,
- b. In the R3V (at a location near the affected EPZ)

The BRP Field Team Coordinator receives field measurement data from the BRP field monitoring teams, and provides that information to BRP staff at the State EOC.

Each BRP field monitoring team is assigned a dedicated Field Team Communicator.

Licensee field monitoring teams are directed by a licensee field team coordinator. Licensee field team information is provided to BRP staff at the licensee EOF, who forward it to BRP staff at the State EOC.

6.3.2 AERIAL MEASUREMENTS

The DOE Aerial Measuring System (AMS) is available for radiation measurements from aircraft. It may be available during plume passage, but its most likely use is in characterizing ground deposition. Requests for AMS are coordinated through DOE-Brookhaven. Availability depends on the location of the aircraft when the request is made. Detailed information on AMS is found in BRP-ER-3.0, Section 3.3.3.2.

6.3.3 ENVIRONMENTAL SAMPLING MEASUREMENTS

Environmental sampling efforts will focus on real sources of radiation dose in the environment. Areas demonstrated to be unaffected by the plume will be monitored only to the extent necessary to demonstrate continuing suitability for unrestricted residential and agricultural use.

No attempt will be made to study pathways in wildlife.

No attempt will be made to perform a materials balance, that is, accounting for all activity believed available for release during the incident.

Upon establishment of the FRMAC, all State field sampling and analysis activities will be coordinated from the FRMAC. Initial monitoring plans for FRMAC activities are found in BRP-ER-6B.

6.3.3.1 Routine Monitoring Program

Wide area field data from existing routine environmental monitoring programs will be available following cessation of uncontrolled releases. These programs, operated by the licensee and by BRP, use TLDs for ambient gamma measurement, air samplers for air particulates and radioiodines, and sampling of other environmental media. Although data from these programs will not be available for evaluating plume passage, they will be useful in post accident population dose assessment.

BRP operates a continuous environmental monitoring program in the environs of each nuclear power plant in Pennsylvania. The program at each plant consists of 30 quarterly TLD stations, four weekly air sampling stations, 2-3 monthly water sampling stations, two monthly dairy farms, and annual fish, silt and vegetation sampling.

In the event of an incident which involves a significant atmospheric release, change out of TLDs will be delayed until uncontrolled releases have ceased. This assures that these detectors will "see" the entire incident. Air samplers will be changed out on schedule, as conditions permit. Sampling of milk, water and other media will be coordinated from the FRMAC.

6.3.3.2 Radioanalytic Priorities

Initial radioassay of environmental samples is performed by the Radiation Measurements Laboratory (RML) in the Bureau of Laboratories. A major objective is to preserve the status of the RML as an environmental radiation lab. Samples accepted for RML analysis will be evaluated to avoid the risk of serious lab contamination.

Only those samples authorized by the BRP Radiological Assessment Manager will enter the analytic queue to RML. These may include samples collected by BRP field teams, DER water teams, PA Department of Agriculture teams, and selected samples collected by federal agency personnel.

Analytic priorities and analytic detection limits (LLD) will be controlled by BRP, until sampling activity has stabilized. Prioritization is based on the expected value of the data to the radiological assessment. A part of the prioritization is the selection of LLDs for assessment. LLD selection will weigh heavily on the through put. For example, an LLD of 2 pCi/l for I-131 in milk requires a counting time of 1000 minutes. Raising the LLD to 64 pCi/l reduces the required counting time to one minute. (The dose commitment to an infant thyroid from ingesting 60 pCi is one millirem.)

A listing of initial LLDs for milk and other environmental media is found in BRP-ER-6B.

FIELD TEAM OPERATIONS

PURPOSE:

The purpose of this procedure is to describe the method for field ambient radiation monitoring, and field air sampling and analysis for radioiodine and particulates, during a nuclear power plant accident or incident.

CONTENTS:

TEAM ACTIVATION	SECTION 1
DEPLOYMENT	SECTION 2
PERSONEL PROTECTION CRITERIA	SECTION 3
FIELD TEAM RESPONSE	SECTION 4
AMBIENT RADIATION MONITORING	SECTION 5
AIR SAMPLE COLLECTION	SECTION 6
RADIOIODINE ANALYSIS	SECTION 7
PARTICULATE FILTER FIELD ESTIMATE	SECTION 8
DECONTAMINATION OF SAMPLING EQUIPMENT	SECTION 9
RECORD KEEPING	SECTION 10

REFERENCES:

- a. "Guidance on Offsite Emergency Radiation Measurement Systems, Phase 1 -- Airborne Release", FEMA REP-2, Rev. 2, June 1990.

SECTION 1: TEAM ACTIVATION

1. **ROLE:** The role of BRP field monitoring teams is the collection of data to determine whether offsite conditions are consistent with what is expected from the existing plant conditions and dose projections. Measurements in the plume path are made by both licensee and BRP field teams. Depending on plume duration, these may be augmented by DOE RAP teams. Measurements consist of ambient beta/gamma exposure rates, and air sampling and analysis for airborne radioiodines and particulates. The normal cartridge for airborne radioiodine analysis is the Silver Zeolite cartridge.

BRP field teams are directed by a Field Team Coordinator. The Field Team Coordinator directs the teams to collect data using one (or a combination of) the following two monitoring strategies

Monitoring Strategy 1: Field teams collect data at pre-identified (or fixed) monitoring locations. The pre-identified monitoring locations are identified on maps used by the field teams.

Monitoring Strategy 2: Field teams proceed in the direction instructed by the Field Team Coordinator to seek the plume, and begin reporting back when a specific dose rate is found (1 mR/hr unless otherwise directed). Field team location is reported either via satellite communications automatically or verbally, using Global Positioning System (GPS) devices.

The field teams report readings to the Field Team Coordinator. BRP field teams are not charged with traversing the plume to determine the peak exposure rate in the plume. Utility field teams perform this function.

2. **COMPOSITION:** Each field team shall consist of at least two people. At least one of the persons shall be BRP technical staff qualified in current BRP plume verification and field airborne radioiodine and particulate procedures. The second member (if not also BRP technical staff) shall be other DEP staff familiar with DEP communications, authorized to operate a Commonwealth vehicle, and have had Emergency Worker Radiological Training.
3. **NOTIFICATION:** Field team members are initially notified by commercial telephone or face to face communication, in accordance with Section 5.0 of this plan, "NOTIFICATIONS AND COMMUNICATIONS".
4. **ALERTING:** Field teams will be alerted following BRP's advisement by PEMA that an **ALERT** or higher classification has been declared.
5. **MOBILIZATION:** Field teams will be mobilized as rapidly as possible following BRP's advisement by PEMA that a **SITE AREA EMERGENCY** or higher classification has been declared.

(NOTE: Field teams may be mobilized at **ALERT** at the discretion of the BRP Radiological Assessment Director or Radiological Assessment Manager.)

Upon mobilization, BRP field teams will assemble at the BRP Regional Offices as follows:

BEAVER VALLEY: Southwest Region -- Pittsburgh Regional Office
THREE MILE ISLAND: Southcentral Region -- Harrisburg Regional Office

PEACH BOTTOM: Southcentral Region -- Harrisburg Regional Office
LIMERICK: Southeast Region -- Norristown Regional Office
SUSQUEHANNA: Southeast Region -- Norristown Regional Office

In the event a field team is requested to respond to a plant in another region, the field team will first go their own regional office to pick-up their emergency response equipment.

SECTION 2: DEPLOYMENT

Upon arriving at their Regional Office, the field teams will execute items found in this procedure.

1. **FIELD MONITORING EQUIPMENT:** Field teams will take into the field the equipment listed in BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance", using the "Emergency Response Instrument Kit Inventory Form" and "Emergency Response Equipment Inventory Form".
2. **DOSIMETRY :** Each field team member will take their pre-issued Thermoluminescent dosimeter (TLD) and will use either Electronic Dosimeters or Direct-Reading Dosimeters of appropriate range, provided in Emergency Response Instrument Kit. For each team member choosing to use direct-reading dosimeters, they must use both a 0-20 R and a 0-100 R dosimeter.
3. **TRANSPORTATION:** Field teams should use the BRP Dedicated Field Team Response Vehicles. If a Dedicated Emergency Response Vehicle is not available, the field team should use a DEP vehicle. The vehicles will be suitable for the weather conditions.
4. **BRIEFING:** Field teams will be briefed prior to departure by the Regional Radiation Protection Program Manager or his/her designate on the items in Section 4, "Field Team Response".
5. **COMMUNICATIONS:** Field teams will communicate with the Field Team Coordinator by satellite phone, cell phone, 800 Mhz radio (when available), or commercial telephone. One method will be the primary means, and all field teams will have in place a method for backup communications. The normal primary method is satellite phone, the normal backup method is cell phone. Communication methods may be changed as necessary to meet requirements.
6. **CONTROL:** Field teams will be directed by the Field Team Coordinator located either at the State EOC or in the R3V (at a location near the affected EPZ).
7. **RENDEZVOUS:** Unless specified otherwise, field teams will rendezvous at the Licensee's Emergency Operations Facility (EOF) or their Regional Office as directed by the Field Team Coordinator.
8. **RECALL:** BRP field teams may be recalled for assignment to other duties upon arrival of Federal Field Teams, or upon termination of the event.
9. **DEPLOYMENT TIMES:** Deployment times to the sites from the primary regional office and from the other DEP regional offices are:

<u>SITE</u>	<u>FROM PRIMARY REGIONAL OFFICE</u>	<u>FROM OTHER REGIONAL OFFICES</u>
Beaver Valley	2 hours	8 hours
Three Mile Island	1 hour	8 hours
Peach Bottom	3 hours	8 hours
Limerick	2 hours	8 hours
Susquehanna	3 hours	8 hours

SECTION 3: PERSONNEL PROTECTION CRITERIA

1. Emergency Worker dose limits are discussed in Section 7.0 of this plan, "Protective Response". The EMERGENCY PHASE dose limits for Emergency Workers are summarized below (As Low As Reasonably Achievable [ALARA] principles apply to all dose limits):

a. The Emergency Worker Dose Limit is 5 rem TEDE for the Emergency Phase.

NOTE: Some situations during the Emergency Phase may justify higher limits for Emergency Workers. These include conditions which prevent the rotation of workers, such as fast moving incidents where the need to facilitate an evacuation is urgent. Other examples are the protection of valuable property, such as livestock, or lifesaving activities.

b. The Emergency Worker Dose Limit for the protection of valuable property, valuable functions, and care of special groups is 10 rem TEDE for the Emergency Phase. This value applies only when lower doses are not achievable through rotation of workers or other dose reduction methods.

c. The Emergency Worker Dose Limit for lifesaving or the protection of large populations is 25 rem TEDE for the Emergency Phase. When the condition is the protection of large populations, the collective dose avoided by the large population must be significantly larger than the collective dose incurred by the emergency workers involved.

d. The dose to Emergency Workers may exceed 25 rem TEDE under certain conditions for the Emergency Phase. These conditions include lifesaving or the avoidance of extensive exposure of large populations. In this condition, the Emergency Worker shall be a **volunteer** with full awareness of the risks of acute and late effects of the dose.

e. The CDE to any organ shall not exceed 10 times the corresponding TEDE for the Emergency Phase.

f. Thyroid Protection: Pennsylvania uses a declaration of a General Emergency or a projected dose of 5 rem CDE (child thyroid) as the threshold for KI administration. The administration of KI requires the approval of the PA Secretary of Health.

2. If at any time during transit or sampling the general area dose rates exceeds 1 R/hour (ADM-300 alarm value) the field teams shall immediately exit the area and move to an area that is < 1 mR/hr general area and contact the Field Team Coordinator.
3. In the event that contact with the Field Team Coordinator is lost, the field monitoring teams shall exit the plume when the total exposure to any one individual exceeds 500 mR.
4. In the event that contact with the Field Team Coordinator is lost, the field monitoring teams shall not re-enter the plume if an Airborne Radioiodine Concentration exceeds $1.0E-5$ uCi/cc.

Movement should be downwind or crosswind (most direct route).

5. Instrument alarm values

a. ADM-300 Alarm setpoints and response

The ADM-300 has the capability to alarm at a preset dose and dose rate. Only the dose rate alarm has been programmed.

The ADM 300 dose rate alarm is set at 1.0 R/Hr.

If the dose rate equals or exceeds 1.0 R/hr, a flashing letter "R" will replace the asterisk in the "Rate*" display. The display will show "Rate R". In addition, if the "AUDIO ON/OFF" switch is "ON", a "beeping" audio alarm will also be heard. To silence the alarm, depress and release the "AUDIO ON/OFF" switch. The "R" will continue to flash even if the dose rate changes to less than 1.0 R/hr. When this occurs, depress and release the "AUDIO ON/OFF" switch a second time and the flashing "R" should no longer display. The display should change to "Rate*" when the alarm is reset. The dose alarm is not set.

b. DMC-2000S alarm setpoints and response

No alarm values have been set for the DMC-2000S

c. FH-40 alarm setpoints and response

No alarm values have been set for the FH-40

SECTION 4-- FIELD TEAM RESPONSE

BRP FIELD TEAMS CONSIST OF A MINIMUM OF TWO INDIVIDUALS; ONE QUALIFIED BRP TECHNICAL STAFF AND ONE DRIVER/COMMUNICATOR.

1. Report to the Regional Office to pick-up equipment and receive briefing on the emergency status, as described below.
2. Before leaving the Regional Office:
 - a. Review Instrument Kit's previously completed inventory form (installed on top of kit.)
 - b. Verify seal intact and number matches last inventory performed. If seal is not intact or does not match inventory, perform full inventory of instrument kit in accordance with BRP-ER-6.02. "Emergency Equipment Operational Checks and Maintenance" procedure.
 - c. Review Equipment Kit's previously completed inventory form (installed on top of kit)
 - d. Verify seal intact and number matches last inventory performed. If seal is not intact or does not match inventory form , perform full inventory of equipment kit in accordance with BRP-ER-6.02. "Emergency Equipment Operational Checks and Maintenance " procedure.
 - e. Open Instrument kit and perform operational checks described in BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance" procedure, on all ADM-300, Ludlum 2221, Radeco H810 and if to be used all the DMC2000S.
 - f. Seal the "pancake" detectors to be used for contamination monitoring in plastic probe covers.
 - g. Prepare air sampler for operation in accordance with Section 6.
 - h. If using direct-reading dosimeters, rezero. If using electronic dosimeters, turn to measurement mode in accordance with BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance" procedure.
 - i. Obtain vehicle to be used for field team, and conduct communication checks with Field Team Coordinator using all types of communication to be used.
 - j. If using a Dedicated Field Team Response Vehicle, conduct operational check of installed FH 40 Dose Rate Meter and satellite interface in accordance with BRP-ER-6.09, "Dedicated Field Team Response Vehicle (DFTR Vehicle) Operation" procedure.
 - k. Verify team members all have their pre-issued TLD.
 - l. Load Instrument Kit and Equipment Kits into vehicles.
 - m. Receive a briefing from the Regional Radiation Protection Program Manager (or designee) on the status of the accident/incident. Some areas that should be discussed are:
 1. Safety
 2. Plant conditions.
 3. Meteorological conditions.
 4. Exposure control procedures (ALARA), including use of KI.
 5. Survey procedures to be followed.
 6. Starting point for the radiation measurements.
 7. Locations that are assigned to be monitored.
 8. Procedures for identifying the plume.
 9. Procedures for iodine sampling.
 10. Communication of radiological data.
 11. Loss of communication actions
 12. Turn back values
3. Prior to leaving the Regional Office, establish communications with Field Team Coordinator. Proceed to the location directed. This will be either a location to meet up with the R3V, or a direction to head and begin sampling.

4. While deployed:
 - a. Contact the Field Team Coordinator at least every 30 minutes.
 - b. Begin a "BRP Field Team Message/Event Log" using Attachment 1, (or other suitable general log form), and a "BRP Field Team Exposure Tracking" form, Attachment 2.
 - c. While enroute to a fixed monitoring location (Monitoring Strategy 1), or while seeking the plume by a specific dose rate (Monitoring Strategy 2), monitor ambient radiation levels using the installed FH-40 Dose Rate Meter (if using a Dedicated Field Team Response Vehicle), or the ADM-300, closed window (if using other vehicle). Notify Field Team Coordinator immediately if closed window GM reading is 1.0 mR/hr or greater. Record date, time and location of ambient radiation readings every $\frac{1}{2}$ hour, using Attachment 1, "BRP Field Team Message/Event Log".
 - d. Record dosimeter exposure readings every $\frac{1}{2}$ hour on Attachment 2, "BRP Field Team Exposure Tracking" form.

SECTION 5-- AMBIENT RADIATION MONITORING

Upon arrival at the assigned fixed monitoring location (Monitoring Strategy 1), or when it appears the plume is located by reaching a specific dose rate [1 mR/hr unless otherwise directed] (Monitoring Strategy 2):

1. Notify the Field Team Coordinator.
2. Take a closed window reading at waist height (1 meter off ground) using the ADM-300. Record the reading on Attachment 3, "BRP Field Team Data Log".
3. Based on the reading in Step 2 above, proceed with step 3-A or 3-B below:

3-A. CLOSED WINDOW READING IN STEP 2 IS LESS THAN 1.0 mR/hr:

IF THE CLOSED WINDOW GM READING AT WAIST HEIGHT IS LESS THAN 1.0 mR/hr, THIS IS EVIDENCE THAT YOU HAVE NOT FOUND THE PLUME. NOTIFY THE FIELD TEAM COORDINATOR OF THE READING, AND STAND BY FOR FURTHER INSTRUCTIONS.

--OR--

3-B. CLOSED WINDOW READING IN STEP 2 IS GREATER THAN OR EQUAL TO 1.0 mR/hr:

IF THE CLOSED WINDOW GM (OR ION CHAMBER) READING AT WAIST HEIGHT IS 1.0 mR/hr OR GREATER, THIS IS EVIDENCE THAT YOU HAVE FOUND THE PLUME. CONTINUE WITH STEP 3-B.1 BELOW.

3-B.1: PLUME VERIFICATION --

To verify your presence in the plume, use the ADM-300 to take these additional readings:

- a. Waist Level (1 meter above ground, window pointed DOWN) -- Open Window.

Take the WAIST LEVEL OPEN WINDOW reading by holding the instrument 1 meter above the ground with beta shield open and the detector window facing down. Record the reading on Attachment 3, "BRP Field Team Data Log".

- b. Ground Level (2-3 inches above ground) -- Closed Window.

Take the GROUND LEVEL CLOSED WINDOW reading by holding the instrument 2-3 inches above the ground with the beta shield closed. Record the reading on Attachment 3, "BRP Field Team Data Log".

- c. Ground Level (2-3 inches above ground, window pointed DOWN) -- Open Window.

Take the GROUND LEVEL OPEN WINDOW reading by holding the instrument 2-3 inches above the ground with the beta shield open and the detector window facing down. Record the reading on Attachment 3, "BRP Field Team Data Log".

NOTE: Open and closed window measurements should be made by averaging the reading obtained over a 30-second time span for low exposure rates (≤ 10 mR/hr), and over a 10-second time span for higher exposure rates.

INTERPRETATION OF OPEN/CLOSED WINDOW MEASUREMENTS:

- a. Measurements made after the plume has passed should have open window Instrument readings which are significantly higher than the closed window readings if there has been deposition of particulate radioactivity or radioiodine, and both the open and closed window readings should increase as the detector position is varied from a height of one meter to ground level.
- b. If measurements are made in the plume, the open window readings should be significantly higher than the closed window readings, but there should be little change in either reading as the height of the instrument is varied from one meter to ground level.
- c. If the plume is above or off to the side of the instrument location, but close enough to be detectable, both the open and closed window readings will be approximately the same, because the instrument response will be due only to the detection of gamma radiation.

As a rule of thumb, if the open window measurement approaches two times the closed window measurement (or more), this indicates the probable presence of beta emitting nuclides.

Report the readings and plume determination results to the Field Team Coordinator, and stand by for further instructions.

4. If directed by the Field Team Coordinator, sample for airborne radioiodine and particulates:

NOTE: An exposure rate of 1 mR/hr closed window or greater at the sampling location, and the determination that the plume is present is needed to consider taking an air sample.

- a. Set up the air sampler and collect the air sample per Section 6.

NOTE: After the air sample has been collected, the field monitoring team **shall** immediately move to a low background (< 300 cpm) area outside of the plume for counting the sample.

- b. Analyze the air sample for radioiodine per Section 7.
- c. Analyze the air sample for particulates per Section 8.

5. Decontaminate sampling equipment as necessary per Section 9.
6. Standby for further instructions from the Field Team Coordinator.

SECTION 6-- AIR SAMPLE COLLECTION

1. Verify the operational checks were performed on the Radeco H810 in accordance with BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance" procedure. Make sure the air sampler power switch and the battery pack switch (if used) is in the "OFF" position.
2. Connect the air sampler cable to the jumper cable plug or battery pack cable.
3. Connect the jumper cables to the vehicle battery or battery pack using the appropriate cables. (black alligator clip to the negative battery terminal or vehicle ground, and the red alligator clip to the positive battery terminal.) If battery pack was used, turn switch on battery pack to "12 Volts" position.
4. Turn the air sampler switch to the "ON" position.
5. Press the "CLEAR" key
6. After completing warm-up, the air sampler will display a target volume of 10 cubic feet.

NOTE: The air sampler is pre-programmed to set the target volume to 10 cubic feet. This is total volume, NOT cubic feet per minute.

7. Check that a Silver Zeolite cartridge and particulate filter are in the sample head. If they are not loaded in the sample head :
 - a. Place a silver zeolite cartridge into the air sampling head, with the arrow in the direction of air flow.
 - b. Using a felt tip pen, mark an "X" on the back of a particulate filter. Place the filter in the sampling head upstream of the cartridge, with the marked side against the cartridge.
 - c. Connect the sampling head to the air sampler.
7. Place the air sampler in a position about 3 to 5 feet above the ground (e.g. roof of vehicle).
9. Press the "START" key. The air sampler will automatically shut off when the pre-set volume is collected.
10. Using the ADM-300, take open and closed window readings at waist height at the beginning, middle, and end of the air sampling period. Record the readings on Attachment 4, " Air Sample Data Log:", column 3.
11. Record the time collected, and location, Ludlum 2221 and Air sampler serial numbers on Attachment 4, "Air Sample Data Log".

12. When air sample collection is completed, leave the particulate filter and silver zeolite cartridge in the sampling head for purging at the counting location.
13. Disconnect the air sampler from the power supply and stow the air sampler for transport to a low background (must be < 300 cpm) area outside the plume for sample counting.

NOTE: After the air sample has been collected, the field monitoring team shall immediately move to a low background area outside (< 300 cpm) of the plume for counting the samples. Upon arrival at the counting location, hook up the sampler to power supply and "run" the sampler for about ten seconds to purge the noble gases.

14. Count the silver zeolite cartridge for radioiodine per Section 7.
15. Count the particulate filter per Section 8.
16. Notify Field Team Coordinator of results.

SECTION 7-- RADIOIODINE ANALYSIS

NOTE: This calculation is valid only for a 10 cubic feet sample using the Ludlum 2221 for analysis. If volume is not equal to 10 cubic feet, calculate results using Attachment 5.

1. Verify the operational checks for air sample analysis mode were performed on the Ludlum 2221 in accordance with BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance" procedures.
2. Record time and location analyzed on Attachment 4, "Air Sample Data Log", column 4 and 5
3. Perform a 1 minute background count, document the results on Attachment 4, "Air Sample Data Log", column 6. Calculate MDCr and record results in column 9.
NOTE : Background must be < 300 cpm to perform radioiodine analysis. If > 300 cpm move to area with lower background.
4. Verify the cartridge to be analyzed is contained in a plastic bag. remove sample tray from holder and place cartridge between three pins on tray, making sure sample intake side is facing detector. insert sample tray back into holder.
5. Perform a 1 minute sample count, document the results on Attachment 4, "Air Sample Data Log". Column 7.
6. Subtract column 6 from column 7, if ≥ 0 record in column 8. If < 0, record 0 in column 8.
7. If column 8 > column 9, calculate iodine activity as follows:
$$\text{Net Counts Per Minute (NCPM) (column 8) X } 3.9 \text{ E-10} = \text{Iodine activity (uci/cc)}$$

Document results in column 10.
8. If column 8 < column 9, calculate MDA as follows :
$$\text{MDCr X } 3.9 \text{ E-10} = \text{MDA uci/cc and record sample results as } < \text{MDA (value calculated)}$$

in column 10
9. Calculate dose to thyroid as follows:
$$\text{Iodine activity (ncpm (in column 8)) x .5} = \text{mrem in one hour to adult thyroid, record results in column 11.}$$
10. Remove cartridge, replace sample holder and perform 1 minute background. If holder/probe contamination is found (> twice previous background), perform decontamination per Section 9.
11. Save cartridge in plastic bag and label bag.

SECTION 8-- PARTICULATE FILTER FIELD ESTIMATE

1. Verify the operational checks for **air sample analysis mode** were performed on the Ludlum 2221 in accordance with BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance" procedures.
2. Perform a 1 minute background count, (if not already done) document the results on Attachment 4, "Air Sample Data Log".
3. Remove sample tray from holder. Verify the elevated planchett holder contains clean planchett. Place filter on top of planchett ensuring that sample intake side is facing detector (side with "X" faces planchett) Place sample tray back into holder.
4. Perform a 1 minute sample count, Subtract background (column 6) results and document the results on Attachment 4, "Air Sample Data Log", column 12.
5. Save filter in plastic bag and label.
5. Remove filter, replace sample holder and perform 1 minute background, if holder/probe contamination is found (> twice previous background), perform decontamination per Section 9.

SECTION 9-- DECONTAMINATION OF SAMPLING EQUIPMENT

USE THIS PROCEDURE IF THE BACKGROUND AFTER SAMPLE COUNTING IS GREATER THAN TWICE THE BACKGROUND PRIOR TO SAMPLE COUNTING, OR IF THE AIR SAMPLER HEAD OR OTHER EQUIPMENT IS CONTAMINATED.

The Ludlum 2221 not being used for air sample analysis should be setup as a contamination monitoring counter in accordance with BRP-ER-6.02, "Emergency Equipment Operational Checks and Maintenance" procedure.

1. If the pancake probe is contaminated, attempt to decon, using very light pressure and decon spray contained in equipment kit.
2. For the sample holder or the air sampler head, remove the filter and cartridge using ALARA principles (latex gloves, tweezers).
3. Wipe equipment inner and outer surfaces with a paper towel moistened with decon solution, then dry with a paper towel.
4. Save the used paper towels in a plastic bag and mark "CONTAMINATED".
5. Re-survey equipment using the Ludlum 2221 that is operating in contamination monitoring mode.. If results are less than twice background, the equipment is ready for the next assignment.
6. If results are greater than twice background, repeat the decontamination procedure.
7. If after two attempts at decontamination the count is still greater than twice background, contact the Field Team Coordinator for instructions.

SECTION 10: RECORD KEEPING

1. Each field team shall use the attachments provided in this procedure to document the following information:
 - a. 30 minute direct-reading dosimeter exposure readings. (Attachment 2)
 - b. Ambient beta/gamma readings. (Attachment 1 (in transit readings) and 3 (assigned sampling locations))
 - c. All radioiodine field analysis raw data and finished results (Attachment 4).
 - d. Particulate filter field estimates. (Attachment 4)
 - e. Information given to the field team from the Field Team Coordinator. (Attachment 1)
 - f. Communication between teams (Attachment 1)
 - g. Administration of KI (Attachment 2)
 - h. Any other items necessary.
2. The 24 hour clock shall be used to record times. For example, 9:00 a.m. is 0900; 8:30 p.m. is 2030.
3. All entries should be legible and professional.
4. All forms/logs generated by each Field Team shall be submitted to the Emergency Planning Coordinator at the end of each monitoring assignment.

ATTACHMENT 4: AIR SAMPLE DATA LOG

Reactor Site _____ Date: _____ Team _____ Air Sampler Serial # _____

Ludlum 2221 (Air sample analysis mode) Serial # _____

1 Time collected	2 Location	3 Dose Rates Open/closed			4 Time analyzed	5 Location analyzed	6 Background (cpm) Must be < 300 cpm	7 Cartridge gross cpm	8 Cartridge NCPM Column # 7 - Column #6	9 Minimum Detectable Count rate (Formula 1)	10 Iodine Activity (uci/cc) (Formula 2)	11 mrem in one hour to adult thyroid (Formula 3)	12 Particulate NCPM
		Start	Middle	End									

To perform radioiodine analysis, background **MUST** be < 300 cpm

FORMULA 1 – $MDCr = 4.66 \times \sqrt{\text{background}}$

FORMULA 2 -- Iodine activity (uci/cc) = NCPM (column 8) x 3.9 E-10 (air sample volume must be 10 ft³)

FORMULA 3 --- mrem in one hour to adult thyroid = ncpm (column 8) x .5

MDA = MDCr x 3.9 E-10

IF column 8 < column 9, record as < MDA

Particulate NCPM = Gross CPM – column 6

ATTACHMENT 5: RADIOIODINE ANALYSIS – NON-STANDARD VOLUME

1. Perform steps 1 – 6 of Section 7 above.
2. Calculate radioiodine concentration as follows :

(a) Enter volume in cubic feet _____

(b) Volume (a) x 2.832 E4 = _____ = volume in cc

(c) Radiiodine concentration =

ncpm (from column 8)

Volume in cc (b) x 0.96 x 0.0043 x 2.2 E 6

Enter results in column 10 of Attachment 4, "Air Sample Data Log"

3. Follow steps 8 – 9 of Section 7 above.

NOTE :

0.96 = Cartridge Collection efficiency

0.0043 = instrument efficiency for iodine using Silver Zeolite cartridge

2.2 E6 = conversion for dpm to uci

EMERGENCY EQUIPMENT OPERATIONAL CHECKS AND MAINTENANCE

PURPOSE:

The purpose of this procedure is to ensure the operability of emergency response equipment used for nuclear power plant accidents and incidents through a regular schedule of inventories, operational checks, calibrations, and maintenance.

CONTENTS:

GENERAL INFORMATION
INVENTORY
OPERATIONAL CHECKS
CALIBRATION
MAINTENANCE

SECTION 1
SECTION 2
SECTION 3
SECTION 4
SECTION 5

REFERENCES:

Criteria for Preparation and Evaluation of Radiological Emergency Response Plans in support of Nuclear Power Plants. NUREG-0654, FEMA-REP-1, Rev. 1

SECTION 1: GENERAL INFORMATION

RESPONSIBILITY: The Radiation Protection Program Manager (or his/her designate) in each region is responsible for the assigned equipment and operational checks. The BRP Emergency Response Section is responsible for instrument calibration, and maintenance.

Each Regional office has three sets of Field Team Emergency Response equipment. Each set consists of an Instrument Kit and an Equipment Kit. Both types of kits have inventories performed quarterly.

SECTION 2: INVENTORY AND OPERATION CHECK FREQUENCY

An inventory of all the emergency kits will be conducted **quarterly**.

1. Instrument Kit Quarterly inventory
 - a. Open Instrument kit and perform operational checks. Section 3 details operational check requirements.
 - b. Perform inventory and complete "Attachment 1: BRP Emergency Response Instrument Kit Inventory Form".
 - c. Attach new numerical seal and document seal # on form. Place completed form on kit top in holder provided.

2. Equipment Kit Quarterly Inventory
 - a. Review previous "Attachment 2: BRP Emergency Response Equipment Kit Inventory Form", checking seal number. Verify seal on case matches number and is intact.
 - b. Review inventory form verifying no equipment contained in kit exceeds expiration date.
 - c. Complete "Quarterly Inventory, Seal Intact, verified by _____" section of inventory form.
 - d. If seal is not intact or it does not match completed inventory form, perform a full inventory and document on "Attachment 2: BRP Emergency Response Equipment Kit Inventory Form". Attach new numerical seal and document seal # on top of form. Place completed form on kit top in holder provided.

Copies of quarterly inventories should be sent to the BRP Emergency Response Section Chief.

Deficiencies in the inventory should be corrected promptly.

SECTION 3: PERFORMANCE OF OPERATIONAL CHECKS

Operational checks may include:

1. Physical inspection
2. Battery check
3. Cal Due Date
4. Response/Source check

All of the instruments in the Instrument Kits require operational checks. Do not use any instrumentation that fails operational checks. Place the instrument out of service and notify the Regional Radiation Protection Manager and the BRP Emergency Response Section as soon as possible. The checks for each instrument are listed below.

A. Ludlum 2221 (Figure 1) - AIR SAMPLE ANALYSIS MODE

Note: In this mode, the instrument is operating in scaler mode and the readings should be taken from the LCD display.

1. Visually inspect the Ludlum 2221, detector and cable for signs of damage. (Do not use if damaged.)
2. Verify by inspection of calibration sticker that instrument is not beyond calibration due date. (Do not use if date exceeded)
3. Install four "D" cell batteries in the Ludlum 2221 taking care to install in proper orientation, close and secure the battery compartment.
4. Ensure that the Ludlum 2221 switches are in the following positions:
 - a. Volume knob in middle position
 - b. AUDIO DIVIDE switch – 10
 - c. ON/OFF POWER switch – OFF
 - d. LAMP switch – LAMP (off)
 - e. WIN switch – OUT
 - f. RATEMETER KNOB – X1K
 - g. RESP switch – S
 - h. TIMER KNOB – 1 MINUTE
 - i. DIGITAL CONTROL switch – SCALER
5. Verify the pancake detector (Ludlum44-40) is installed in the sample holder and the sample tray is installed, (if not install) and then connect cable to detector and instrument.
6. Place the "ON/OFF POWER" switch in the ON position
7. The instrument will perform some self-checks and when completed the LED display should read 0.
8. Depress and hold the TEST "BAT" switch and verify that a (minimum) reading of 5 volts is displayed on the LED display. (Replace batteries if less than 5 volts)

9. Depress and hold the TEST "HV" switch and verify that a reading of 900 volts (± 50 volts) is evident on the LED display. If out of range, do not use instrument.
10. Remove the 1 uCi Cs-137 (orange button) source from the instrument storage case portfolio and place the 1 uCi Cs-137 source **label side facing detector** in the **center** of a planchette on the particulate sample holder. Insert the sample tray containing the source back into the holder, making sure the source remains centered.
11. Depress and release the DIGITAL CONTROL "COUNT" (red) button on the bottom right portion of the meter. At the end of one minute the scaler should stop counting. Verify the value displayed is within the range specified on the source sticker located on the side of the Ludlum 2221 for the scaler mode.
12. Remove the 1 uCi Cs-137 source and planchette and return them to the instrument storage case portfolio.
13. Instrument is ready for air sample analysis.
14. When monitoring is complete and instrument is to be returned to storage, verify instrument is turned off, remove cable and batteries and return instrument and detector/sample holder to Instrument Kit.

B. Ludlum 2221 (Figure 1) - CONTAMINATION MONITORING MODE

Note: In this mode the instrument is operating in the Digital RATEMETER mode, and readings should be taken from the lower scale on the ratemeter display (0 –500 cpm scale) The “Log” scale (upper scale on ratemeter) is not used by Field Teams

1. Visually inspect the Ludlum 2221, detector and cable for signs of damage. (Do not use if damaged.)
2. Verify by inspection of calibration sticker that instrument is not beyond calibration due date. (Do not use if date exceeded)
3. Install four “D” cell batteries in the Ludlum 2221 taking care to install in proper orientation, close and secure the battery compartment.
4. Ensure that the Ludlum 2221 switches are in the following positions:
 - A. Volume knob in middle position
 - B. AUDIO DIVIDE switch – 10
 - C. ON/OFF POWER switch – OFF
 - D. LAMP switch – LAMP (off)
 - E. WIN switch – OUT
 - F. RATEMETER KNOB – X1K
 - G. RESP switch – S
 - H. TIMER KNOB – 1 MINUTE
 - I. DIGITAL CONTROL switch – DIG RATE
5. Connect cable to pancake detector (Ludlum 44-40) and instrument.
6. Place the “ON/OFF POWER” switch in the ON position
7. The instrument will perform some self-checks and then be ready for use.
8. Depress and hold the TEST “BAT” switch and verify that a (minimum) reading of 5 volts is displayed on the LED display. (Replace batteries if less than 5 volts)
9. Depress and hold the TEST “HV” switch and verify that a reading of 900 volts (\pm 50 volts) is evident on the LED display. If out of range, do not use instrument.
10. Remove the 1 uCi Cs-137 source (orange button) from the instrument storage case portfolio and place the 1 uCi Cs-137 source **label side facing detector** on a smooth flat surface.
11. Position the Ludlum 44-40 probe (centered on) approximately 1/2 inch above the 1 uCi Cs-137 source. Allow time for reading to stabilize. Verify the value displayed is within the range specified on the source sticker located on the side of the Ludlum 2221 for the ratemeter mode.
12. While holding the Ludlum 44-40 probe in position to count the source, depress the RATEMETER “ZERO” button and ensure that the digital rate-meter needle indicates zero (0) cpm

13. Return the 1 uCi Cs-137 source to the instrument storage case portfolio.
14. Change the Ratemeter Knob to the X1 scale.
15. Instrument is ready for contamination monitoring.
16. When monitoring is complete and instrument is to be returned to storage, verify instrument is turned off, remove cable and batteries and return to Instrument Kit.

C. ADM-300 (Figure 2)

1. Visually inspect the ADM 300 and its' handle for signs of damage. (Do not use if damaged.)
2. Verify by inspection of calibration sticker that instrument is not beyond calibration due date. (Do not use if date exceeded)
3. Using a common screwdriver, open the battery compartment and install 9- volt batteries (2 each). Close and secure the battery compartment door. (Meter should turn on, if not depress and hold the "POWER ON/OFF" until it turns on.) If batteries do not have sufficient voltage to power instrument, "Low Battery" will be displayed. Replace batteries prior to use.
4. Verify that the meter performs "diagnostic self checks" as indicated below:
 - A. a bar graph appears on the LED display
 - B. "Please wait" message appears on the LED display, followed by
 - C. the instrument displays "### uR/Hr" in the left hand portion of the display and the mode is Rate which appears in the right hand portion of the display.
5. Depress and release the "LIGHT On/OFF" switch to and verify the backlight functions. Depress and release and turn off backlight.
6. Obtain the appropriate check source (as indicated on ADM 300 source check label). Place the source against the (closed) beta shield on the front of ADM 300.
7. Depress and momentarily hold the "AUDIO ON/OFF" switch until the audio is activated, then release the switch.
8. Obtain instrument reading and verify that the "closed window" dose rate falls within the expected range (as indicated on the source check label).
9. Remove the check source from the beta shield and open the beta shield and reposition the source to obtain an "open window" reading. Verify that the "open window" dose rate falls within the expected range (as indicated on the source check label). Do not use instrument if either source check exceeds values.

10. Close the beta window, then return the source to its designated storage location.
11. Install the ADM-300 handle. Instrument is ready for operation.
12. When monitoring is complete and instrument is to be returned to storage, verify instrument is turned off, remove handle and batteries and return to Instrument Kit.

D. DMC-2000S (Figure 3)

1. Visually inspect the DMC200S for signs of damage. (Do not use if damaged.)
2. Verify by inspection of calibration sticker that instrument is not beyond calibration due date. (Do not use if date exceeded)
3. The DMC-2000s is stored in the "PAUSE" mode, if the display reads "BA LO" in this mode, replace the battery before using.
4. Turn the DMC2000S from "PAUSE" mode to "MEASUREMENT" mode as follows:
 - a. Depress then **immediately** release the selector button, the display will change from "PAUSE" to "CHANGE".
 - b. After about 3 seconds, the display will read "ENTER", **immediately** depress and release the selector button.
 - c. The DMC 2000S display changes to "IN" and then will perform some self diagnostics. After the self-diagnostics are complete the display will read "d 0.0^{mrem}". This is the integrated dose mode. To toggle to dose rate mode press and release the selector button. In dose rate mode the display reads "R 0 ^{mrem/h}". After 30 seconds it will return to the dose mode.

Note: If during use in the "Measurement" mode the display shows "BA LOX" this means the battery is low and will be completely drained in "X" hours. Replace the battery as soon as possible.

- d. The dosimeter is ready for use.
5. When monitoring is complete and the DMC2000S is to be returned to storage turn the dosimeter off as follows:
 - a. Depress and hold the selector button for approximately 10 seconds. While continuing to hold the selector button the display will read "CHANGE" and then display "GO OUT", **immediately** release the selector button. The display will show "OUT" and then change to "PAUSE"
 - b. Return to kit for storage.

E. Radeco H810

The air sampler operational check is accomplished by taking a 10 cu.ft. air sample.

1. Visually inspect the Radeco H810 and cables for signs of damage. (Do not use if damaged.)
2. Verify by inspection of calibration sticker that instrument is not beyond calibration due date. (Do not use if date exceeded)
3. Make sure the air sampler power switch is in the "OFF" position.
4. Connect the sampler power cables by:
 - a. Connect the jumper cables to the air sampler cable and then the vehicle battery, attaching the black alligator clip to the negative battery terminal or vehicle ground, and the red alligator clip to the positive battery cable.

OR

- b. If the battery pack is to be used and is currently being charged, disconnect the charger. Depress the "test" button and verify all three red lights are on, indicating battery pack is fully charged. Turn the battery pack switch to the off position and attach the air sampler cable to the battery pack cable. Turn the battery pack switch to the "12 VOLT" position.

NOTE : DO NOT USE THE 24 VOLT POSITION ON THE BATTERY PACK

5. Place a charcoal cartridge and particulate filter in the sample head and connect sample head to air sampler.
6. Turn the air sampler switch to "ON"
7. After completing warm-up, press the "CLEAR" key, the air sampler will display a target volume of 10 ft³. This is total volume not cubic feet per minute.
8. Press the "START" key. The air sampler will automatically shut off when the pre-set volume is collected.
9. When monitoring is complete and the sampler is to be returned to storage, turn the sampler and battery pack (if used) to "OFF". Disconnect cables and return to storage in ER Instrument Kit.

Deficiencies in the operational checks should be corrected promptly by having the defective equipment repaired or replaced.

SECTION 4: CALIBRATION

Calibration of survey meters, counter scalers, electronic dosimeters and the air sampler will be conducted **annually or at a frequency directed by the BRP Bureau Director, or after repair of an instrument.** Records of calibrations will be maintained at the BRP Central Office in Harrisburg, and copies will be provided to the Regional Offices. Instruments failing calibration shall be promptly repaired or replaced.

SECTION 5: MAINTENANCE

Maintenance of equipment shall be performed per the manufacturer's directions, and when a problem with the equipment is found. Specific instructions for the battery pack is listed below:

Maintenance of the RADECO Emergency Power Supply Model 12/24 Volt

CAUTION: This is a lead acid unit. Keep away from foam, water and other liquids

1. Inspect the power supply, power adapter and cables to make sure they are in good physical condition.
2. Place the 12/OFF/24 volt switch in the 12- volt position when charging and using unit for air sampling. Place in the OFF position when in storage.

CAUTION: Failure to ensure the 12/OFF/24 volt switch is in the 12-volt position when charging can result in damage to this unit!

3. When not in use, connect the power supply cable to the terminal on the side of the power supply, Observe proper polarity when connecting cable to terminal.
4. Attach the trickle charge adapter connector to the CHARGING PORT outlet on front side of the RADECO Emergency Power Supply Model 12/24 Volt unit, and then plug the adapter into a 110V receptacle. The yellow LED "charging" light will turn on, the red LED lights indicate the amount of charge left on the power supply, when all three red lights are lit, the unit is fully charged. The charging adapter may be left connected, a smart circuit will maintain a trickle charge to the battery pack. The battery pack is capable of being charged from a 12V circuit such as a vehicle lighter plug, but this method should not be used by BRP Field Teams. **It is possible to overcharge the unit using this method.**

ATTACHMENT 1: BRP EMERGENCY RESPONSE INSTRUMENT KIT INVENTORY FORM

QUARTER (1st, 2nd, etc.) _____ YEAR _____ KIT _____

SEAL # _____

Instruments	Serial No.	Cal Due Date	Batteries	Batt. Exp. Date	Op Checks Sat - Init.
Canberra ADM 300			9 volt (2 each)		
Canberra ADM 300			9 volt (2 each)		
Ludlum 2221 w 44-40 probe and cable			'D' Cells (4 each)		
Ludlum 2221 w 44-40 probe and cable			'D' Cells (4 each)		
MGP DMC 2000 S			CR 2450 N (1 each)		
MGP DMC 2000 S			CR 2450 N (1 each)		
MGP DMC 2000 S			CR 2450 N (1 each)		
RADECO H - 810			N/A		
Miscellaneous	Qty	COMMENTS			Init.
Detector cable	1 each	Spare cable for Ludlum 2221			
Dosimeter charger	1 each	N/A			
Tool kit	1 each	N/A			
Radeco carrying strap	1 each	N/A			
Radeco cable	1 each	Alligator clip type to connect Radeco to vehicle battery			
Radeco A/S head	1 each	N/A			
Sample holder	1 each	Stainless steel - with tray for filter / cartridge counting.			
LED Flashlight	1 each	Include 4 "D" cell batteries for flashlight			
Field Team procedures & Inventory forms	10 each	Blank procedure forms for future inventories.			
Canvas portfolio bag "GO KIT"	1 each	Canvas bag contains: pair of tweezers (1)____, gloves (latex min 10 pair)____ Air sample planchettes (3)____, 47 mm A/S filters (5)____ 47 mm charcoal filters (2)____, 47 mm AgZ cartridges (2)____, DMC2000S battery change tool (1)____, Pens (2)____, markers (2)____ DMC2000S spare batteries (3)____, calculator____, glove liners (1 pack)____ 0 - 20 R dosimeters (3)____, 0 - 100 R dosimeters (3)____, Zip loc bags (10)____, pre-labeled sample bags (4)____ 1 uCi CS 137 button source (1)____, Instruction cards for DMC 2000 S (3)_____.			

NOTE: Additional batteries and air sampling supplies are in ER Equipment Kit.

Inventory completed by : _____ DATE: _____

Forward copy of completed inventory forms to Chief – ER Section each quarter.

ATTACHMENT 2: BRP EMERGENCY RESPONSE EQUIPMENT KIT INVENTORY FORM

REGION _____ KIT _____

Item Description	Qty	Units	Comments	Sat.(Y/N)	Item Description	Qty	Units	Comments	Sat.(Y/N)
Air sample cartridge, charcoal	2	each			Lighter plug adapter (4-way)	1	each		
Air sample cartridge, silver zeolite	7	each			Maps (plant specific)	1	each		
Air sample filter	2	boxes			Map Light	1	each		
Bags, plastic (2 mils, small)	20	each			Marker	1	each	in portfolio	
Bags, plastic (6 mils, large)	20	each			Neck chain	3	each		
Battery, 'AA'	24	each			Pens, ball point	1	each	in portfolio	
Battery, 9 volt, alkaline	4	each			Planchettes (2" diameter)	7	each	in portfolio	
Battery, 'D' cell, alkaline	10	each			Poncho style rain gear	3	each		
BRP E-Plan	1	each			Portfolio	1	each		
Clipboard	1	each			Reflective vest	2	each		
Decontaminant hand cleaner	1	can			Revolving warning light (amber)	1	each	With bulb & auth.letter	
Decontaminant surface cleaner	1	can			Rubber shoe covers	3	pair		
Dust mask	1	box			Safety goggles	3	pair		
Flashlight (headlamp)	3	each			Sponge	1	each		
Glove liners (cotton)	1	pack			Tablet (8 1/2" X 11")	1	each		
Gloves (latex, large)	1	box			Tape, duct	1	roll		
Hard hat (with liner)	3	each			Tape, masking	1	roll		
KI tablets (with instructions)	3	bottles	In portfolio		Tape, radioactive material	1	roll		
Knife, Utility	1	each			Tape, reflective	1	roll		
Labels, sample	20	each			Towels, paper	1	Roll		

Seal # _____ (applied after inventory completed)

Full Inventory completed by: _____ Date: _____

Quarterly inventory, Seal intact, verified by _____ Date: _____

Quarterly inventory, Seal intact, verified by _____ Date: _____

Quarterly inventory, Seal intact, verified by _____ Date: _____

FIGURE 1 - LUDLUM 2221

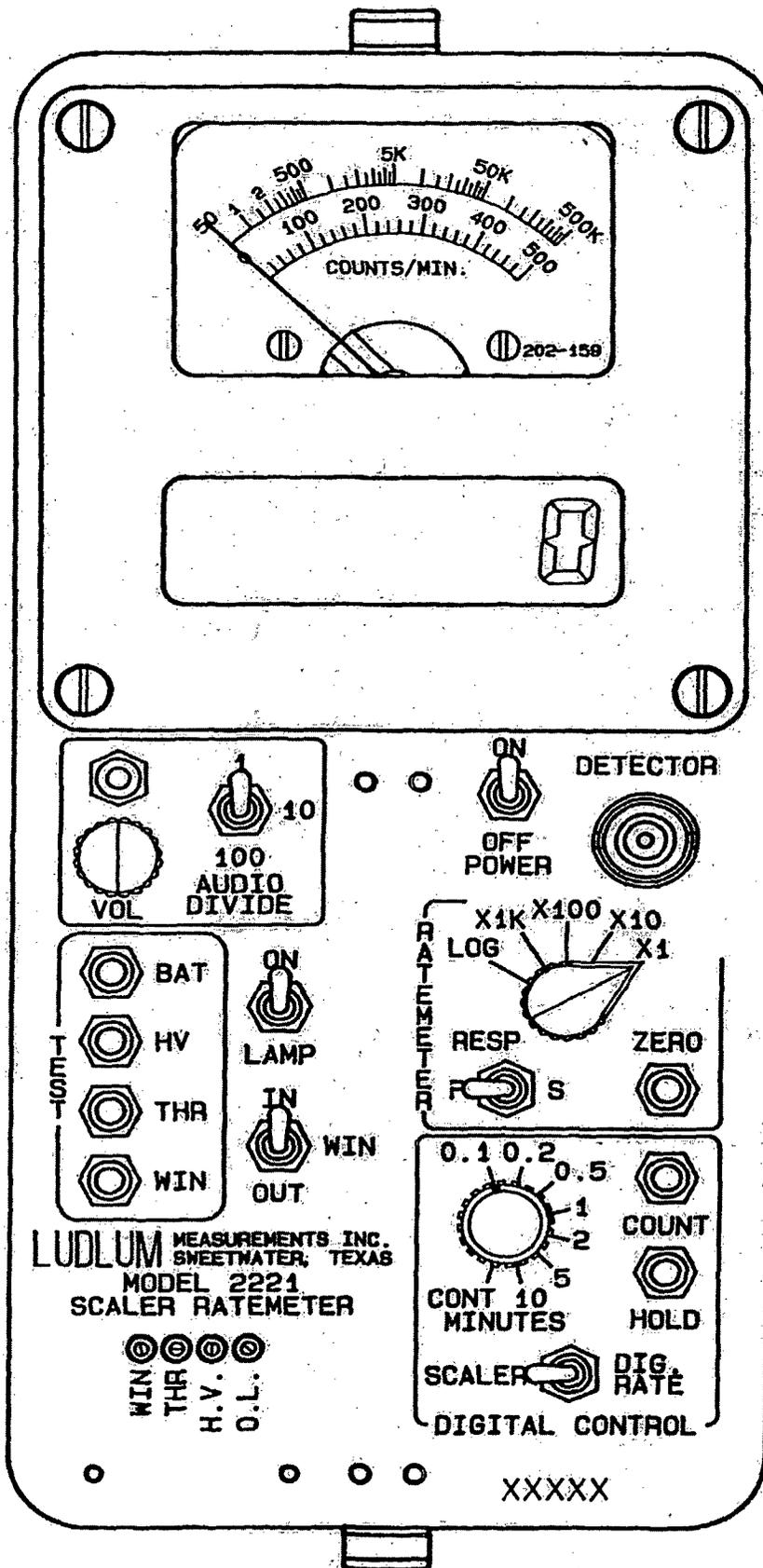


FIGURE 2 – ADM 300

DESCRIPTION AND USE OF CONTROLS AND INDICATORS

EQUIPMENT CONTROLS AND INDICATORS

a) MEMBRANE SWITCHES:

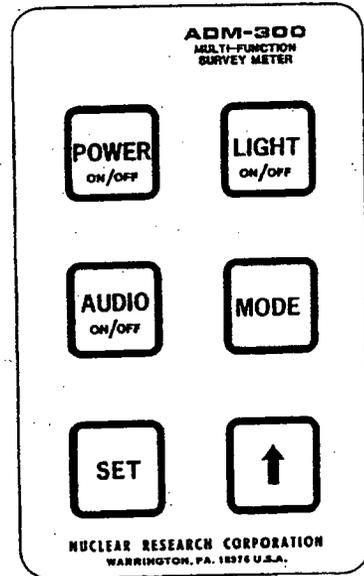
POWER
 Turns unit On or Off when pressed for at least 2 seconds.

LIGHT
 Turns LCD backlight On or Off.

AUDIO
 Turns audio On or Off.

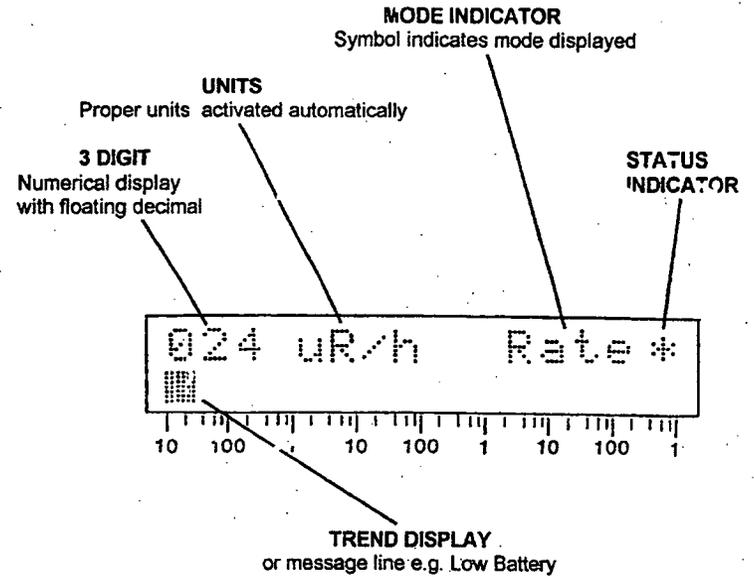
MODE
 Displays available modes.

SET
 Used to enter modes and adjust alarms set points.



↑
 Called **INC** for **increment**.
 Used to adjust alarm set points, clear dose, and select other available rate displays.

b) DIGITAL DISPLAY



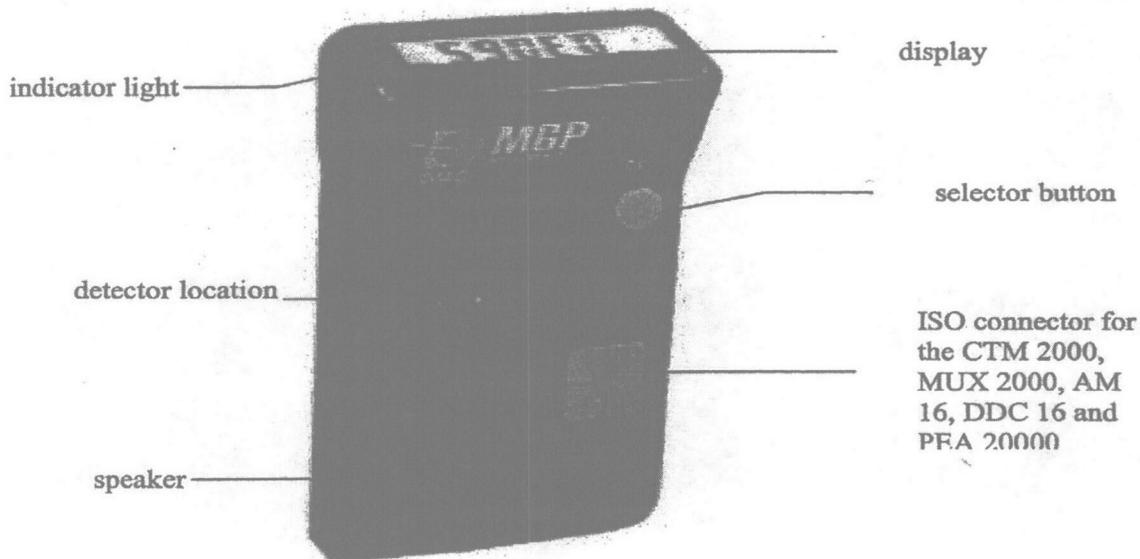
MODE		STATUS	
OPERATING MODE	MODE INDICATOR	SYSTEM STATUS	STATUS INDICATOR
Dose Rate	Rate	Normal (Audio Enabled)	*
Dose	Dose	Normal (Audio Disabled)	(Blank)
Rate Alarm	RaAlm	Rate Alarm	R (Flashing)
Dose Alarm	DoAlm	Dose Alarm	D (Flashing)
		Both Rate & Dose	B (Flashing)

FIGURE 3 – DMC2000S

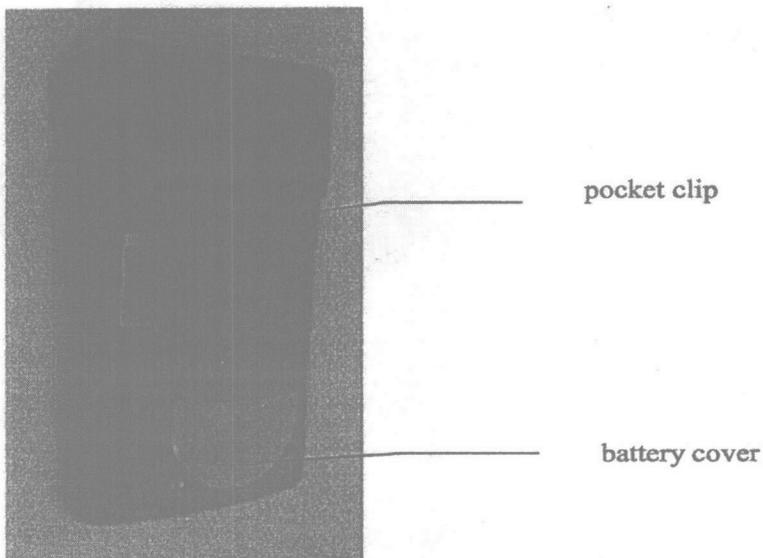
DMC 2000S Dosimeter

Description

Front view



Back view



ESTIMATION OF AIRBORNE CONSEQUENCES FOR GROUND LEVEL SOURCES

PURPOSE:

This procedure provides for the hand calculation of dose projections from an accident or incident at a nuclear power plant involving the release of radionuclides to the atmosphere.

This procedure serves as a back-up to BRP's primary computer dose projection modeling software, RASCAL.

Projected whole body dose (TEDE), and child thyroid dose (CDE) dose can be calculated using this procedure.

CONTENTS OF PROCEDURE:

INPUT PARAMETERS	SECTION 1
CALCULATING WHOLE BODY DOSE	SECTION 2
CALCULATING THYROID DOSE	SECTION 3
USE OF RESULTS	SECTION 4
WHOLE BODY DOSE PROJECTION WORKSHEET	ATTACHMENT 1
CHILD THYROID DOSE PROJECTION WORKSHEET	ATTACHMENT 2
PASQUILL TURBULENCE CLASSIFICATION	TABLE 1
ATMOSPHERIC DILUTION FACTORS	FIGURE 1
DOSE CONVERSION FACTORS FOR NOBEL GASES	TABLE 2
DOSE CONVERSION FACTORS FOR RADIOIODINE	TABLE 3

ESTIMATION OF AIRBORNE CONSEQUENCES FOR GROUND LEVEL SOURCES

SECTION 1 -- INPUT PARAMETERS

A. In order to determine the instantaneous ground level radionuclide air concentration ($X=Ci/m^3$) at a particular location downwind, certain parameters must be known:

1. Pasquill Turbulence Class, A through F.
2. Source Term, Q (Ci/sec.).
3. Mean Wind Speed, u (m/sec.).
NOTE: miles per hour \times 0.45 = m/sec.
4. Wind Direction (degrees).
NOTE: Wind direction is measured "OUT OF ..."

B. The data for the parameters listed above will normally be obtained from the Licensee.

C. **IF** all of the data from 'A' above is available, **THEN GO** to Section 2.

IF some of the data from 'A' above is missing, the following information may be used:

1. Weather Data:
 - a. From the National Weather Service (See phone numbers in BRP Emergency Phone List.)
 - b. From the airport closest to the Licensee.

2. Source Term:

If no source term is available, refer to "RTM-96 -- Response Technical Manual, U.S. Nuclear Regulatory Commission (NUREG/BR-0150, Vol. 1, Rev. 4), March 1996". This document provides dose estimates based on plant conditions for a variety of situations. Also, in the event a source term is not available, dose projections can be hand calculated using actual field data using procedure BRP-ER-6.05, "Estimation of Airborne Radiological Consequences using Field Sampling Data".

SECTION 2 -- WHOLE BODY DOSE PROJECTION

- A. Use the "Whole Body Dose Projection Worksheet", Attachment 1.
- B. Record the data described in Section 1 above on the worksheet.
- C. Enter the $\frac{Xu}{Q}$ values in column (b) of the worksheet for the distances of interest.
These values are obtained from Figure 1, "Atmospheric Dilution Factors".
- D. Obtain the appropriate "Dose Conversion Factor for Noble Gases" from Table 2.
- E. For each downwind distance, calculate the projected dose in column (f) of the worksheet.

SECTION 3 -- CHILD THYROID DOSE PROJECTION

- A. Use the "Child Thyroid Dose Projection Worksheet", Attachment 2.
- B. Record the data described in Section 1 above on the worksheet.
- C. Enter the $\frac{Xu}{Q}$ values in column (b) of the worksheet for the distances of interest.
These values are obtained from Figure 1, "Atmospheric Dilution Factors".
- D. Obtain the appropriate "Dose Conversion Factor for Radioiodine" from Table 3.
- E. For each downwind distance, calculate the projected child thyroid dose in column (g).
NOTE: Projected Adult Thyroid Dose = 0.5 x Projected Child Thyroid Dose

SECTION 4 -- USE OF RESULTS

- A. Report results to Supervisor and BRP -EOC and BRP-EOF

ATTACHMENT 1: WHOLE BODY DOSE PROJECTION WORKSHEET

This worksheet provides the Whole Body Dose (TEDE) to an individual in the plume.

PLANT: _____ UNIT: _____ DATE: _____ TIME: _____ WIND DIRECTION OUT OF: _____

PASQUILL CLASS: _____ NOBLE GAS Q = _____ Ci/sec. WIND SPEED u = _____ x 0.45 = _____ m/sec.
 (mph)

a	b		c		d		e		f		G		h
Distance (miles)	$\frac{Xu}{Q}$ (m ³) Fig. 1	x	Noble Gas Q (Ci/sec.)	÷	u (m/sec.)	x	DCF Rem-m ³ Ci-hr Table 2	=	WHOLE BODY DOSE (Rem) (1 hr. exposure)	x	Expos. Time (hrs)	=	TOTAL WHOLE BODY DOSE (Rem)
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	
		x		÷		x		=		x		=	

a -- Choose appropriate distances.

d -- As obtained.

g -- As obtained.

b -- From Figure 1.

e -- From Table 2.

h = f x g

c -- As obtained.

$$f = \frac{b \times c \times e}{d}$$

ATTACHMENT 2: CHILD THYROID DOSE PROJECTION WORKSHEET

This worksheet provides the Child Thyroid Dose (CDE) to an individual in the plume.

NOTE: Projected Adult Thyroid Dose = 0.5 x Projected Child Thyroid Dose.

PLANT: _____ UNIT: _____ DATE: _____ TIME: _____ WIND DIRECTION OUT OF: _____

PASQUILL CLASS: _____ IODINE Q = _____ Ci/sec. WIND SPEED u = _____ x 0.45 = _____ m/sec.
 (mph)

a	b		c		d		e		F		g		h
Distance (miles)	$\frac{Xu}{Q}$ (m ³) Fig. 1	x	Iodine Q (Ci/sec.)	÷	u (m/sec.)	x	DCF $\frac{\text{Rem-m}^3}{\text{Ci-hr}}$ Table 3	x ² =	CHILD THYROID DOSE (Rem) (1 hr. exp)	x	Expos. Time (hrs)	=	TOTAL CHILD THYROID DOSE (Rem)
		x		÷		x		x ² =		x		=	
		x		÷		x		x ² =		x		=	
		x		÷		x		x ² =		x		=	
		x		÷		x		x ² =		x		=	
		x		÷		x		x ² =		x		=	
		x		÷		x		x ² =		x		=	
		x		÷		x		x ² =		x		=	

a -- Choose appropriate distances.

d -- As obtained.

g -- as obtained

b -- From Figure 1.

e -- From Table 3.

h = f x g

c -- As obtained.

$$f = \frac{b \times c \times e \times 2}{d}$$

TABLE 1: PASQUILL TURBULENCE CLASSIFICATION**Table 1a: Relation of Stability Class to Weather Conditions**

A -- Extremely Unstable D -- Neutral (1)
 B -- Moderately Unstable E -- Slightly Stable
 C -- Slightly Unstable F -- Moderately Stable

Surface Wind Speed (m/sec)	Daytime Insolation			Night Conditions	
	Strong	Moderate	Slight	>4/8 (2) Clouds	<3/8 (2) Clouds
< 2	A	A-B	B		
2	A-B	B	C	E	F
4	B	B-C	C	D	E
6	C	C-D	D	D	D
> 6	C	D	D	D	D

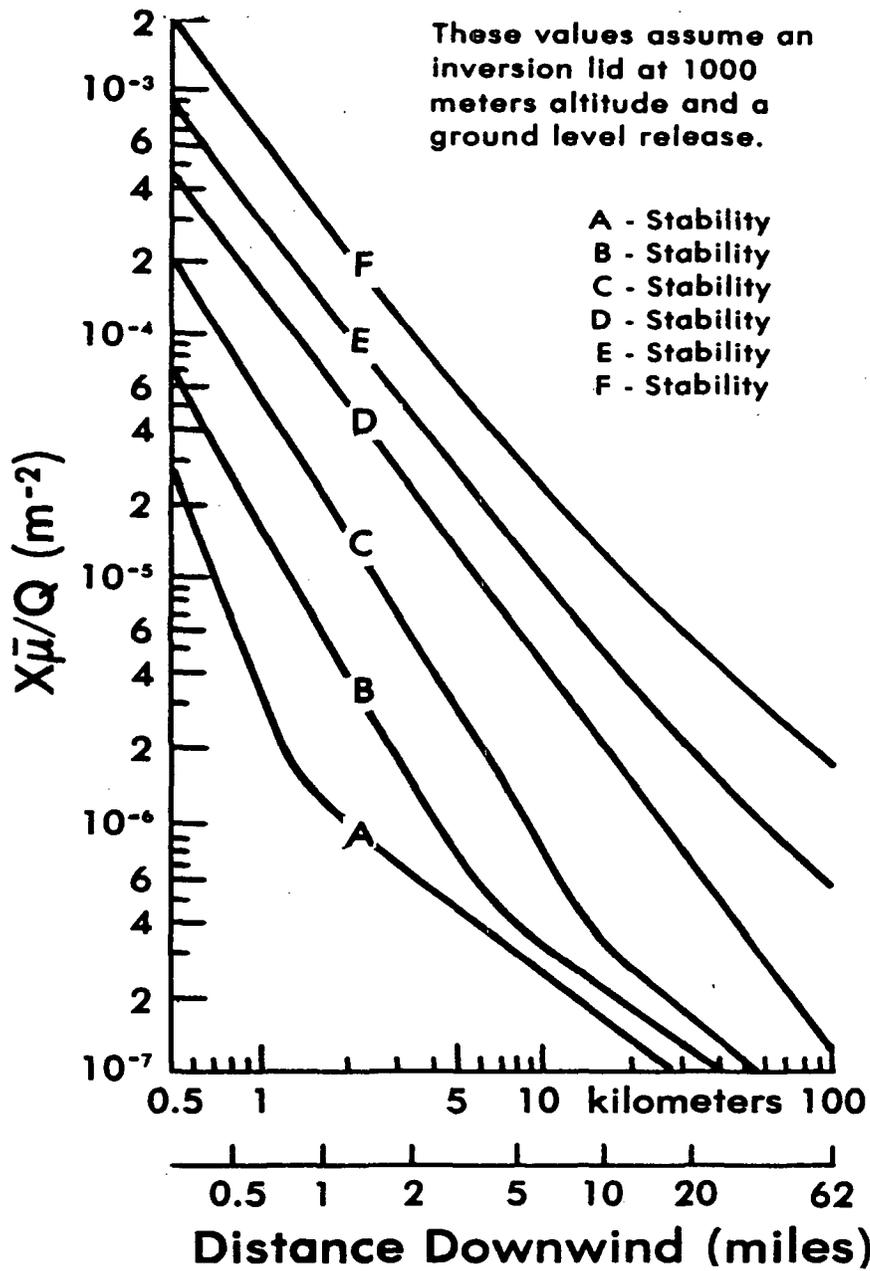
NOTES: (1) Applicable to heavy overcast day or night.

(2) The degree of cloudiness is defined as that fraction of sky above the local apparent horizon which is covered by clouds.

Table 1b: Classification of Atmospheric Stability by Temperature

<u>Stability Classification</u>	<u>Pasquill Categories</u>	<u>Delta T (°F/100 feet)</u>
Extremely Unstable	A	< -1.04
Moderately Unstable	B	≥ -1.04 to < -0.93
Slightly Unstable	C	≥ -0.93 to < -0.82
Neutral	D	≥ -0.82 to < -0.27
Slightly Stable	E	≥ -0.27 to < +0.82
Moderately Stable	F	≥ +0.82 to < + 2.19

FIGURE 1
ATMOSPHERIC DILUTION FACTORS



Typical values for $\bar{X}\bar{u}/Q$ as a function of atmospheric stability class and downwind distance (from the Environmental Protection Agency's Protective Action Guidance EPA 52011-75-001, Revised June 1980)

TABLE 2: DOSE CONVERSION FACTORS FOR NOBLE GASES

<u>Time After Shutdown at Which Emissions Measured (hours)</u>	<u>Gross Noble Gas DCF for One Hour Exposure (rem-m³ /Ci-hr)</u>
1	2.6E+2
2	2.2E+2
3	1.8E+2
5	1.3E+2
10	6.3E+1

NOTE: DCF for Kr-87 is 5.1E+2. Use of Kr-87 DCF is conservative.

NOTE: Source of DCF's: Manual for "Radiological Accident Assessment -- Plume Phase" Course, FEMA National Emergency Training Center, Emmitsburg, MD, 1994.

TABLE 3: DOSE CONVERSION FACTORS FOR RADIOIODINE

<u>Time After Shutdown at Which Emissions Measured (hours)</u>	<u>Iodine DCF for One Hour Exposure (Rem-m /Ci-hr)</u>
1	3.2E+5
2	3.5E+5
3	3.9E+5
5	4.4E+5
10	5.3E+5

NOTE: DCF for I-131 is 1.3E+6; Use of I-131 DCF is conservative.

As time after shutdown increases, DCF approaches I-131 DCF.

Only I-133 ($t_{1/2} = 21$ hours) has much influence on dose calculations compared to I-131.

NOTE: Source of DCF's: Manual for "Radiological Accident Assessment -- Plume Phase" Course, FEMA National Emergency Training Center, Emmittsburg, MD, 1994.

RADIOLOGICAL RAPID RESPONSE VEHICLE (R3V) OPERATION

PURPOSE:

The purpose of this procedure is to describe the method of operation and maintenance of the radiation monitoring, mechanical, AC electrical, and communications equipment in the Radiological Rapid Response Vehicle (R3V).

CONTENTS:

GENERAL INFORMATION	SECTION 1
EQUIPMENT START-UP	SECTION 2
DEPLOYMENT AND RETRIEVAL OF MATRIX ESP PROBES	SECTION 3
EQUIPMENT SHUTDOWN	SECTION 4
R3V STORAGE	SECTION 5
CALIBRATION	SECTION 6
MAINTENANCE	SECTION 7
MECHANICAL, AC ELECTRICAL, AND COMMUNICATIONS EQUIPMENT OPERATIONAL CHECK PROCEDURES	APPENDIX A
RADIATION MONITORING EQUIPMENT OPERATIONAL AND SOURCE CHECK PROCEDURES	APPENDIX B
R3V RADIATION MONITORING EQUIPMENT OPERATIONAL CHECKS	ATTACHMENT 1

REFERENCES:

- a. "Guidance on Offsite Emergency Radiation Measurement Systems, Phase 1 – Airborne Release", FEMA REP-2, Rev. 2, June 1990

SECTION 1: GENERAL INFORMATION

The Radiological Rapid Response Vehicle (R3V) is designed to conduct radiological monitoring and to serve as a command and control platform. The major radiation monitoring equipment on the R3V includes:

- Installed on-board Thermo Electron FHZ-671 7 Liter plastic scintillator detector for low range gamma measurements (<10 uR/hr to 25 mR/hr). (Display on ViewPoint and with satellite uplink capability.)
- Installed on-board Thermo Electron FHZ-621 wide range proportional detector for gamma measurements (10 uR/hr to 1000 R/hr). (Display on ViewPoint and with satellite uplink capability.)
- Installed on-board Thermo Electron AMS-4 air monitoring system for noble gas, iodine and particulates. (Display on ViewPoint and with satellite uplink capability.)
- Thermo Electron Matrix Environmental Satellite Probes (Matrix ESP) (4) with FHZ-621 wide range proportional detector (10 uR/hr to 1000 R/hr) for gamma measurements. These probes have line-of-site radio and satellite uplink capability for radiological data and GPS information transfer. These probes are battery powered and can be dropped off in the field. They can be monitored from remote locations, including the R3V, using the ViewPoint Software.

All of the radiation monitoring equipment on the R3V can transmit data to the ViewPoint Client computer display system. The ViewPoint system collects data from the radiation monitoring equipment, and displays it on computers in the R3V. Through satellite links, this data can also be transmitted to computers with the ViewPoint Client software in remote locations, such as the State EOC and BRP-RAC.

The major communications equipment on the R3V include:

- Satellite uplink capability to transmit radiological data from the following radiation monitoring equipment to remote locations using the ViewPoint Client software:
 - On-board FHZ-671 7 Liter plastic scintillator
 - On-board FHZ-621 wide range proportional detector
 - On-board AMS-4 air monitoring system
 - Deployable Matrix ESP probes
- Computer(s) for email to/from other response locations
- Computer(s) with software to monitor R3V and Field Team Parameters
- GPS unit with data transfer via satellite link
- Satellite phones
- 800 Mhz radio (when available)
- Commercial television viewing capability via satellite link

The R3V can be used for Field Team Control when necessary. In this role, the R3V can also receive data transmitted from the installed FH-40 Dose Rate Meter installed in the Dedicated Field Team Response Vehicles, and display it on the ViewPoint Client display on computers in the R3V.

The R3V is equipped with an on-board generator for AC electrical power supply at remote locations. It is also equipped with flashing lights and a siren for emergency response activities.

SECTION 2: EQUIPMENT START-UP

This procedure covers start-up of the R3V on-board radiation monitoring, mechanical, AC electrical, and communications equipment.

This start-up procedure begins with the R3V parked in its storage area.

NOTE: When stored, the R3V should be plugged into shore power.

A. General:

1. Unlock R3V doors. Place key in ignition and turn to 'Accessory' position. Turn on interior DC lights. The switch for the interior lights is located on the driver's side, above and behind the driver's seat. (The vehicle key must be in the 'Accessory' or 'Vehicle On' position for the interior lights to operate.)
2. On electrical control panel, place '120/240 Volt AC Selection' switch to 'OFF'.
3. Disconnect shore power cables. Place them in storage compartment in rear of vehicle.
4. Drive vehicle to desired location. When parking at location, orient vehicle on East – West axis, with clear view of southern sky for satellite reception. (Compass on dashboard.)
5. Unlock all compartments.

B. AC Electrical System Start-up:

The R3V AC electrical system can be powered by either shore power or an on-board 12 kW diesel generator. The AC electrical system control panel and circuit breaker box is located in the R3V on the driver's side, next to the TV screen.

1. If using Shore Power:
 - a. Set '120/240 Volt AC Selection' switch to 'OFF'.
 - b. Plug in shore power cables to outlets at rear of R3V, and source of power.
 - c. Verify 'Power Available' lights on electrical control panel are green. 'Reverse Polarity' lights (red) should NOT be lit. If red 'Reverse Polarity' lights are lit, DO NOT connect to shore power. If red 'Reverse Polarity' lights are lit, change shore power source or use on-board generator.
 - d. Set '120/240 Volt AC Selection' switch to 'SHORE'.

2. If using Diesel Generator:

IMPORTANT SAFETY NOTE: DO NOT RUN THE DIESEL GENERATOR IF R3V IS PARKED IN AN ENCLOSED GARAGE OR OTHER UNVENTILATED SPACE. THE DIESEL GENERATOR PRODUCES EXHAUST FUMES, AND MUST HAVE OUTSIDE VENTILATION FOR OPERATION.

IMPORTANT OPERATIONAL NOTE: IF THE OUTSIDE TEMPERATURE IS 80 DEGREES FARENHEIT OR HIGHER, AND THE DIESEL GENERATOR IS TO BE RUN FOR ONE HOUR OR MORE, OPEN THE DOORS TO THE DIESEL GENERATOR COMPARTMENT TO PROVIDE FOR ADEQUATE COOLING FOR THE GENERATOR.

- a. The on-board diesel generator is 12 kW. It is located in an outside compartment on the driver's side of the R3V.
- b. Start diesel generator on 'Quiet Diesel' panel, located above the storage cabinet on the driver's side in the R3V. On the panel, press and hold the 'START/PREHEAT' switch. Diesel will start. Release 'START/PREHEAT' switch after diesel starts. Fuel gauge should begin to register. (There is also a 'START' switch on the generator.)
- c. Verify 'Power Available' lights on electrical control panel are green. 'Reverse Polarity' light (red) should NOT be lit. If red 'Reverse Polarity' light is lit, DO NOT connect to diesel generator. If red 'Reverse Polarity' light is lit, change to alternate power source.
- d. Set '120/240 Volt AC Selection' switch to 'GENERATOR'.

3. Breaker Position:

The breaker box is located above the electrical control panel in the R3V. It contains breakers for all AC electrical components in the R3V.

- a. Breakers that should always be 'ON', for vehicle in storage or in operation:
 - Battery Charger
 - Fan and Powerstrips
 - Volt Meter
 - Volt and Hertz Meters

NOTE: The 'Fan and Powerstrips' breaker is always 'ON' to maintain a charge on the Matrix ESP probes.

- b. As a minimum for vehicle equipment operation, these additional breakers need to be 'ON':
 - 2 Recepts. Plug Mold
 - Right Recepts. Rear Interior
 - Recepts. Pass Side Int.
- c. The remaining breakers can be placed to 'ON' as needed:
 - Heat (Passenger and Drivers Side)
 - Refrigerator
 - Cord Reel (located in outside cabinet on driver's side of vehicle)
 - Air Conditioner
 - Pole Light

NOTE: Several outlets have 'Reset' buttons on the outlet face. If no power is available at an outlet, check outlet is reset.

C. Satellite Internet (and E-mail) Start-up:

The R3V connects to the internet by a satellite link. The large dish on the roof of the R3V (driver's side, rear) is used for satellite internet. E-mail is also available through the satellite internet link.

The R3V has three laptop computers that can be used for Internet access, E-mail, and ViewPoint software. All laptops can run Internet access, E-mail, and ViewPoint software at the same time.

IMPORTANT SAFETY NOTE: DO NOT GO ONTO THE ROOF OF THE R3V WHEN A SATELLITE DISH IS DEPLOYED. THE SATELLITE DISH PRODUCES ELECTROMAGNETIC WAVES THAT ARE HAZARDOUS TO PERSONS STANDING IN FRONT OF THE SATELLITE DISH.

IMPORTANT SAFETY NOTE: BEFORE DEPLOYING A SATELLITE DISH, CONDUCT A VISUAL INSPECTION OUTSIDE THE R3V TO VERIFY THAT NO OVERHEAD OBSTRUCTIONS WILL INTERFERE WITH SATELLITE DISH DEPLOYMENT.

1. Orient R3V on East-West axis, with clear view of southern sky for satellite reception.
2. Remove laptop computer from storage and start-up.
3. Log onto laptop with passwords found on laptop.
4. Start 'Internet Explorer'.
5. Under 'Favorites', select 'MotoSAT Datastorm' website (<http://192.168.1.250>).
6. On 'MotoSAT Datastorm' screen, select 'SEARCH'.
Satellite dish will deploy, and acquire satellite. Satellite acquisition can take 7-15 minutes.

NOTE: If a 'System Status' Error Message is displayed (Such as "Waiting for Modem" or "Modem Not Found"), turn off '2 Recept. Plug Mold' breaker for a few seconds and then reenergize it. Reset 'Internet Explorer'. Go to 'MotoSAT Datastorm' website and select 'SEARCH' again.

If this fails to reset error, it may be necessary to individually power down and restart satellite controller, wireless router, and/or satellite modem.

7. When satellite has acquired, the following messages will be displayed on the 'MotoSAT Datastorm' screen:
TX Status: Transmitter ready.
RX Status: Receiver operational.
8. Internet access (including e-mail) is now available. To use e-mail, follow instructions in "BRP Emergency Telephone Directory", BRP-ER-5A.

D. Satellite TV Start-up:

The R3V receives TV signals from a satellite through Dish Network TV. The TV satellite dish is the smaller dish on the roof of the R3V, located on the passenger side, forward.

IMPORTANT SAFETY NOTE: DO NOT GO ONTO THE ROOF OF THE R3V WHEN A SATELLITE DISH IS DEPLOYED. THE SATELLITE DISH PRODUCES ELECTROMAGNETIC WAVES THAT ARE HAZARDOUS TO PERSONS STANDING IN FRONT OF THE SATELLITE DISH.

IMPORTANT SAFETY NOTE: BEFORE DEPLOYING A SATELLITE DISH, CONDUCT A VISUAL INSPECTION OUTSIDE THE R3V TO VERIFY THAT NO OVERHEAD OBSTRUCTIONS WILL INTERFERE WITH SATELLITE DISH DEPLOYMENT.

1. Turn TV 'ON' with white remote control (STAR).
2. Using 'Input' button on white remote control, be sure you have selected:
 'VIDEO
 AUTO'
displayed on the TV screen.
3. The satellite TV dish control box is located in the foremost overhead compartment on the passenger side. On this box, push the 'FIND' button. This deploys TV satellite dish.
NOTE: If satellite fails to acquire, stow dish, turn off satellite controller (switch is on rear of unit) and wait 10 sec. Turn power back on and wait 30 sec. Push 'FIND' to deploy dish.
4. On the TV screen, the status of the TV satellite link will be displayed.
5. When TV satellite link is established, change channels using satellite receiver remote control (black) located in cabinet containing satellite TV control box.

E. Satellite Phones Start-up:

Three satellite phones are mounted in the work area of the R3V. They are in cradles, with a handset. While the phones remain in the cradle, they use an antenna mounted on the roof of the R3V.

1. Press the 'PWR' button on the satellite phone face.
2. Use satellite phones in accordance with instructions found in the "BRP Emergency Telephone Directory", BRP-ER-5A.

F. ViewPoint Software Start-up:

ViewPoint is Thermo Electron's software for viewing radiation monitoring data from multiple pieces of equipment. It is run from computers with the installed ViewPoint Client software. The R3V has three laptop computers with ViewPoint software installed. The vehicle has a wireless network to interface between laptops, server, and satellite internet. The ViewPoint server is located in the upper passenger side compartment in the R3V.

1. Remove laptop computer from storage and start-up.
2. Log onto laptop computer with passwords found on laptop.
3. Double click 'ViewPoint Client'.
4. Log onto 'ViewPoint Client' (Logon is case sensitive):

Username:
Password:
Server:



5. ViewPoint will display data from radiation equipment in R3V, and data from radiation monitoring equipment in deployed Field Team Support Vehicles. For further instructions, use ViewPoint manual.

G. Radiation Monitoring Equipment (On-Board) Start-up:

1. Perform operational and source checks of AMS-4, FHZ-671 and FHZ-621 as found in 'Appendix B – Radiation Monitoring Equipment Operational and Source Check Procedures'.
2. After completing operational and source check procedures, turn on pump for AMS-4 air monitoring system using switch on pump cord.
3. The installed on-board equipment is now in a continuous monitoring mode. The monitoring data is being sent to the ViewPoint software.

When it is necessary to change the filter on the AMS-4 Particulate and Iodine units:

NOTE: Pump must be 'OFF' when changing filters on AMS-4 Iodine unit and Particulate collection unit.

4. Turn off air pump for AMS-4 air monitoring system.
5. Obtain glass fiber filter for AMS-4 Particulate unit, and charcoal filter for AMS-4 Iodine unit. Filters are stored in cabinet behind driver's seat. Mark filters on side that will be facing away from detector.
6. On AMS-4 Particulate unit, unlatch clasp, remove filter holder housing, and place glass fiber filter in filter holder, with marked side facing away from the detector. Replace filter holder housing, and relatch clasp.
7. On AMS-4 Iodine unit, unlatch clasp, remove filter holder housing, and place charcoal filter in filter holder, with marked side facing away from the detector. Replace filter holder housing, and relatch clasp.
8. Turn on pump for AMS-4 air monitoring system pump using switch on pump cord.

SECTION 3: DEPLOYMENT AND RETRIEVAL OF MATRIX ESP PROBES

The Matrix ESP probes are battery powered radiation probes. They have a GPS unit installed. By means of an installed radio transmitter or the satellite antenna mounted on top of the unit, they can transmit radiation data to remote locations, which is viewed on the ViewPoint software. The Matrix ESP probes are designed to be dropped off in remote locations, where they can monitor radiation levels and provide that information to BRP staff in the R3V or other locations. Matrix ESP probes are stored in the R3V, in the cabinet containing the AMS-4 air monitoring equipment. See illustration of Matrix ESP probe in Figure 1 below for description of lights and key positions.

1. Disconnect the 'Network' and 'Power' cables from each of the Matrix ESP probes that are going to be used.
2. Move Matrix ESP probes outside R3V.
3. Turn key to 'TEST/FAST'. Have R3V staff verify reception of data.
4. Perform operational and source checks for Matrix ESP probes as found in 'Appendix B – Radiation Monitoring Equipment Operational and Source Check Procedures'.
5. Turn key to 'OFF'.
6. Take Matrix ESP probes to desired locations for radiation monitoring. The locations should have a clear view of the southern sky, so the satellite transmitter can successfully connect to the satellite.
7. Turn the key to 'TEST/FAST'. The lights on the Matrix ESP probe should flash, indicating the unit is started.
8. Verify with the R3V or command center that the Matrix ESP probe is appearing on ViewPoint, and is transmitting data. Turn the key to 'ON'.
9. For Normal Operation: When in the field and >1 mile from R3V, the lights on the Matrix ESP probes should be:

Status:	Solid Green
SAT:	Flashing Red
Probe:	Flashing Red
Radio:	Solid Red
GPS:	Flashing Red
GSM:	Solid Red

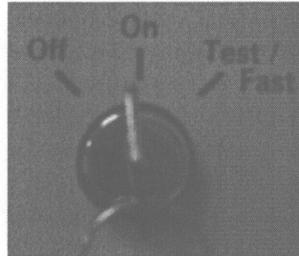
NOTE: See Matrix ESP Probe Manual for more details.

When Matrix ESP probe deployment is finished and the probes are retrieved, place Matrix ESP probes in their storage locker in the R3V.

1. Turn key on Matrix ESP probe to 'OFF'.
2. Transport Matrix ESP probes
3. Stow Matrix ESP probes in locker, and reconnect the 'Network' and 'Power' cables.

Figure 1 – Matrix ESP Probes

The Matrix ESP probe is equipped with an electronic style key switch for easy start-up and secure operation. There are two modes of start-up operation available with the Matrix ESP Probe:



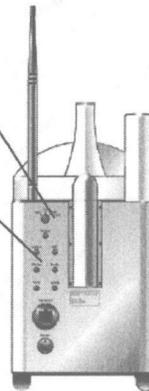
On – When the key switch is in the “On” position, the unit begins startup functions based on the standard transmit times programmed in the CNET-1500 Controller. For the “On” position, the normal transmit time is 5 minutes.

Test/Fast – When the unit is in the “Test/Fast” position, the unit will begin transmitting data at the rate setup in the CNET-1500 for fast operation. For the “Test/Fast” position, the transmit time is 30 seconds.

The ESP unit will begin transmitting once initialization is complete and while the switch is turned on to either the “On” or “Test/Fast” positions. The switch can be changed from “On” to “Test/Fast” at anytime required without resetting the unit’s operation.



- **Key Switch**
 - 3 Positions
 - Off
 - On (Normal)
 - Test/Fast
- **LEDs**
 - Power (Green)
 - Indicates power left based on flash rate
 - Status (Green)
 - Will stay continuous when all systems are normal
 - Satellite (Red)
 - Flashes based on Transmit rate
 - Solid indicates problems
 - Probe (Red)
 - Flashes based on Transmit rate
 - Solid indicates problems
 - Radio (Red)
 - Flashes based on Transmit rate
 - Solid indicates problems
 - GPS (Red)
 - Flashes based on Transmit rate
 - Solid indicates problems
 - GSM/Cellular (Red)
 - Flashes based on Transmit rate
 - Solid indicates problems



- **Connectors**
 - RJ-45 Ethernet Connection
 - Power Connector
 - TNC Antenna Connector

SECTION 4: EQUIPMENT SHUTDOWN

Upon completion of R3V operations at a location, the radiation monitoring, communications, and AC electrical, equipment should be shutdown in accordance with the following instructions.

A. Radiation Monitoring Equipment (On-Board) and ViewPoint Shutdown:

1. Turn off the power strip behind the Iodine unit. This deenergizes the AMS-4, FHZ-671, and FHZ-621.
2. Turn off the air pump for AMS-4 with the switch on the pump cord.
3. Close out of 'ViewPoint' window on computer.

B. Satellite Phones Shutdown:

1. Press 'PWR' button to turn power off on each satellite phone unit.

C. Satellite TV Shutdown:

1. Turn off TV with white controller (STAR).
2. Retract satellite dish by pressing 'STOW' button on satellite TV dish control box.

IMPORTANT SAFETY NOTE: BEFORE MOVING R3V, CONDUCT A VISUAL INSPECTION TO ENSURE SATELLITE DISH HAS STOWED.

D. Satellite Internet (and E-mail) Shutdown:

1. Log off of e-mail.
2. On 'MotoSAT Datastorm' screen on computer, select 'STOW'.
3. When dish is stowed, the message will read:
 'System Status: Stow dish operation completed.'
4. When dish is stowed, log off of 'MotoSAT Datastorm' screen on computer.

IMPORTANT SAFETY NOTE: BEFORE MOVING R3V, CONDUCT A VISUAL INSPECTION TO ENSURE SATELLITE DISH HAS STOWED.

E. AC Electrical System Shutdown:

1. If using Shore Power:
 - a. Open all breakers on circuit breaker panel EXCEPT:
 - Battery Charger
 - Fan and Powerstrips
 - Volt Meter
 - Volt and Hertz Meters
 - b. Move '120/240 Volt AC Selection' switch to 'OFF'.

- c. Remove shore power cables and store in cabinet in back of R3V.
-
2. If using Diesel Generator:
 - a. Open all breakers on circuit breaker panel EXCEPT:
 - Battery Charger
 - Fan and Powerstrips
 - Volt Meter
 - Volt and Hertz Meters
 - b. Move '120/240 Volt AC Selection' switch to 'OFF'.
 - c. On 'Quiet Diesel' control panel, press 'STOP'.
 - d. Verify diesel generator has stopped.
 - e. If diesel generator compartment doors were opened, shut diesel generator compartment doors.

F. General:

1. Turn off interior DC lights with switch on driver's side, above and behind the driver's seat.

IMPORTANT SAFETY NOTE: BEFORE MOVING R3V, CONDUCT A VISUAL INSEPTION OUTSIDE VEHICLE TO VERIFY THAT ALL SATELLITE DISHES ARE STOWED, AND ALL OTHER EQUIPMENT IS PROPERLY STOWED.

SECTION 5: R3V STORAGE

When the R3V is parked in its assigned storage space, perform the following items:

1. Verify '120/240 Volt AC Selection' switch is set to 'OFF'.
2. Verify that all circuit breakers are 'OFF' except:
 - Battery Charger
 - Fan and Powerstrips
 - Volt Meter
 - Volt and Hertz Meters
3. Connect shore power cables to shore power outlets.
4. Verify 'Power Available' lights on electrical control panel are green. 'Reverse Polarity' lights (red) should NOT be lit. If red 'Reverse Polarity' lights are lit, DO NOT connect to shore power. If red 'Reverse Polarity' lights are lit, change shore power source.
5. Set '120/240 Volt AC Selection' switch to 'SHORE'.
6. Lock all cabinets and lock vehicle.

SECTION 6: CALIBRATION

Calibration of the installed on board radiation monitoring instruments on the R3V will be conducted **annually or at a frequency directed by the BRP Bureau Director, or after repair of an instrument.** Records of calibration will be maintained by the BRP Central Office in Harrisburg, and copies will be provided to the Regional Offices.

SECTION 7: MAINTENANCE

Maintenance of equipment shall be performed per the manufacturer's directions, and when a problem with the equipment is found. If questions arise about maintenance, contact the BRP Emergency Response Section Chief.

**APPENDIX A: MECHANICAL, AC ELECTRICAL, AND COMMUNICATIONS
EQUIPMENT OPERATIONAL CHECKS**

Operational checks of mechanical, AC electrical, and communications equipment should be conducted **monthly**.

A. Mechanical Equipment:

1. Engine of R3V should be run and vehicle driven at least 20 miles per month.
2. To perform operational checks of mechanical equipment, perform Item A: General, in Section 2: Equipment Start-up.

B. AC Electrical System:

1. Diesel generator should be run under load for 2 hours each month.
2. To perform operational checks of AC electrical system, perform Item B: AC Electrical System Start-up, in Section 2: Equipment Start-up.

C. Communications Equipment:

1. To perform operational checks of communications equipment, perform the following items in Section 2: Equipment Start-up:

Item C: Satellite Internet (and E-mail) Start-up
Item D: Satellite TV Start-up
Item E: Satellite Phones Start-up

D. If Performing Quarterly Operational and Source Checks of Radiation Monitoring Equipment in Accordance with Appendix B, Perform Them Here.

E. Equipment Shutdown:

Upon completion of operational checks of AC electrical system, mechanical equipment, and communications equipment, perform the following items in Section 4: Equipment Shutdown:

Item B: Satellite Phones Shutdown
Item C: Satellite TV Shutdown
Item D: Satellite Internet (and E-mail) Shutdown
Item E: AC Electrical System Shutdown
Item F: General

F. R3V Storage:

Upon completion of AC electrical, mechanical, and communications operational checks, place R3V in storage in accordance with Section 5: R3V storage.

Deficiencies in operational checks should be corrected promptly by having the defective equipment repaired or replaced. Report deficiencies in operational checks to Regional Program Manager and BRP Emergency Response Section.

APPENDIX B: RADIATION MONITORING EQUIPMENT OPERATIONAL AND SOURCE CHECK PROCEDURES

Operational checks may include:

1. Physical inspection
2. Battery check
3. Calibration due date
4. Response/source check.

Operational checks are performed on radiation monitoring equipment **quarterly and prior to use.**

Perform the quarterly operational checks of the radiation monitoring equipment in conjunction with the monthly operational checks of the mechanical, AC electrical, and communications equipment. This will ensure that all systems are operating, and that power is available for all equipment.

Do not use an instrument if it fails an operational check. Place the instrument out-of-service and notify the Regional Program Manager and the DEP Emergency Response Section as soon as possible. When performing operational checks, complete Attachment 1, "R3V Radiation Monitoring Equipment Operational Checks" form. Keep a copy of the completed form. Forward a copy of the completed form to the BRP Emergency Response Section Chief.

A. Performance of Operational Checks on R3V Radiation Monitoring Equipment:

1. Visually inspect the equipment, including detectors and cables, for signs of damage. (Do not use if damaged.)
2. Verify by inspection of calibration sticker or calibration documents that radiation monitoring instruments are not beyond calibration due date. (Do not use if date exceeded.)
3. To perform operational checks of radiation monitoring equipment:
 - a. AMS-4, FHZ-671, and FHZ-621:
 1. Turn on power strip behind AMS-4 Iodine unit. This power strip powers:
 - i. AMS-4 Noble Gas, Particulate, and Iodine monitors
 - ii. FHZ-671 7 Liter plastic scintillator detector
 - iii. FHZ-621 wide range proportional detector

NOTE: To silence alarms on AMS-4 units, press 'ACK' button on AMS-4 Particulate, Iodine, and Noble Gas units.

2. Perform source checks for AMS-4, FHZ-671, and FHZ-621 as

described in Section B: Source Check Procedures, below.

- b. Matrix ESP Probes:
 - 1. Disconnect 'Network' and 'Power' cables from each of the Matrix ESP probes that are being used.
 - 2. Move Matrix ESP Probes outside R3V.
 - 3. Turn key to 'TEST/FAST'. Have R3V staff verify reception of data.
 - 4. Perform source checks for Matrix ESP probes as described in Section B: Source Check Procedures, below.

Deficiencies in operational checks should be corrected promptly by having the defective equipment repaired or replaced.

B. Source Check Procedures for R3V Radiation Monitoring Equipment:

1. Source Check of FHZ-671 7 Liter Plastic Scintillator Probe:

- a. Verify power is on for FHZ-671. Power is provided from power strip behind Iodine unit in cabinet containing FHZ-671.
- b. Place 10 uCi Cs-137 source on red centerline of probe (source label facing out).
- c. On ViewPoint display, read the 'Total Rate' (uRem/hr) column. Reading should fall into the range given for the FHZ-671 probe.

2. Source Check of FHZ-621 Wide Range Proportional Detector:

- a. Verify power is on for FHZ-621. Power is provided from power strip behind Iodine unit in cabinet containing FHZ-621.
- b. Place 10 uCi Cs-137 source on red centerline of probe (source label facing out).
- c. On ViewPoint display, read the 'Dose Rate' (mRem/hr) column. Reading should fall into the range given for the FHZ-621 probe.

3. Source Check of Matrix ESP Probes:

- a. Verify that key on Matrix ESP probe is in 'TEST/FAST' position.
- b. Place 10 uCi Cs-137 source on red centerline of probe (source label facing out).
- c. On ViewPoint display, the readings for the Matrix ESP probe will be found two places:
 - a. FHZ-621 Section, 'Dose Rate' (mRem/hr)
 - b. Matrix DEP FHZ-621 Section, 'Dose Rate' (mRem/hr)Reading should fall into the range given for the Matrix ESP probe.

4. Source Check of AMS-4 Air Monitor:

Prerequisites:

- a. AMS-4 check sources are available for the source check procedure.
- b. Ensure that the Counting Time is pre-loaded into the AMS-4 Particulate, Iodine and Noble Gas units (See NOTE and Section B below.)
- c. Ensure the Source Activity Data is pre-loaded into AMS-4 Particulate and Iodine units. (See NOTE and Section C below.)
- d. Ensure that the AMS-4 pump is turned off prior to starting the source check procedure.

NOTE: Entry of the Counting Time and Source Activity Data in Steps B and C below only have to be done the first time a source check is conducted. If these parameters have already been loaded into the AMS-4, go immediately to Step A. The Counting Time and Source Activity Data settings are saved

in the AMS-4 memory and will be used as the default settings. The Counting Time and Source Activity Data currently entered in the AMS-4 units will be noted on the "Source Check Information" sheet in the R3V.

A. AMS-4 Source Check Procedure:

IMPORTANT NOTE: ENSURE THE PUMP IS OFF BEFORE PERFORMING AMS-4 SOURCE CHECKS.

1. Particulate Unit:
 - a. To begin the source check, press 'Menu Button' on AMS-4 Particulate unit display.
 - b. Enter the 1-4 digit Password. ([REDACTED])
 - c. Press "Enter".
 - d. Press the ↓ arrow to "Calibrate"
 - e. Press "Enter".
 - f. Press the ↓ to "Source Check".
 - g. Press "Enter".
 - h. You will get a scrolling screen with a message. Read message and press "Enter".
 - i. Press any key.
 - j. The unit will start into a Background Check Mode and count down for 60 seconds. At the end of the background count (60 seconds), the display will read: Bkg = XX.YY CPM.
 - k. Press any key to continue.
 - l. A scrolling message will appear on the display describing positioning of the check source, instructing that the active side of the source be placed towards the detector.
 - m. Position the check source with the active side towards detector:
 - i. Unlatch clasp, remove filter holder housing, and remove glass fiber filter (if one installed).
 - ii. Place Tc-99 check source in filter holder housing with active side of source facing detector.
 - iii. Replace filter holder housing and latch clasp.
 - n. Press "Enter".
 - o. Press any key to continue.
 - p. The check source count (60 seconds) will begin.
 - q. At the end of the 60 seconds, the display will show:
EFF: = XX.YY % (Indicates % efficiency in respect to completed source check.)
EFF DIFF: +/- XX.YY % (Indicates difference (in %) from the expected reading.) The EFF DIFF must be +/- 20% for the source check to be satisfactory, as noted on the "Source Check Information" sheet in the R3V.
 - r. Take the AMS-4 Particulate unit 'Out of Service' or repeat source check if % difference is out of the accepted tolerance.
 - s. Press "Menu" button repeatedly to get back to Main Display screen.
 - t. Remove check source and install filter:

- i. Unlatch clasp, remove filter holder housing, and remove check source.
- ii. Install new glass fiber filter in filter holder. (Mark side of filter facing away from detector.)
- iii. Replace filter holder housing and latch clasp.
- u. Source check is complete.

2. Iodine Unit:

- a. To begin the source check, press 'Menu Button' on AMS-4 Iodine unit display.
- b. Enter the 1-4 digit Password. ()
- c. Press "Enter".
- d. Press the ↓ arrow to "Calibrate"
- e. Press "Enter".
- f. Press the ↓ to "Source Check".
- g. Press "Enter".
- h. You will get a scrolling screen with a message. Read message and press "Enter".
- i. Press any key.
- j. The unit will start into a Background Check Mode and count down for 60 seconds. At the end of the background count (60 seconds), the display will read: Bkg = XX.YY CPM.
- k. Press any key to continue.
- l. A scrolling message will appear on the display describing positioning of the check source, instructing that the active side of the source be placed towards the detector.
- m. Position the check source with the active side towards detector:
 - i. Unlatch clasp, remove filter holder housing, and remove charcoal filter (if one installed).
 - ii. Place Tc-99 check source in filter holder housing with active side of source facing detector.
 - iii. Replace filter holder housing and latch clasp.
- n. Press "Enter".
- o. Press any key to continue.
- p. The check source count (60 seconds) will begin.
- q. At the end of the 60 seconds, the Display will show:
EFF: = XX.YY % (Indicates % efficiency in respect to completed source check.)
EFF DIFF: +/- XX.YY % (Indicates difference (in %) from the expected reading.) The EFF DIFF must be +/- 20% for the source check to be satisfactory, as noted on the "Source Check Information" sheet in the R3V.
- r. Take the AMS-4 Iodine unit 'Out of Service' or repeat source check if % difference is out of the accepted tolerance.
- s. Press "Menu" button repeatedly to get back to Main Display screen.
- t. Remove check source and install filter:
 - i. Unlatch clasp, remove filter holder housing, and remove check source.

- ii. Install new charcoal filter in filter holder. (Mark side of filter facing away from detector.)
- iii. Replace filter holder housing and latch clasp.
- u. Source check is complete.

3. Noble Gas Unit:

- a. To begin the source check, press 'Menu Button' on AMS-4 display.
- b. Enter the 1-4 digit Password. ()
- c. Press "Enter".
- d. Press the ↓ arrow to "Calibrate"
- e. Press "Enter".
- f. Press the ↓ to "Source Check".
- g. Press "Enter".
- h. You will get a scrolling screen with a message. Read message and press "Enter".
- i. Press any key.
- j. The unit will start into a Background Check Mode and count down for 60 seconds. At the end of the background count (60 seconds), the display will read: Bkg = XX.YY CPM.
- k. Press any key to continue.
- l. A scrolling message will appear on the display describing positioning of the check source, instructing that the active side of the source be placed towards the detector.
- m. Position the 10 uCi Cs-137 check source on top of the black cover of the Noble Gas detector unit, at the spot indicated by the label on the top of the black cover. The label side of the source should face up.
- n. Press "Enter".
- o. Press any key to continue.
- p. The check source count (60 seconds) will begin.
- q. Let the count run for 20 seconds for the count to stabilize. (From 60 seconds to 40 seconds.)
- r. Beginning at the 40 seconds mark, monitor the CPM from the check source for 10 seconds. (Until the counter reaches 30 seconds.)
- s. The CPM during this 10 second period should be within the acceptable range given for the Noble Gas unit, as noted on the "Source Check Information" sheet in the R3V.
- t. Allow the source check count to run to 0 seconds. Ignore the EFF and EFF DIFF data displayed at the end of the count.
- u. Take the AMS-4 Noble Gas unit 'Out of Service' or repeat source check if observed CPM is out of the accepted tolerance.
- v. Press "Menu" button repeatedly to get back to Main Display screen.
- w. Source check is complete.

B. Setting Counting Time for Background and Source Check for Particulate, Iodine, and Noble Gas units:

1. Press 'Menu' Button on AMS 4 Display
2. Enter 1-4 digit Password. (XXXX)
3. Press Enter.
4. Press the ↓ arrow to "Instrument Parameters"
5. Press "Enter"
6. Press the ↓ arrow to "Calibration Count Time"
7. Press "Edit".
8. Using keypad, enter time of 60 seconds.
9. Press "Enter" to save time.
10. Press "Menu" twice to return to main window.

C. Entering Source Activity Data (in uCi) for Particulate and Iodine units:

1. Press 'Menu' Button on AMS 4 Display
2. Enter 1-4 digit Password. (XXXX)
3. Press "Enter".
4. Press the ↓ arrow to "Instrument Parameters"
5. Press "Enter"
6. Press ↓ to "Calib. Source ACT."
7. Press "Edit"
8. Using keypad, enter activity of check source in uCi.
9. Press "Enter" to save data.
10. Press "Menu" twice to return to main screen.

ATTACHMENT 1: R3V RADIATION MONITORING EQUIPMENT OPERATIONAL CHECKS

Quarter: (1st, 2nd, etc.) _____ Year _____ Vehicle License #: _____

Instrument	Component	Serial No.	Cal. Due Date	Operational Checks (Check One)		Initial
				SAT	UNSAT	
AMS-4	Pump					
AMS-4	NG Unit					
AMS-4	Iodine Unit					
AMS-4	Part. Unit					
FHZ-671	N/A					
FHZ-621	N/A					
Matrix ESP	N/A					
Matrix ESP	N/A					
Matrix ESP	N/A					
Matrix ESP	N/A					

NOTES:

Completed By: _____ Date: _____

Forward copy of completed form to BRP Emergency Response Section Chief each quarter.

ESTIMATION OF AIRBORNE RADIOLOGICAL CONSEQUENCES USING FIELD SAMPLING DATA

PURPOSE:

This procedure provides for the hand calculation of dose projections from an accident or incident at a nuclear power plant involving the release of radionuclides to the atmosphere.

This procedure utilizes field measurements to calculate projected whole body dose (TEDE), and child thyroid dose (CDE).

This procedure supplements BRP-ER-6.03, "ESTIMATION OF RADIOLOGICAL CONSEQUENCES OF AIRBORNE RADIOACTIVE MATERIAL FROM GROUND LEVEL SOURCES", in the event no source term information is available, but field measurement information is available.

CONTENTS OF PROCEDURE:

INPUT PARAMETERS	SECTION 1
PROJECTED WHOLE BODY DOSE (TEDE) USING FIELD GAMMA EXPOSURE RATES	SECTION 2
PROJECTED CHILD THYROID DOSE (CDE) USING FIELD IODINE AIR CONCENTRATION	SECTION 3
PROJECTED CHILD THYROID DOSE (CDE) USING FIELD GAMMA EXPOSURE RATES	SECTION 4
USE OF RESULTS	SECTION 5
WHOLE BODY DOSE (TEDE) PROJECTION WORKSHEET	ATTACHMENT 1
CHILD THYROID DOSE (CDE) PROJECTION USING FIELD IODINE MEASUREMENTS WORKSHEET	ATTACHMENT 2
CHILD THYROID DOSE (CDE) PROJECTION USING FIELD GAMMA EXPOSURE RATES WORKSHEET	ATTACHMENT 3
RADIOIODINE DOSE CONVERSION FACTORS	TABLE 1
PROJECTED THYROID DOSE AS A FUNCTION OF EITHER GAMMA EXPOSURE RATE OR RADIOIODINE CONCENTRATION IN AIR	FIGURE 1
CORRECTION FACTORS FOR THYROID INHALATION DOSE AS A FUNCTION OF TIME AFTER SHUTDOWN	FIGURE 2
GAMMA EXPOSURE RATE FINITE CLOUD CORRECTION FACTOR	FIGURE 3

ESTIMATION OF AIRBORNE RADIOLOGICAL CONSEQUENCES USING FIELD SAMPLING DATA

SECTION 1 -- INPUT PARAMETERS

- A. The necessary data is:
1. The field gamma exposure rate (mR/hr), to calculate Whole Body Dose (TEDE).
 2. The field iodine air concentration (uCi/cc) and/or the field gamma exposure rate (mR/hr), to calculate Child Thyroid Dose (CDE).
- B. The "FIELD TEAM OPERATIONS PROCEDURE", BRP-ER-6.01, is used by the field teams to obtain the field gamma exposure rate (mR/hr), and field iodine concentration (uCi/cc).

SECTION 2 -- PROJECTED WHOLE BODY DOSE (TEDE) USING FIELD GAMMA EXPOSURE RATES

- A. Enter the appropriate field measurement data on the "Whole Body Dose (TEDE) Projection Worksheet", Attachment 1.
- B. Use the Worksheet to calculate the projected whole body dose (TEDE).

SECTION 3 -- PROJECTED CHILD THYROID DOSE (CDE) USING FIELD IODINE AIR CONCENTRATION

- A. Enter the appropriate field measurement data on the "Child Thyroid Dose (CDE) Projection Using Field Iodine Measurements Worksheet", Attachment 2.
- B. Enter the appropriate "Radioiodine Dose Conversion Factor" from Table 1 in Column 'E' of Attachment 2.
- C. Use the Worksheet to calculate the projected child thyroid (CDE) dose.

SECTION 4 -- PROJECTED CHILD THYROID DOSE (CDE) USING FIELD GAMMA EXPOSURE RATES

It is possible to obtain a crude estimate of the radioiodine air concentration, and the child thyroid dose (CDE) using field gamma exposure rates, if field iodine air concentrations are not available. (For discussion, see "Preparedness and Response in Radiation Accidents", U.S. Department of Health and Human Services, Food and Drug Administration, Center for Devices and Radiological Health, Rockville, MD, August, 1983. Reprinted by Nucleon Lectern Associates, Inc., Olney, MD. Chapter 3.5, "Protective Actions".)

- A. Enter the appropriate data in the first four columns ('A'-'D') of the "Child Thyroid Dose (CDE) Projection Using Field Gamma Exposure Rates Worksheet", Attachment 3.
- B. Enter the appropriate projected child thyroid dose (CDE) as a function of gamma exposure rate from Figure 1, in Column 'E' of Attachment 3.
- C. Enter the appropriate correction factor for thyroid inhalation dose as a function of time after shutdown from Figure 2, in Column 'F' of Attachment 3.
- D. Enter the appropriate gamma exposure rate finite cloud correction factor from Figure 3, in Column 'G' of Attachment 3.
- E. Calculate the projected child thyroid dose (CDE) using the data on the Worksheet, Attachment 3.

SECTION 5 -- USE OF RESULTS

- A. Report results to supervisor, and to BRP-EOC and BRP-EOF.

TABLE 1: RADIOIODINE DOSE CONVERSION FACTORS

<u>Time After Shutdown at Which Emissions Measured (hours)</u>	<u>Iodine DCF for One Hour Exposure (rem-m³ /Ci-hr)</u>
1	3.2E+5
2	3.5E+5
3	3.9E+5
5	4.4E+5
10	5.3E+5

NOTE: DCF for I-131 is 1.3E+6. Use of I-131 DCF is conservative.
As time after shutdown increases, DCF approaches I-131 DCF.
Only I-133 (t_{1/2} = 21 hours) has much influence on dose calculations
compared to I-131.

NOTE: Source of DCF's: Manual for "Radiological Accident Assessment --
Plume Phase" Course, FEMA National Emergency Training Center,
Emmitsburg, MD, 1994, Tab 14.

ATTACHMENT 1: WHOLE BODY DOSE (TEDE) PROJECTION WORKSHEET

This worksheet provides the Whole Body Dose (TEDE) to an individual in the plume.

PLANT: _____ UNIT: _____ DATE: _____ TIME: _____

A	B	C	D		E	=	F
Time of Measurement	Distance from Plant (miles)	Direction from Plant	Gamma Exp. Rate (R/hr)	X	Exposure Time (hours)	=	Whole Body Dose (TEDE) (rem)
				X		=	
				X		=	
				X		=	
				X		=	
				X		=	
				X		=	
				X		=	

A, B, C -- As Obtained E -- As Obtained

D -- Field Measurement F = D x E

ATTACHMENT 2: CHILD THYROID DOSE (CDE) PROJECTION USING FIELD IODINE MEASUREMENTS WORKSHEET

This worksheet provides the Child Thyroid Dose (CDE) to an individual in the plume.

NOTE: Projected Adult Thyroid Dose = 0.5 x Projected Child Thyroid Dose.

PLANT: _____ UNIT: _____ DATE: _____ TIME: _____

SHUTDOWN TIME: _____ TIME AFTER SHUTDOWN AT WHICH EMISSIONS MEASURED (HOURS): _____

A	B	C	D		E			F		G		H
Time of Measurement	Dist. From Plant (mi)	Direction From Plant	Iodine Conc. (Ci/m)	x	DCF (rem-m ³ /Ci-hr) (Table 1)	x2	=	Child Thyroid Dose (1 hr. exposure) (rem)	x	Expos. Time (hrs.)	=	Total Child Thy. Dose (rem)
				x		x2	=		x		=	
				x		x2	=		x		=	
				x		x2	=		x		=	
				x		x2	=		x		=	
				x		x2	=		x		=	
				x		x2	=		x		=	
				x		x2	=		x		=	
				x		x2	=		x		=	

A, B, C -- As Obtained. E -- From Table 1 G -- As Obtained.

D -- Field Measurement F = D x E x 2 H = F x G

ATTACHMENT 3: CHILD THYROID DOSE (CDE) PROJECTION USING FIELD GAMMA EXPOSURE RATES WORKSHEET

This worksheet provides the Child Thyroid Dose (CDE) to an individual in the plume.

NOTE: Projected Adult Thyroid Dose = 0.5 x Projected Child Thyroid Dose

PLANT: _____ UNIT: _____ DATE: _____ TIME: _____

SHUTDOWN TIME: _____ TIME AFTER SHUTDOWN AT WHICH EMISSIONS MEASURED (HOURS): _____

A	B	C	D	E		F		G		H		I		J
Time of Meas.	Dist. From Plant (mi)	Dir. From Plant	Gamma Exp. Rate (mR/hr)	Child Thy. Dose (rem) (Use 1 hr exp. time) (Figure 1)	x	Shutdown Corr. Factor (Figure 2)	x	Cloud Corr. Factor (Figure 3)	=	Child Thy. Dose (rem) (1 hr. exp.)	x	Exp. Time (hrs)	=	Total Child Thyroid Dose (rem)
					x		x		=		x		=	
					x		x		=		x		=	
					x		x		=		x		=	
					x		x		=		x		=	
					x		x		=		x		=	
					x		x		=		x		=	
					x		x		=		x		=	

A, B, C -- As Obtained F -- From Figure 2 I -- As Obtained.
 D -- Field Measurement G -- From Figure 3 J = H x I
 E -- From Figure 1 H = E x F x G

Figure 1

Projected Thyroid Dose as a Function of Either Gamma Exposure Rate or Radioiodine Concentration in Air

Ref: "Preparedness and Response in Radiation Accidents", U.S. Dept. of Health and Human Services, Food and Drug Admin., Center for Devices and Radiological Health, Rockville, MD, August 1983. Reprinted by Nucleon Lectern Assoc., Inc. Page 145.

To use this Chart

Plot the point representing the exposure rate when using a 1 hour exposure time and estimate the projected CHILD Thyroid Dose, enter this value in Column "E" of Attachment

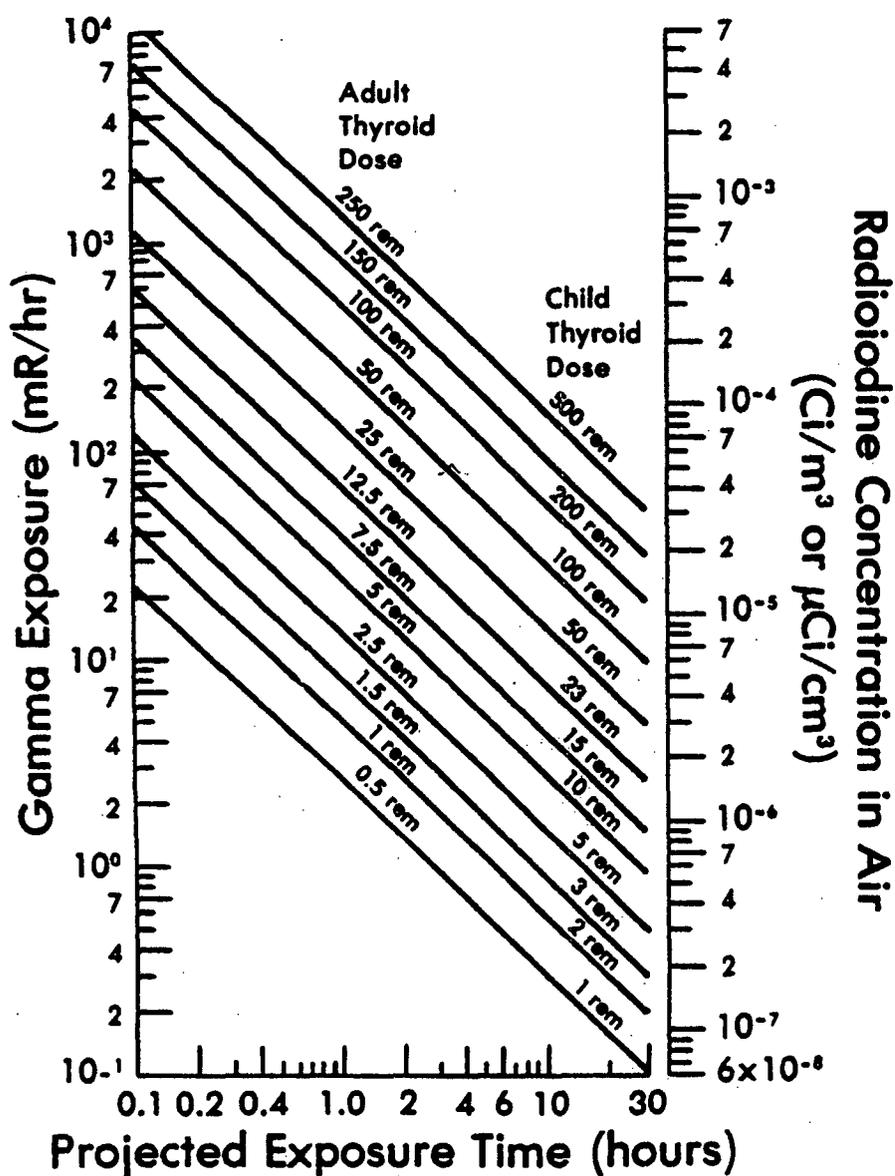


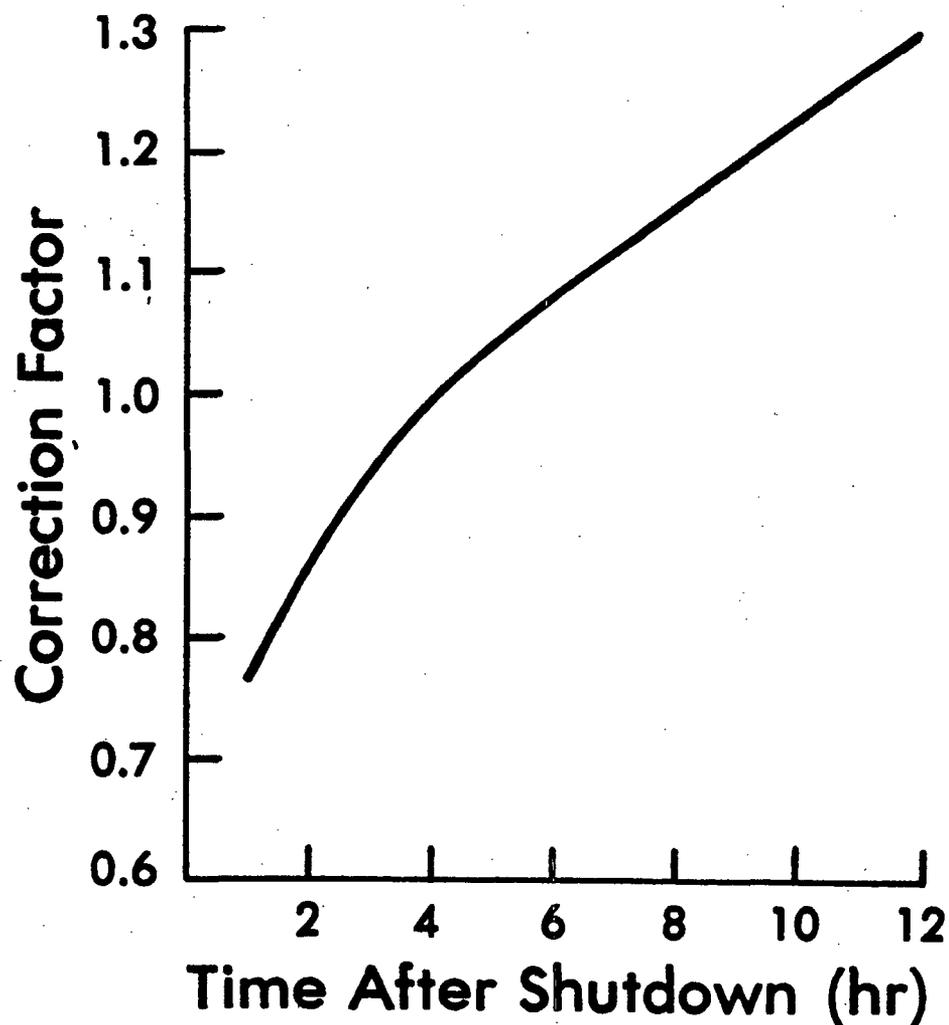
Figure 2

Correction Factors for Thyroid Inhalation Dose as a Function of Time After Shutdown

Ref: "Preparedness and Response in Radiation Accidents", U.S. Dept. of Health and Human Services, Food and Drug Admin., Center for Devices and Radiological Health, Rockville, MD, August 1983. Reprinted by Nucleon Lectern Assoc., Inc. Page 146.

To use this Chart

Obtain the correction factor corresponding to the time of exposure in terms of hours after shutdown and enter this value in Column "F" of Attachment 3



Correction factors for thyroid inhalation dose as a function of time after reactor shutdown that radioiodine concentration is measured

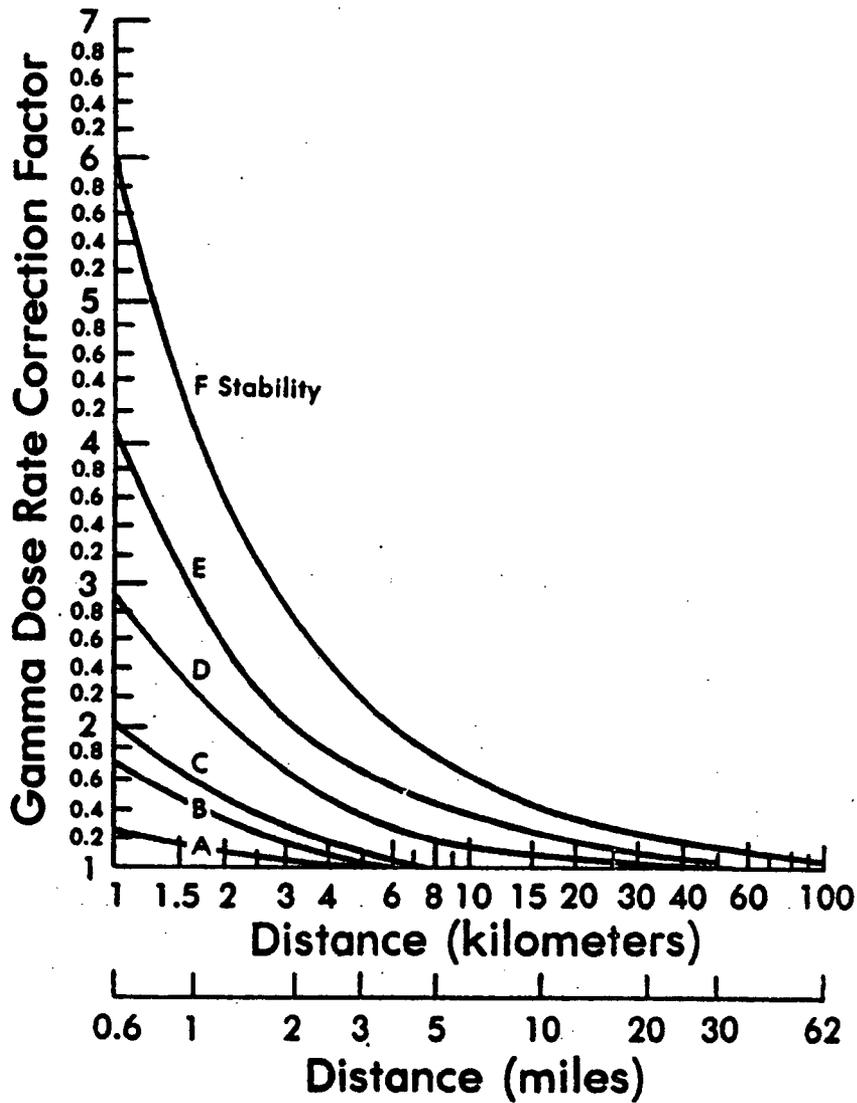
Figure 3
Gamma Exposure Rate Finite Cloud Correction Factor

Ref: "Preparedness and Response in Radiation Accidents", U.S. Dept. of Health and Human Services, Food and Drug Admin., Center for Devices and Radiological Health, Rockville, MD, August 1983. Reprinted by Nucleon Lectern Assoc., Inc. Page 147.

To use this Chart

Find the correction factor corresponding to the distance and atmospheric stability class at which the exposure measurement was made

Enter this value in Column "G" of Attachment 3



ESTIMATION OF LIQUID RELEASE CONSEQUENCES TO DOWNSTREAM WATER USERS

PURPOSE:

This procedure is used to calculate the concentration of radionuclides and spill arrival time at downstream water users from a non-routine liquid release.

NOTE: DO NOT use this procedure for aerial deposition onto water or for rainout. For aerial deposition or rainout, use BRP-ER-8.01.

This procedure utilizes Maximum Permissible Annual Average Concentrations of radionuclides in drinking water as found in National Interim Primary Drinking Water Regulations, EPA-570/9-76-003, Appendix 'B'. These concentration values were calculated on the basis of a 2 liter per day drinking water intake using the 168 hour data listed in "Maximum Permissible Body Burdens and Maximum Permissible Concentration of Radionuclides in Air or Water for Occupational Exposure", National Bureau of Standards Handbook 69 as amended August 1963, U.S. Department of Commerce. (NOTE on Tritium and Sr-90: All Maximum Permissible Annual Average Concentration values for radionuclides in EPA-570/9-76-003, Appendix 'B', except for Tritium and Sr-90, are based on the NBS Handbook 69 concentration values. The Maximum Permissible Annual Average Concentration values for Tritium and Sr-90 are developed separately in EPA-570/9-76-003, Appendix 'B'.) A 4 millirem per year annual dose commitment to the total body or any internal organ will be received from ingesting finished drinking water at 2.0 liters per day with a radionuclide concentration at the EPA-570/9-76-003 Appendix 'B' value.

REFERENCE:

- a. National Interim Primary Drinking Water Regulations, EPA-570/9-76-003. U.S. EPA
(See also 40 CFR 141.15,141.16)
- b. Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure, National Bureau of Standards Handbook 69, Issued June 5, 1959; Amended August, 1963. U.S. Department of Commerce.
- c. FEMA REP-13, Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 - Water and Non-Dairy Food Pathway, FEMA, May 1990.

CONTENTS OF PROCEDURE:

BACKGROUND	SECTION 1
GENERAL PROCEDURE	SECTION 2
BVPS LIQUID EFFLUENT CALCULATION	APPENDIX A
PBAPS LIQUID EFFLUENT CALCULATION	APPENDIX B
LGS LIQUID EFFLUENT CALCULATION	APPENDIX C
SSES LIQUID EFFLUENT CALCULATION	APPENDIX D
TMI LIQUID EFFLUENT CALCULATION	APPENDIX E
MAXIMUM PERMISSIBLE ANNUAL AVERAGE CONCENTRATIONS OF RADIONUCLIDES IN DRINKING WATER (EPA-570/9-76-003)	ATTACHMENT 1
DERIVED PREVENTIVE RESPONSE LEVELS FOR DRINKING WATER (FEMA REP-13)	ATTACHMENT 2
LIQUID RELEASE DETERMINATION WORKSHEET	ATTACHMENT 3

ESTIMATION OF LIQUID RELEASE CONSEQUENCES TO DOWNSTREAM WATER USERS

SECTION 1 -- BACKGROUND

In the event of a non-routine release of radioactive liquid from a nuclear power plant, the consequences to downstream water users must be determined. Protective Action Guides (PAGs) for drinking water have not been formally promulgated by EPA. This procedure utilizes Maximum Permissible Annual Average Concentrations of Radionuclides in drinking water (MPAAC)_w which are given in Reference (a), Appendix 'B', Tables IV-2A and IV-2B under the heading 'C4' to determine the suitability of drinking water for human consumption. Intake of finished drinking water with a radionuclide concentration at the (MPAAC)_w at a rate of 2.0 liters per day will produce an annual dose commitment to the total body or any internal organ no greater than 4 millirem per year. These (MPAAC)_w values from Reference (a) are provided in Attachment 1 of this procedure.

When two or more radionuclides are present in the drinking water, their respective contributions to the annual dose commitment to the total body or to any organ are added together.

Three distinct situations involving non-routine radionuclide releases to waterways are considered in deciding if drinking water from the affected waterways should be consumed:

1. **Controlled Releases:** For controlled liquid releases to surface water, the EPA 570/9-76-003 (MPAAC)_w are applied to finished drinking water. The associated dose commitment to the whole body or any internal organ is 4 millirem per year. In this case, the Sum Total of 'River (MPAAC)_w Fractions' computed in Column 'F' of Attachment 3 of this procedure should not be greater than 1.0.

2. **Uncontrolled Releases:** For uncontrolled liquid releases to surface water, the EPA 570/9-76-003 (MPAAC)_w multiplied by 12 will apply to finished drinking water. This criterion assumes the uptake time will not exceed one year. The associated dose commitment to the whole body or any internal organ is 50 millirem. In this case, the Sum Total of 'River (MPAAC)_w Fractions' computed in Column 'F' of Attachment 3 of this procedure should not be greater than 12.0.

3. **Crisis Conditions:** When no other source of drinking water is available, and the duration of the uptake is 30 days or less, the concentration of radionuclides in finished drinking water may reach 1000 times the EPA 570/9-76-003 (MPAAC)_w values. The associated dose commitment to the whole body or any internal organ is 330 millirem. In this case, the Sum Total of 'River (MPAAC)_w Fractions' computed in Column 'F' of Attachment 3 of this procedure should not be greater than 1000.

NOTE: In addition to the guidance provided in References (a) and (b), the Federal Emergency Management Agency (FEMA) has provided Early Emergency Phase Derived Preventive Response Levels for Drinking Water (for a Five Day Ingestion Period), and Long Term Derived Preventive Response Levels for Drinking Water (One Year Ingestion Period), in Reference (c). The exposed infant is taken to be the exposed person of concern. The Reference (c) Preventive Protection Action Guide (PAG) for ingestion is:

<u>Organ of Interest</u>	<u>Dose Limit in Rem</u>
Whole Body, bone marrow, and other organs	0.5
Thyroid	1.5

The drinking water ingestion rates assumed in Reference (c) are:

Adult	2.0 liters per day
Teenager and Child	1.4 liters per day
Infant	0.9 liters per day

The material presented in Reference (c) is part of planning for an airborne release of radioactive material. See DEP/BRP/IP-211, "Ingestion Pathway Dose Projections" for a discussion of airborne release ingestion pathway dose projections. In the event of an airborne release, it is anticipated that large areas would be affected, and that ground transportation would be disrupted.

This procedure covers a liquid release from a nuclear power plant to an adjacent waterway. In the event of such a release, it is expected that the affected waterway will be well defined, and that ground transportation will not be significantly affected. Drinking water could be trucked in to affected communities from unaffected areas. Thus, the use of the (MPAAC)_w from Reference (a), with their lower dose commitment, instead of the Derived Preventive Response Levels from Reference (c), with their higher dose commitment, is desirable.

The Early Emergency Phase Derived Preventive Response Levels for Drinking Water (Five Day Ingestion Period) and the Long-Term Derived Preventive Response Levels for Drinking Water (One Year Ingestion Period) from Reference (c) are provided in Attachment 2 of this procedure for information.

- A. Select the appropriate Appendix of this procedure for the plant which is the source of the release.
- B. Have a copy of Attachments 1, 2 and 3 of this procedure in front of you.
- C. Follow the steps in the appropriate Appendix of this procedure for the plant which is the source of the release.

NOTE: IF, A. NO RADIONUCLIDE RELEASE INFORMATION IS AVAILABLE,

-- OR --

**B. IF THE SUM TOTAL OF THE RIVER (MPAAC)_w FRACTIONS
FROM COLUMN 'F' OF ATTACHMENT 3 ARE >1.0,**

**NOTIFY THE DEP EMERGENCY RESPONSE COORDINATOR IMMEDIATELY
SO THAT A DECISION CAN BE MADE ON WHETHER TO ADVISE DOWNSTREAM
WATER TREATMENT PLANTS AND WATER USERS TO CLOSE THEIR INTAKES.**

(Notification of downstream water users is performed by DEP Regional Water Supply and Community Health personnel, as per Annex 'E' of the Department of Environmental Protection Emergency Response Plan.)

APPENDIX A -- BVPS LIQUID EFFLUENT CALCULATION

1. Have a copy of Attachments 1, 2 and 3 of the procedure in front of you.
2. Enter Plant, Unit, Date, Release Start Time, Release Stop Time (if available) and Affected Waterway on Attachment 3.
3. Obtain the isotopes released and the liquid concentration (in pCi/l) of each isotope released from the utility or analytical laboratory. Enter the Isotopes in Column 'A' of Attachment 3 and Release Concentrations in Column 'B' of Attachment 3.

NOTE: If isotopic release information for the released liquid is not available, notify the DEP Emergency Response Coordinator immediately so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify the Ohio and West Virginia Departments of Health.

4. Compute the Dilution Factor as follows, and enter in Column 'C' of Attachment 3:
 - A. If the sample was taken at the MIDLAND Water Treatment Plant Intake, the Release Concentration is that same as the sample concentration. So, enter 1.0 as the Dilution Factor in Column 'C' of Attachment 3.

- otherwise-

- B. Obtain the liquid release rate from the plant:

$$\text{Release Rate} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

(If the release is given only in gallons, compute the release rate as:

$$\text{Release Rate} = \frac{\text{_____ gal. (Release Volume)}}{\text{_____ min. (Release Time)}} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.)}$$

- C. Obtain the Ohio River flow rate from one of the sources below:

- a. Call the U.S. Army Corps of Engineers at the Montgomery Locks Dam (412) 643-8400, to obtain the current Ohio River flow rate or current stage height at Montgomery Locks Dam. Derive flow rate from stage height, if necessary, using Figure A-1.

- b. Call the U.S. Geological Survey office in Pittsburgh (412) 644-2801 or the U.S. Army Corps of Engineers office in Pittsburgh (412) 644-6862 to obtain the current Ohio River flow rate or the current stage height at the Montgomery Locks Dam. Derive flow rate from stage height, if necessary, using Figure A-1.
- c. Request information from utility at plant.

$$\text{Ohio River Flow Rate} = \frac{\text{_____}}{(b)} \text{ cu.ft./sec.}$$

D. Dilution Factor =

$$\frac{\text{_____ gal./min.}}{(a)} \times 2.23\text{E-3 cu.ft./sec/gal./min.}$$

$$\frac{\text{_____ cu. ft./sec}}{(b)}$$

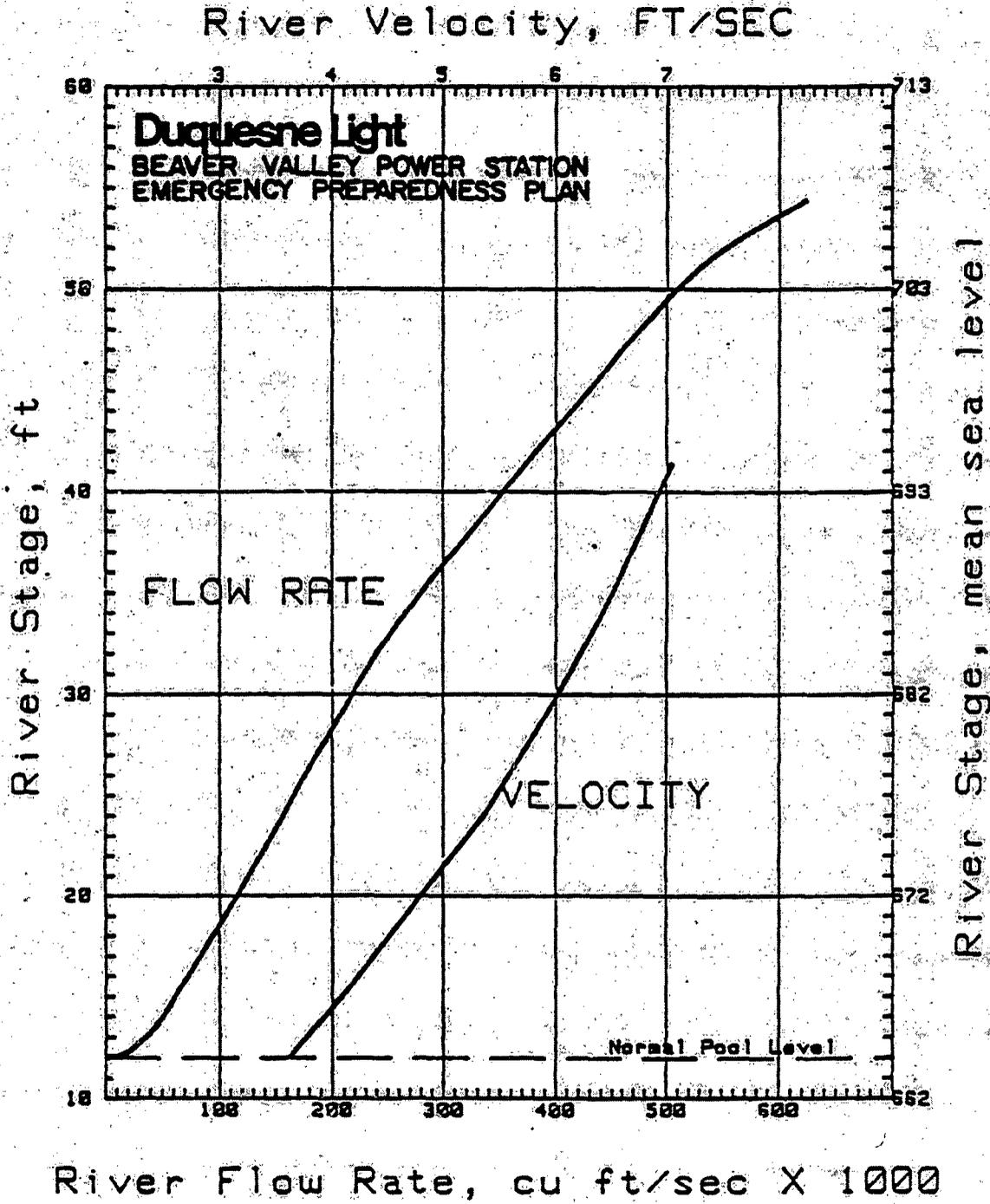
Dilution Factor = _____ (Enter in Column 'C' of Attachment 3.)

- 5. Compute the River Concentration (in pCi/l) of the isotopes released in Column 'D' of Attachment 3.
- 6. Enter the (MPAAC)_w from Attachment 1 for each isotope released in Column 'E' of Attachment 3.
- 7. Compute the River (MPAAC)_w Fraction for each isotope released in Column 'F' of Attachment 3.
- 8. Sum the River (MPAAC)_w Fractions for all isotopes released in Column 'F' of Attachment 3. Notify the DEP Emergency Response Coordinator of the result.

NOTE: If the Sum Total of the River (MPAAC)_w Fractions is >1.0, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify Ohio and West Virginia Departments of Health.

9. Estimation of Travel Time of Flume: For MIDLAND water intake, assume no travel time when making Protective Action Recommendation (PAR). If travel time of flume is needed for a downstream location, it can be determined by using the river velocity from Figure A-1.

FIGURE A-1



Based on Corps of Engineers data for Montgomery Dam

APPENDIX B -- PBAPS LIQUID EFFLUENT CALCULATION

1. Have a copy of Attachments 1, 2 and 3 of this procedure in front of you.
2. Enter Plant, Unit, Date, Release Start Time, Release Stop Time (if available), and Affected Waterway on Attachment 3.
3. Obtain the isotopes released and the liquid concentration (in pCi/l) of each isotope released from the utility or analytical laboratory. Enter the Isotopes in Column 'A' of Attachment 3 and Release Concentrations in Column 'B' of Attachment 3.

NOTE: If isotopic release information for the released liquid is not available, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify the Maryland Department of Health.

4. Compute the Dilution Factor as follows, and enter in Column 'C' of Attachment 3:

- A. Obtain the liquid release rate from the plant:

$$\text{Release Rate} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

(If the release is given only in gallons, compute the release rate as:

$$\text{Release Rate} = \frac{\text{_____ gal. (Release Volume)}}{\text{_____ min. (Release Time)}} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

- B. Peach Bottom has a Discharge Canal, which can dilute the release before it enters the Susquehanna River. Compute the Discharge Canal Dilution Factor (DCDL) first as follows:

Discharge is: _____ Directly into River _____ Into Discharge Canal

1. If discharge is directly into the river, DCDL = 1.0. (ie, no dilution in discharge canal.)

2. If discharge is into the discharge canal, then into the river, DCDL =:

$$\text{Release Volume} = \frac{\text{_____ gal./min. Release Rate}}{(a)} \times \frac{\text{_____ Release Time (min.)}}{(b)}$$

$$\text{Release Volume} = \frac{\text{_____ gal.}}{(c)}$$

$$\text{Discharge Canal Volume} = \frac{\text{_____ gal.}}{(d)} \quad (\text{Obtain from PBAPS Dose Assess. Personnel})$$

$$\text{DCDL} = \frac{\frac{\text{_____ gal.}}{(c)}}{\frac{\text{_____ gal.}}{(d)}} = \frac{\text{_____}}{(e)}$$

C. Obtain the Susquehanna River Flow rate from one of the sources below:

- a. Call Engineer's Office at Conowingo Dam (410) 643-8400 to obtain Susquehanna River flow rate at Conowingo Dam.
- b. Call the U.S. Geological Survey office in Harrisburg (717) 730-6900, or the U.S. Army Corps of Engineers office in Philadelphia, (215) 656-6685, to obtain the current Susquehanna River flow rate or gage height at Marietta. Derive flow rate from gage height, if necessary, using Figure B-1.
- c. PECO load dispatcher, (215) 841-5141.

$$\text{Susquehanna River Flow Rate} = \frac{\text{_____}}{(f)} \text{ cubic feet/sec.}$$

D. Dilution Factor =

$$\frac{\text{_____}}{(e)} \times \frac{\frac{\text{_____ gal./min.}}{(a)}}{\frac{\text{_____ cu.ft./sec.}}{(f)}} \times 2.23\text{E-3 cu.ft./sec./gal./min.}$$

$$\text{Dilution Factor} = \text{_____} \quad (\text{Enter in Column 'C' of Attachment 1.})$$

5. Compute the River Concentration (in pCi/l) of the isotopes released in Column 'D' of Attachment 3.

6. Enter the (MPAAC)_w from Attachment 1 for each isotope released in Column 'E' of Attachment 3.
7. Compute the River (MPAAC)_w Fraction for each isotope released in Column 'F' of Attachment 3.
8. Sum the River (MPAAC)_w Fractions for all isotopes released in Column 'F' of Attachment 3. Notify the DEP Emergency Response Coordinator of the result.

NOTE: If the Sum Total of the River (MPAAC)_w Fractions is > 1.0, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify the Maryland Department of Health.

9. Estimation of Travel Time of Flume: For CHESTER water intake, assume no travel time when making Protective Action Recommendation (PAR). If travel time of flume is needed for a downstream location, it can be determined by using the river velocity from Figure B-2.

Figure B-1

PBAPS -- Susq. River at Marietta-- Flow vs. Gage Height

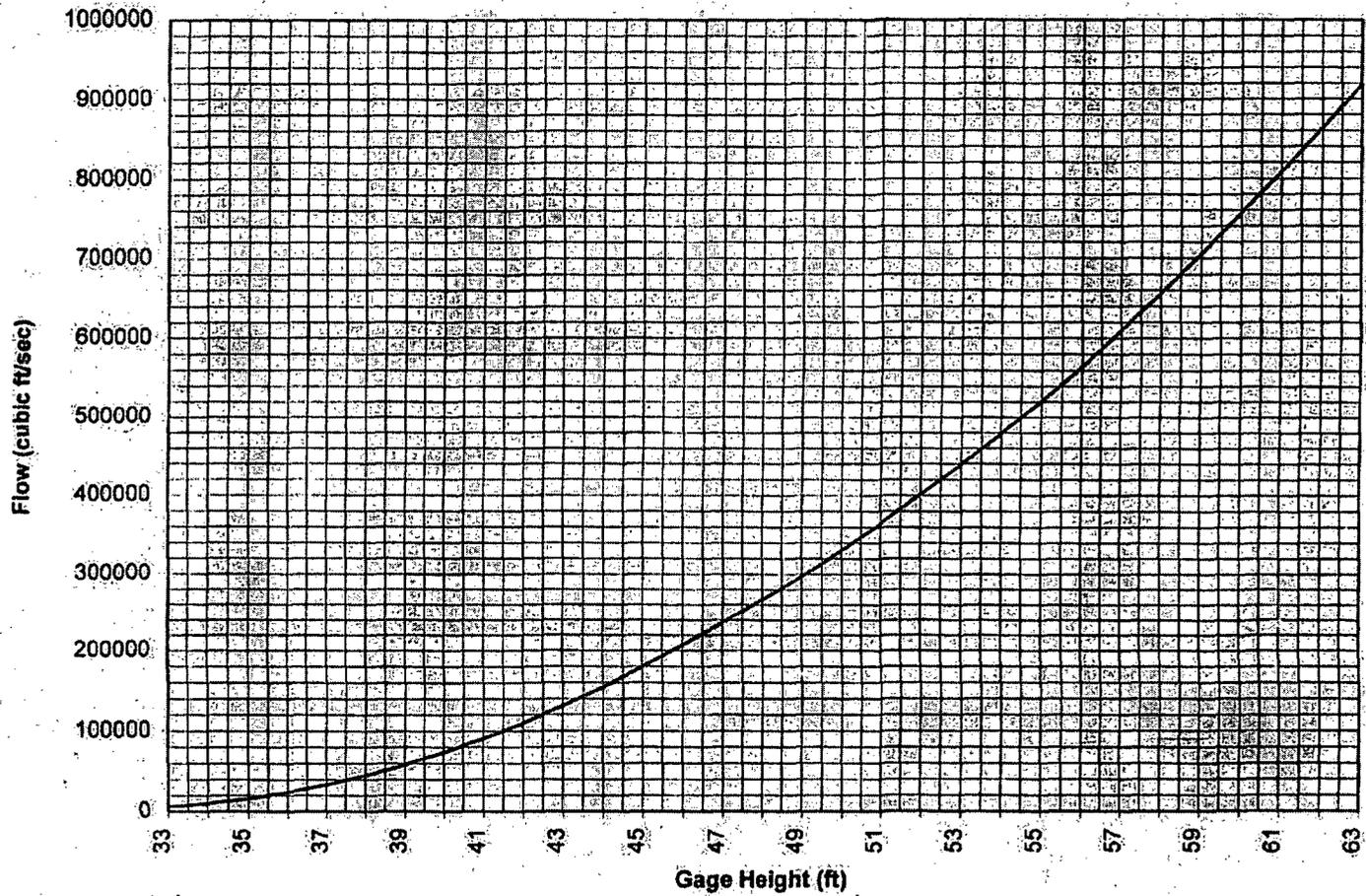
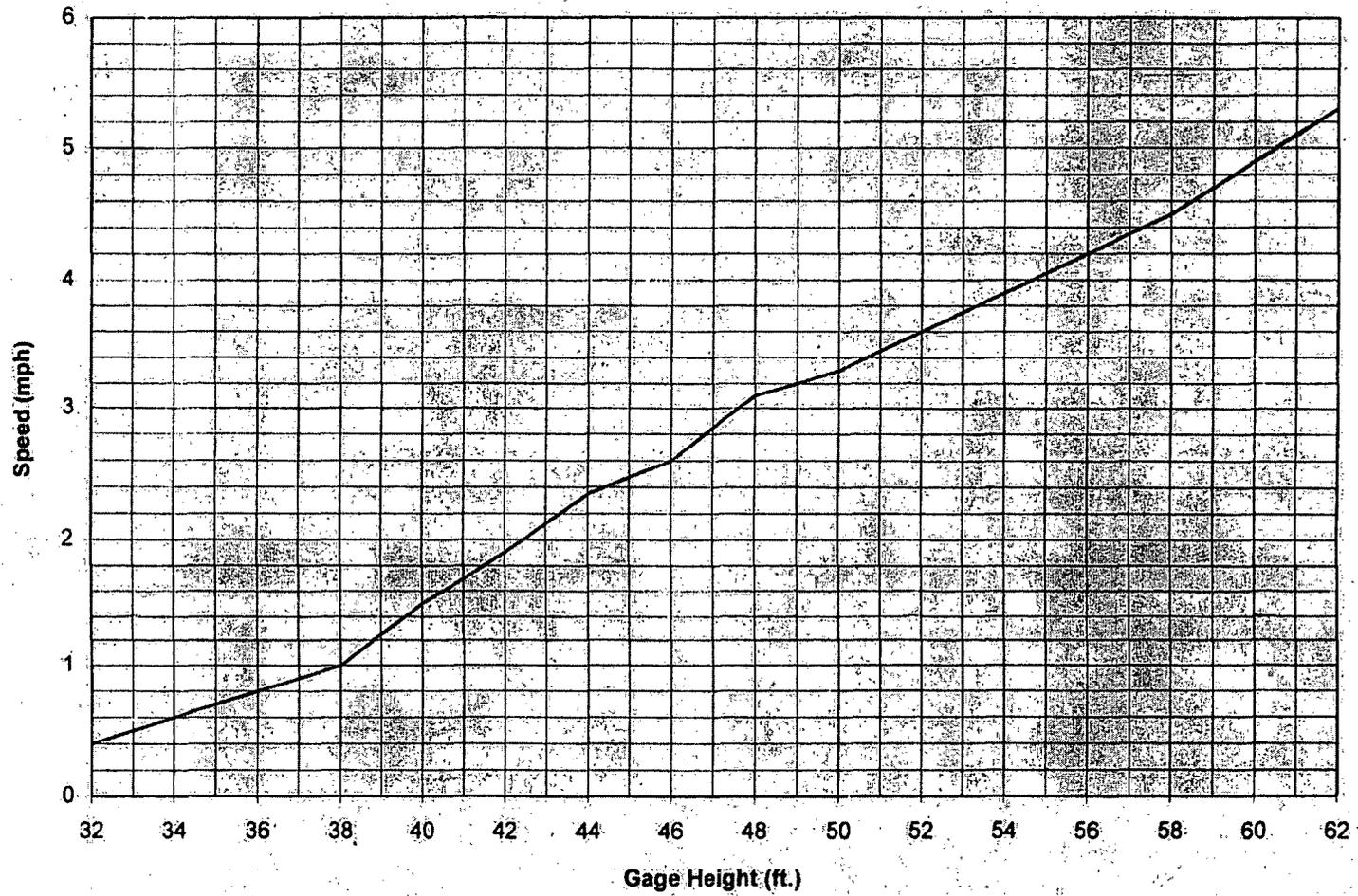


Figure B-2

PBAPS -- Susquehanna River at Marietta -- Speed vs. Gage Height



APPENDIX C -- LGS LIQUID EFFLUENT CALCULATION

1. Have a copy of Attachments 1, 2, and 3 of this procedure in front of you.
2. Enter Plant, Unit, Date, Release Start Time, Release Stop Time (if available) and Affected Waterway on Attachment 3.
3. Obtain the isotopes released and the liquid concentration (in pCi/l) of each isotope released from the utility or analytical laboratory. Enter the Isotopes in Column 'A' of Attachment 3 and Release Concentrations in Column 'B' of Attachment 3.

NOTE: If isotopic release information for the released liquid is not available, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify the New Jersey and Delaware Departments of Health.

4. Compute the Dilution Factor as follows, and enter in Column 'C' of Attachment 3:

- A. Obtain the liquid release rate from the plant:

$$\text{Release Rate} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

(If the release is given only in gallons, compute the release rate as:

$$\text{Release Rate} = \frac{\text{_____ gal. (Release Volume)}}{\text{_____ min. (Release Time)}} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.)}$$

- B. Obtain the Schuylkill River flow rate from one of the sources below:

- a. Call the U.S. Geological Survey office in Harrisburg (717) 730-6900 or the U.S. Army Corps of Engineers office in Philadelphia (215) 656-6685 to obtain the current Schuylkill River flow rate or current gage height at Pottstown. Derive flow rate from gage height, if necessary, using Figure C-1.
- b. Call the Pottstown gage automatic phone number (610) 326-8498 for river height. Derive flow rate from gage height using Figure C-1.
- c. Request information from the utility at the plant.

$$\text{Schuylkill River Flow Rate} = \frac{\text{_____}}{\text{(b)}} \text{ cubic feet/second}$$

D. Dilution Factor =

$$\frac{\text{_____ gal./min.}}{\text{(a) _____ cu.ft./sec.}} \times 2.23\text{E-}3 \text{ cu.ft./sec/gal./min.}$$

$$\text{(b)}$$

Dilution Factor = _____ (Enter in Column 'C' of Attachment 3.)

5. Compute the River Concentration (in pCi/l) of the isotopes released in Column 'D' of Attachment 3.
6. Enter the (MPAAC)_w from Attachment 1 for each isotope released in Column 'E' of Attachment 3.
7. Compute the River (MPAAC)_w Fraction for each isotope released in Column 'F' of Attachment 3.
8. Sum the River (MPAAC)_w Fractions for all isotopes released in Column 'F' of Attachment 3. Notify the DEP Emergency Response Coordinator of the result.

NOTE: If the Sum Total of the River (MPAAC)_w Fractions is >1.0, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify New Jersey and Delaware Departments of Health.

NOTE: For LGS, the City of Philadelphia must be notified of the results of the calculation, and the its interpretation. Call (215) 228-7087, Philadelphia Water Department Load Control. It is manned 24 hours a day.

9. Estimation of Travel Time of Flume:

The time for the release to reach downstream water users is calculated using the following Table C-1, and Figure C-2:

TABLE C-1 -- LGS DOWNSTREAM WATER USERS FLUME TRAVEL TIME WORKSHEET

Time Release Started: _____ (From Attachment 3)

	A		B	=	C	D
DOWNSTREAM WATER USER	RIVER DIST. FROM PLANT (miles)	X	RIVER MPH (Figure C-2)	=	ESTIMATED TRAVEL TIME (hours)	ESTIMATED ARRIVAL TIME
Citizen Utilities	2.9	X		=		
Phoenixville Water Authority	9.0	X		=		
Philadelphia Suburban	13.6	X		=		
Keystone (Norristown)	24.0	X		=		
Philadelphia Belmont	35.2	X		=		

A -- Best Estimate.

B -- From Figure C-2

C = A x B

D = C + Time Release Started (From Attachment 3)

Figure C-1

LGS -- Schuylkill River at Pottstown -- Flow vs. Gage Height

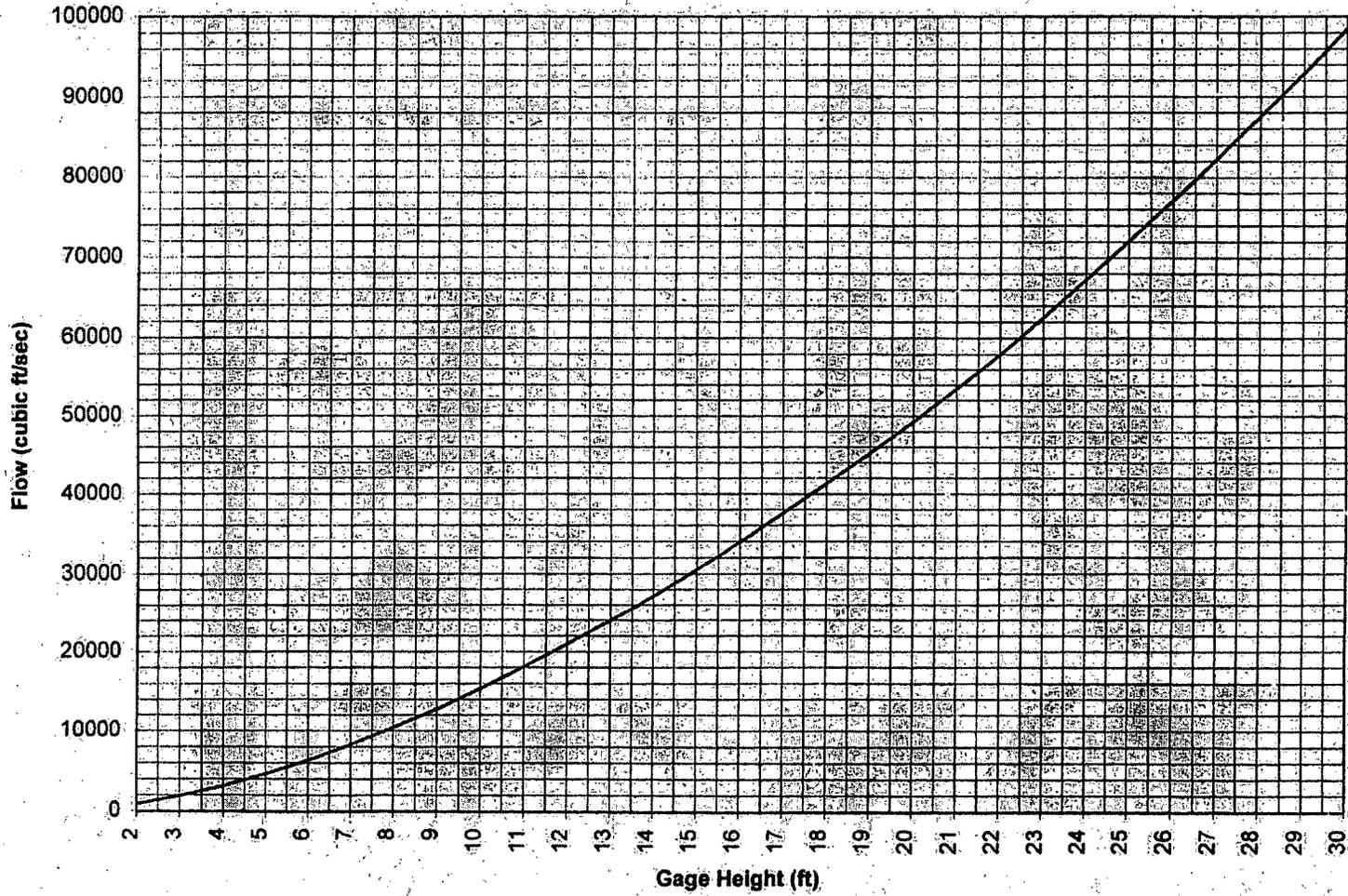
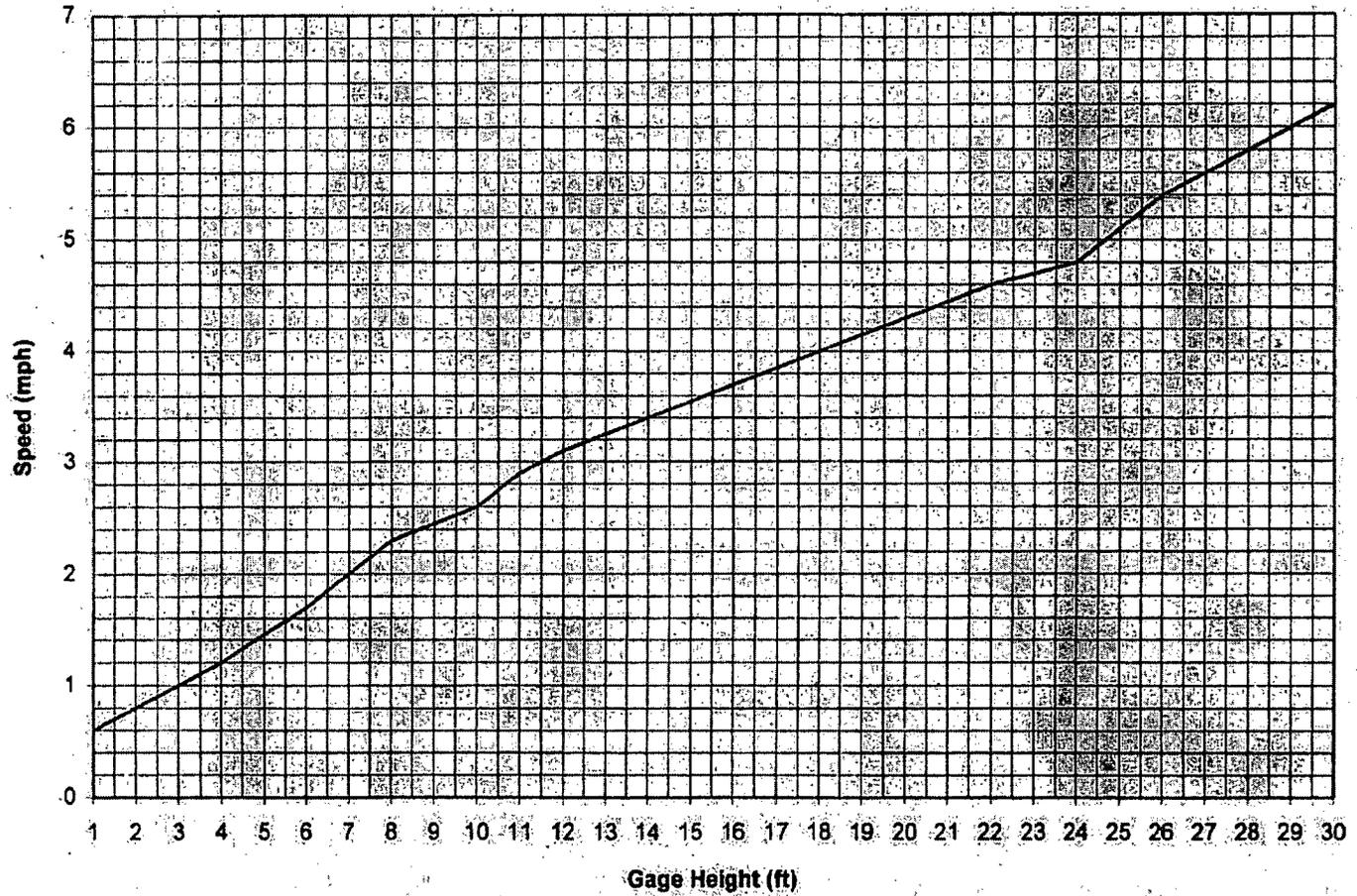


Figure C-2

LGS -- Schuylkill River at Pottstown -- Speed vs. Gage Height



APPENDIX D -- SSES LIQUID EFFLUENT CALCULATION

1. Have a copy of Attachments 1, 2, and 3 of this procedure in front of you.
2. Enter Plant, Unit, Date, Release Start Time, Release Stop Time (if available), and on Affected Waterway Attachment 3.
3. Obtain the isotopes released and the liquid concentration (in pCi/l) of each isotope released from the utility or analytical laboratory. Enter the Isotopes in Column 'A' of Attachment 3, and Release Concentrations in Column 'B' of Attachment 3.

NOTE: If isotopic release information for the released liquid is not available, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes.

4. Compute the Dilution Factor as follows, and enter in Column 'C' of Attachment 3:

- A. Obtain the liquid release rate from the plant:

$$\text{Release Rate} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

(If the release is given only in gallons, compute the release rate as:

$$\text{Release Rate} = \frac{\text{_____ gal. (Release Volume)}}{\text{_____ min. (Release Time)}} = \text{_____ gal./min.}$$

- B. Obtain the Susquehanna River flow rate from one of the sources below:

- a. Call the U.S. Geological Survey office in Harrisburg (717) 730-6900 or the U.S. Army Corps of Engineers office in Philadelphia (215) 656-6685 to obtain the current Susquehanna River flow rate or current gage height at Wilkes-Barre. Derive flow rate from gage height, if necessary, using Figure D-1.

- b. Request information from utility at plant.

$$\text{Susquehanna River Flow Rate} = \text{_____} \text{ cubic feet/second}$$

C. Dilution Factor =

$$\frac{\frac{\text{_____ gal./min.}}{\text{(a)}}}{\text{(b) cu.ft./sec.}} \times 2.23\text{E-3 cu.ft./sec./gal./min.}$$

Dilution Factor = _____ (Enter in Column 'C' of Attachment 3.)

5. Compute the River Concentration (in pCi/l) of the isotopes released in Column 'D' of Attachment 3.
6. Enter the (MPAAC)_w from Attachment 1 for each isotope released in Column 'E' of Attachment 3.
7. Compute the River (MPAAC)_w Fraction for each isotope released in Column 'F' of Attachment 3.
8. Sum the River (MPAAC)_w Fractions for all isotopes released in Column 'F' of Attachment 3. Notify the DEP Emergency Response Coordinator of the result.

NOTE: If the Sum Total of the River (MPAAC)_w Fractions is > 1.0, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes.

9. Estimation of Travel Time of Flume:

a. Estimate the travel time of the Flume to DANVILLE, using Figure D-2:

Flume Travel Time to DANVILLE = _____ hours (Figure D-2)

Release Start Time = _____ (From Attachment 1)

$$\text{Flume Arrival Time at DANVILLE} = \frac{\text{_____}}{\text{(Travel Time)}} + \frac{\text{_____}}{\text{(Rel. Start Time)}}$$

$$= \text{_____}$$

Figure D-1

SSES -Susq. River at Wilkes-Barre -- Flow vs. Gage Height

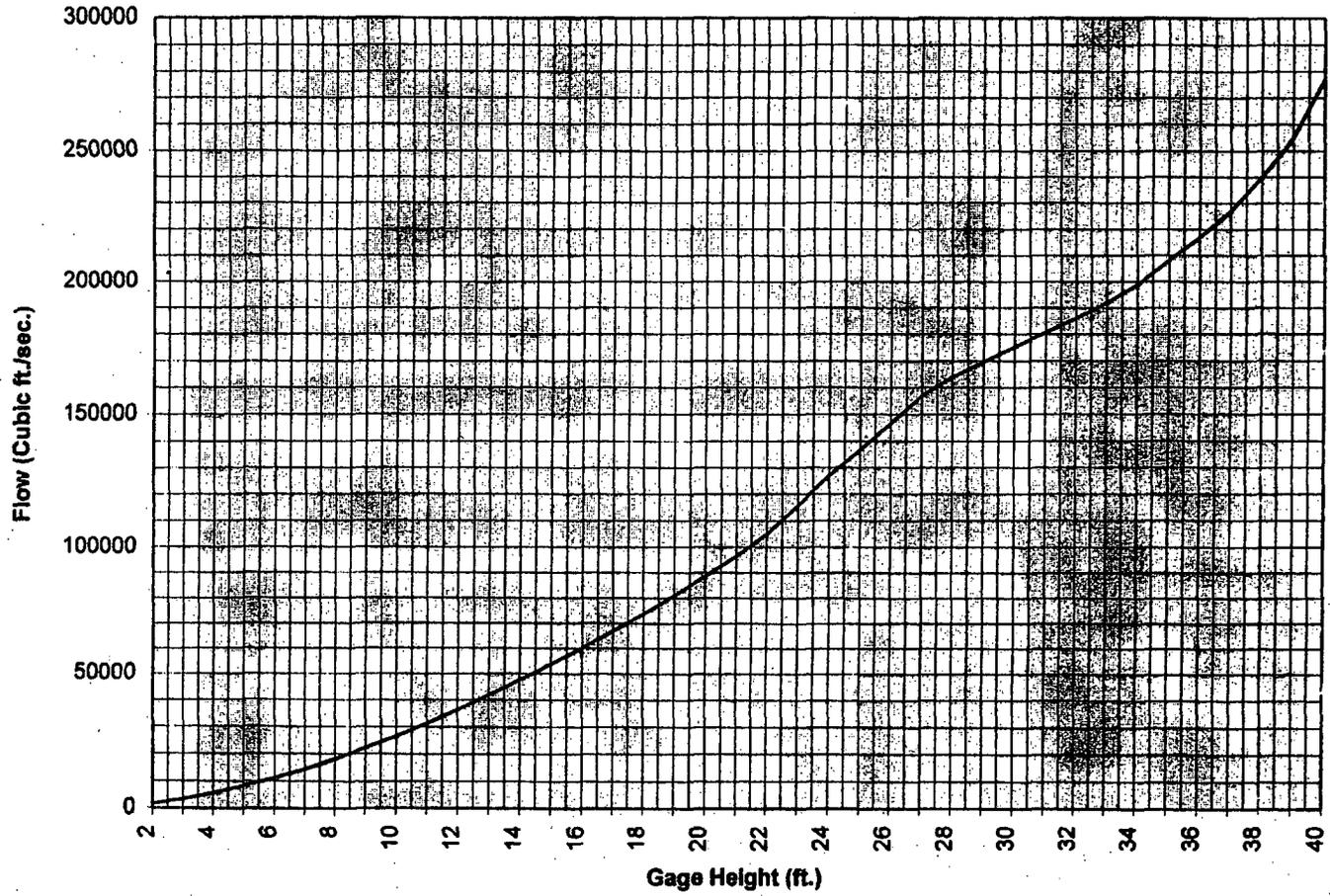
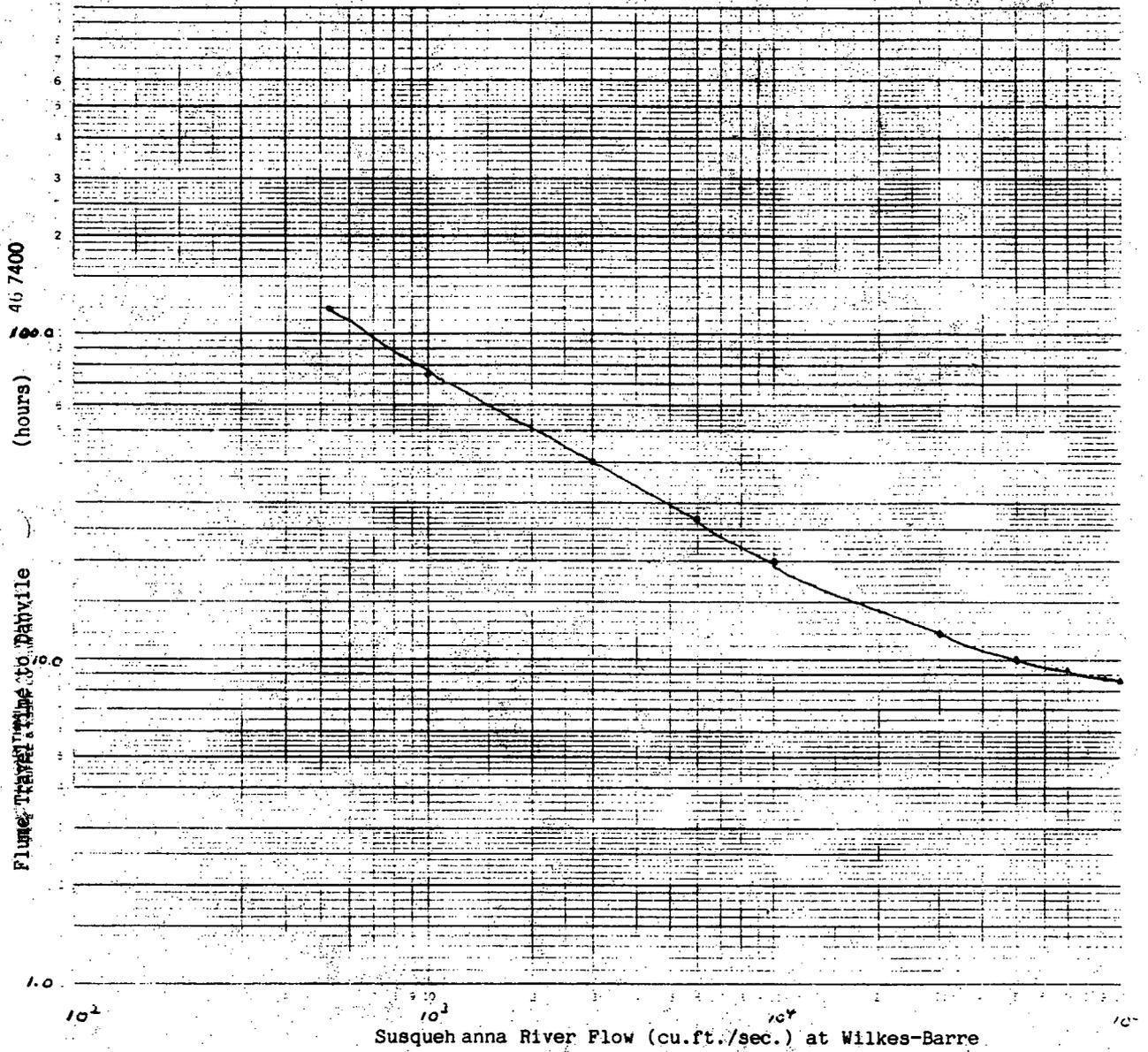


Figure D-2
SSES Flume Travel Time (hours) to Danville vs. River Flow (cu.ft./sec.)



APPENDIX E -- TMI LIQUID EFFLUENT CALCULATION

1. Have a copy of Attachments 1, 2, and 3 of this procedure in front of you.
2. Enter Plant, Unit, Date, Release Start Time, Release Stop Time (if available) and Affected Waterway on Attachment 3.
3. Obtain the isotopes released and the liquid concentration (in pCi/l) of each isotope released from the utility or analytical laboratory. Enter the Isotopes in Column 'A' of Attachment 3, and Release Concentrations in Column 'B' of Attachment 3.

NOTE: If isotopic release information for the released liquid is not available, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify Maryland Department of Health.

4. Compute the Dilution Factor as follows, and enter in Column 'C' of Attachment 3:

- A. Obtain the liquid release rate from the plant:

$$\text{Release Rate} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

(If the release is given only in gallons, compute the release rate as:

$$\text{Release Rate} = \frac{\text{_____ gal. (Release Volume)}}{\text{_____ min. (Release Time)}} = \frac{\text{_____}}{\text{(a)}} \text{ gal./min.}$$

- B. Obtain the Susquehanna River flow rate from one of the sources below:

- a. Call the U.S. Geological Survey office in Harrisburg (717) 730-6900 or the U.S. Army Corps of Engineers office in Philadelphia (215) 656-6685 to obtain the current Susquehanna River flow rate or gage height at Harrisburg. Derive the flow rate from gage height, if necessary, using Figure E-1.
- b. Request the information from the utility at the plant.

$$\text{Susquehanna River Flow Rate} = \frac{\text{_____}}{\text{(b)}} \text{ cu.ft./sec.}$$

C. Dilution Factor =

$$\frac{\frac{\text{_____ gal./min.}}{\text{(a)}}}{\text{(b) _____ cu.ft./sec.}} \times 2.23\text{E-3 cu.ft./sec./gal./min.}$$

Dilution Factor = _____ (Enter in Column 'C' of Attachment 3.)

5. Compute the River Concentration (in pCi/l) of the isotopes released in Column 'D' of Attachment 3.
6. Enter the (MPAAC)_w from Attachment 1 for each isotope released in Column 'E' of Attachment 3.
7. Compute the River (MPAAC)_w Fraction for each isotope released in Column 'F' of Attachment 3.
8. Sum the River (MPAAC)_w Fractions for all isotopes released in Column 'F' of Attachment 3. Notify the DEP Emergency Response Coordinator of the result.

NOTE: If the Sum Total of the River (MPAAC)_w Fractions is > 1.0, notify the DEP Emergency Response Coordinator immediately, so that a decision can be made on whether to advise downstream water treatment plants and water users to close their intakes. Also, notify Maryland Department of Health.

9. Estimation of Travel Time of Flume:

The time for the release to reach downstream water users is calculated using the following Table E-1, and Figure E-2:

TABLE E-1 -- TMI DOWNSTREAM WATER USERS FLUME TRAVEL TIME WORKSHEET

Time Release Started: _____ (From Attachment 3)

	A		B		C	D
DOWNSTREAM WATER USER	RIVER DIST. FROM PLANT (miles)	x	RIVER MPH (Figure E-2)	=	ESTIMATED TRAVEL TIME (hours)	ESTIMATED ARRIVAL TIME
Wrightsville Water Supply Co.	16.3	x		=		
Borough of Columbia	16.8	x		=		
City of Lancaster	16.8	x		=		
Chester Water Authority	43.0	x		=		

A -- Best Estimate

B -- From Figure E-2

C = A x B

D = C + Time Release Started (From Attachment 3)

Figure E-1

TMI -- Susq. River at Harrisburg -- Flow vs. Gage Height

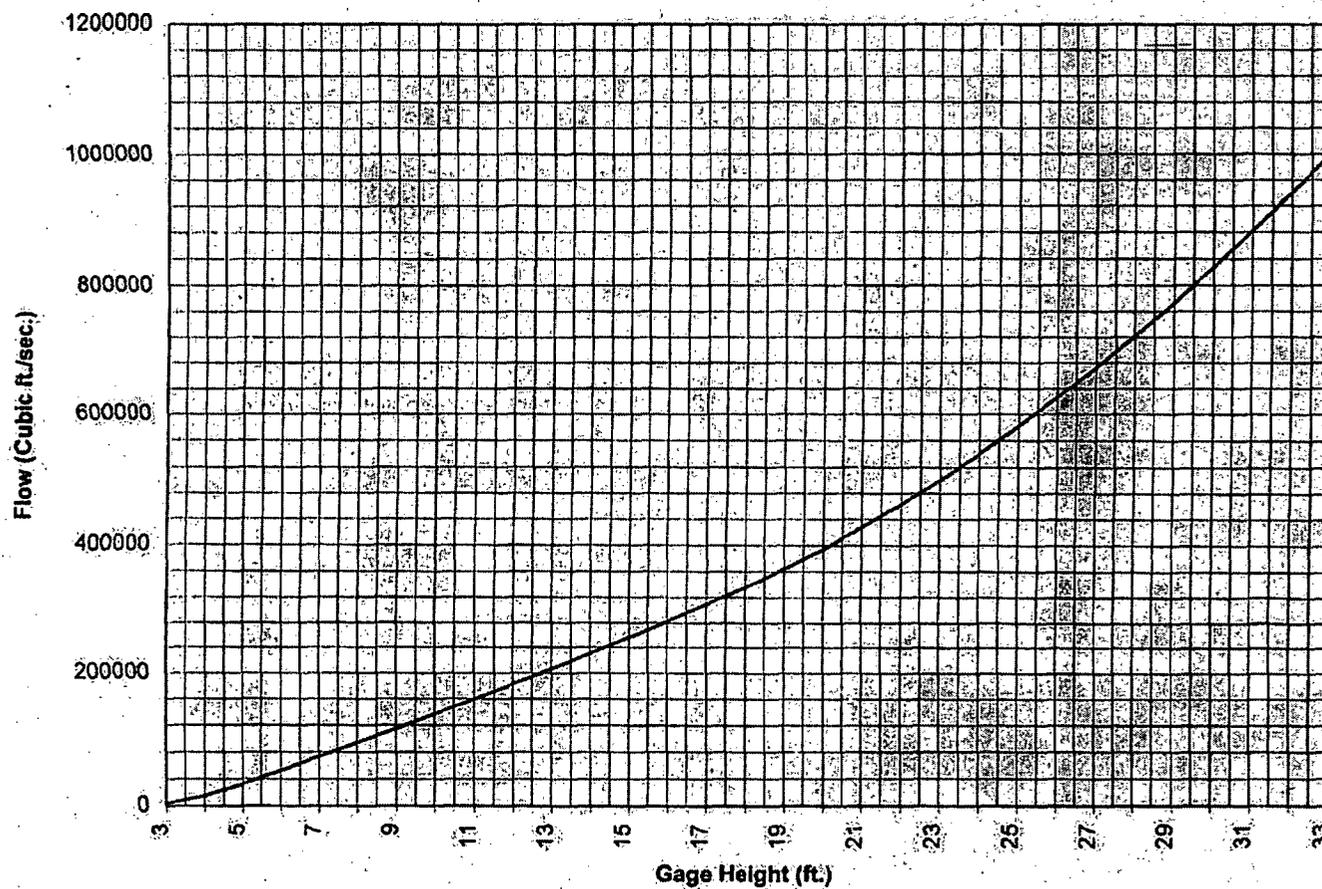
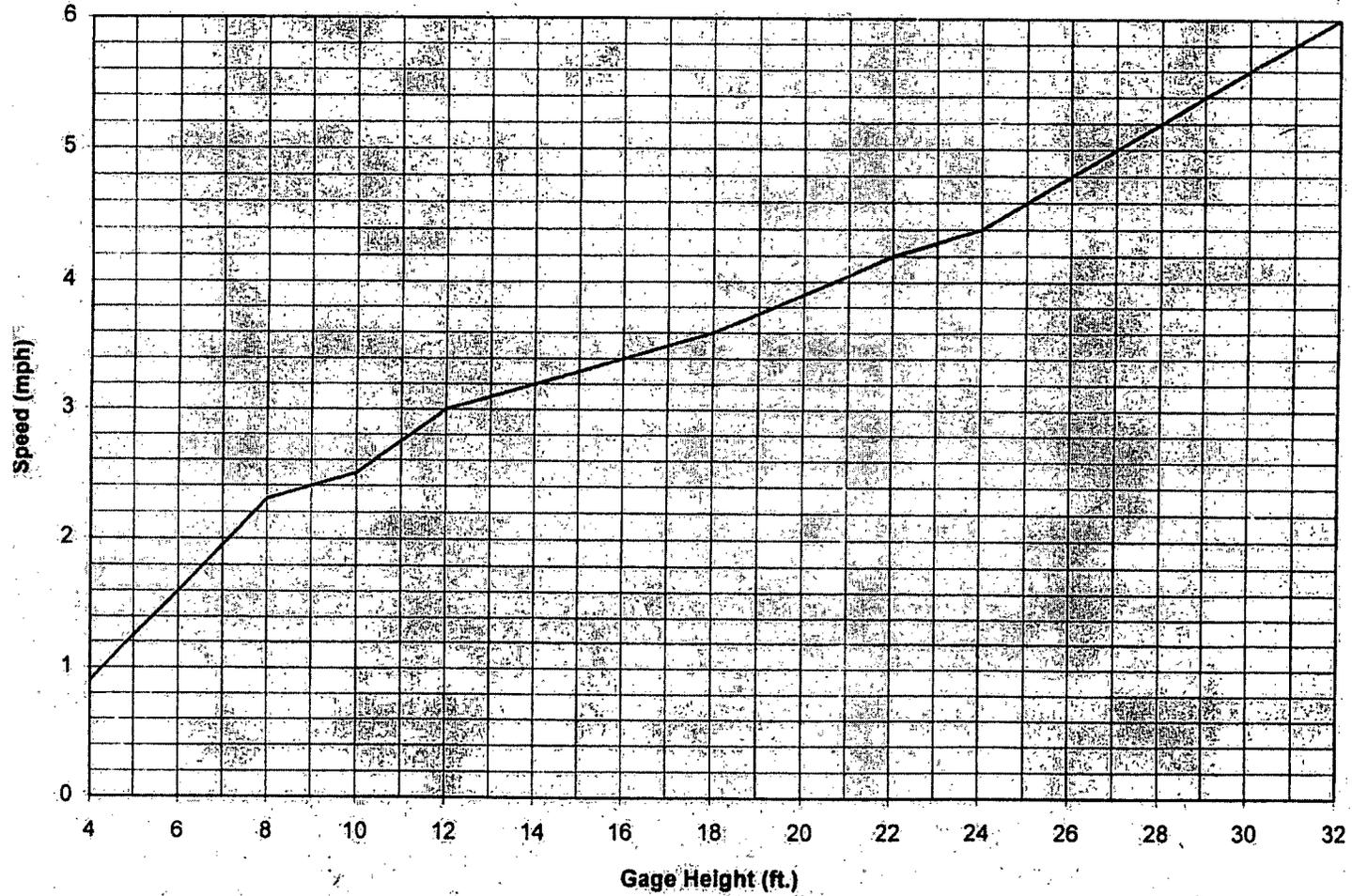


Figure E-2

TMI -- Susquehanna River at Harrisburg -- Speed vs. Gage Height



**ATTACHMENT 1 -- MAXIMUM PERMISSIBLE ANNUAL AVERAGE
CONCENTRATIONS OF RADIONUCLIDES IN DRINKING WATER
(EPA 570/9-76-003)**

This Attachment 1 consists of two tables from National Interim Primary Drinking Water Regulations, EPA-570/9-76-003, Appendix 'B':

1. Table IV-2A. Annual Average Concentrations Yielding 4 Millirem per Year for a Two Liter Daily Intake (Half-life greater than 24 hours.)
2. Table IV-2B. Annual Average Concentrations Yielding 4 Millirem per Year for a Two Liter Daily Intake (Half-life less than 24 hours.)

C. Concentrations yielding an Annual Dose of 4 Millirem

Tables IV-2A and IV-2B give C_1 the annual average concentrations for man-made radionuclides which are assumed to yield an annual dose of 4 millirem to the indicated organ. Table IV-2A comprises those nuclides having half-lives greater than one day. Table IV-2B contains shorter half-life radionuclides not expected to appear in drinking water supplies. Ingestion at a rate of 2.0 liters per day is assumed. The values shown were calculated from the Maximum Permissible Concentrations listed in Handbook 69 (1) as outlined above.

TABLE IV-2A. Annual Average Concentrations Yielding 4 Millirem per Year for a Two Liter Daily Intake

(Half-life greater than 24 hours)		
Radionuclide	Critical Organ	C_1 (pCi/l)
Tritium	Total Body	20,000
⁴ Be ⁷	GI (LLI)	6,000
⁶ C ¹⁴	Fat	2,000
¹¹ Na ²²	Total Body	400
¹⁵ P ³²	Bone	30
¹⁶ S ³⁵	Testis	500
¹⁷ Cl ³⁶	Total Body	700
²⁰ Ca ⁴⁵	Bone	10
²⁰ Ca ⁴⁷	Bone	80
²¹ Sc ⁴⁶	GI (LLI)	1,000
²¹ Sc ⁴⁷	GI (LLI)	300
²¹ Sc ⁴⁸	GI (LLI)	80
²³ V ⁴⁸	GI (LLI)	90
²⁴ Cr ⁵¹	GI (LLI)	6,000
²⁵ Mn ⁵²	GI (LLI)	90
²⁵ Mn ⁵⁴	GI (LLI)	300
²⁶ Fe ⁵⁵	Spleen	2,000
²⁶ Fe ⁵⁹	GI (LLI)	200
²⁷ Co ⁵⁷	GI (LLI)	1,000
²⁷ Co ⁵⁸	GI (LLI)	9,000
²⁷ Co ⁶⁰	GI (LLI)	100
²⁸ Ni ⁵⁹	Bone	300
²⁸ Ni ⁶³	Bone	50
³⁰ Zn ⁶⁵	Liver	300
³² Ge ⁷¹	GI (LLI)	6,000
³³ As ⁷³	GI (LLI)	1,000
³³ As ⁷⁴	GI (LLI)	100
³³ As ⁷⁶	GI (LLI)	60
³³ As ⁷⁷	GI (LLI)	200

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³⁴ Se ⁷⁵	Kidney	900
³⁵ Br ⁸³	GI (LLI)	100
³⁷ Rb ⁸⁶	Total Body	600
³⁷ Rb ⁸⁷	Pancreas	300
³⁸ Sr ⁸⁵	GI (SI)	21,000
³⁸ Sr ⁸⁹	Bone	20
³⁸ Sr ⁸⁹	Bone Marrow (FRC)	80
³⁸ Sr ⁹⁰	Bone Marrow (FRC)	8
³⁹ Y ⁹⁰	GI (LLI)	60
³⁹ Y ⁹¹	GI (LLI)	90
⁴⁰ Zr ⁹³	GI (LLI)	2,000
⁴⁰ Zr ⁹⁵	GI (LLI)	200
⁴¹ Nb ^{93m}	GI (LLI)	1,000
⁴¹ Nb ⁹⁵	GI (LLI)	300
⁴² Mo ⁹⁹	Kidney	600
⁴³ Tc ⁹⁶	GI (LLI)	300
⁴³ Tc ^{97m}	GI (LLI)	1,000
⁴³ Tc ⁹⁷	GI (LLI)	6,000
⁴³ Tc ⁹⁹	GI (LLI)	900
⁴⁴ Ru ⁹⁷	GI (LLI)	1,000
⁴⁴ Ru ¹⁰³	GI (LLI)	200
⁴⁴ Ru ¹⁰⁶	GI (LLI)	30
⁴⁵ Rh ¹⁰⁵	GI (LLI)	300
⁴⁶ Pd ¹⁰³	GI (LLI)	900
⁴⁶ Pd ¹⁰⁹	GI (LLI)	300
⁴⁷ Ag ¹⁰⁶	GI (LLI)	300
⁴⁷ Ag ^{110m}	GI (LLI)	90
⁴⁷ Ag ¹¹¹	GI (LLI)	100
⁴⁸ Cd ¹⁰⁹	GI (LLI)	600
⁴⁸ Cd ^{116m}	GI (LLI)	90
⁴⁸ Cd ¹¹⁶	GI (LLI)	90
⁴⁹ In ¹¹⁵	GI (LLI)	300
⁵⁰ Sn ¹¹³	GI (LLI)	300
⁵⁰ Sn ¹²⁶	GI (LLI)	60
⁵¹ Sb ¹²²	GI (LLI)	90
⁵¹ Sb ¹²⁴	GI (LLI)	60
⁵¹ Sb ¹²⁵	GI (LLI)	300
⁵² Te ^{126m}	Kidney	600
⁵² Te ^{127m}	Kidney	200
⁵² Te ¹²⁷	GI (LLI)	900
⁵² Te ^{129m}	GI (LLI)	90
⁵² Te ¹²⁹	GI (S)	2,000
⁵² Te ^{131m}	GI (LLI)	200
⁵² Te ¹³²	GI (LLI)	90
⁵³ I ¹²⁶	Thyroid	3
⁵³ I ¹²⁹	Thyroid	1
⁵³ I ¹³¹	Thyroid	3
⁵⁵ Cs ¹³¹	Total Body	20,000
⁵⁵ Cs ¹³⁴	GI (S)	20,000
⁵⁵ Cs ¹³⁵	Total Body	900
⁵⁵ Cs ¹³⁶	Total Body	800
⁵⁵ Cs ¹³⁷	Total Body	200
⁵⁶ Ba ¹³¹	GI (LLI)	600

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⁵⁶ Ba ¹⁴⁰	GI(LLI)	90
⁵⁷ La ¹⁴⁰	GI(LLI)	60
⁵⁸ Ce ¹⁴¹	GI(LLI)	300
⁵⁸ Ce ¹⁴³	GI(LLI)	100
⁶⁰ Pr ¹⁴³	GI(LLI)	100
⁶¹ Pm ¹⁴⁹	GI(LLI)	100
⁶² Sm ¹⁵¹	GI(LLI)	1,000
⁶² Sm ¹⁵³	GI(LLI)	200
⁶³ Eu ¹⁵²	GI(LLI)	60
⁶³ Eu ¹⁵⁴	GI(LLI)	200
⁶³ Eu ¹⁵⁵	GI(LLI)	600
⁶⁴ Gd ¹⁵³	GI(LLI)	600
⁶⁵ Tb ¹⁶⁰	GI(LLI)	100
⁶⁶ Dy ¹⁶⁵	GI(LLI)	100
⁶⁷ Ho ¹⁶⁶	GI(LLI)	90
⁶⁸ Er ¹⁶⁹	GI(LLI)	300
⁶⁹ Tm ¹⁷⁰	GI(LLI)	100
⁶⁹ Tm ¹⁷¹	GI(LLI)	1,000
⁷⁰ Yb ¹⁷⁵	GI(LLI)	300
⁷¹ Lu ¹⁷⁷	GI(LLI)	300
⁷² Hf ¹⁸¹	GI(LLI)	200
⁷³ Ta ¹⁸²	GI(LLI)	100
⁷⁴ W ¹⁸¹	GI(LLI)	1,000
⁷⁴ W ¹⁸⁵	GI(LLI)	300
⁷⁵ Re ¹⁸³	GI(LLI)	2,000
⁷⁵ Re ¹⁸⁶	GI(LLI)	300
⁷⁵ Re ¹⁸⁷	GI(LLI)	9,000
⁷⁶ Os ¹⁸⁵	GI(LLI)	200
⁷⁶ Os ¹⁹¹	GI(LLI)	600
⁷⁶ Os ¹⁹³	GI(LLI)	200
⁷⁷ Ir ¹⁹⁰	GI(LLI)	600
⁷⁷ Ir ¹⁹²	GI(LLI)	100
⁷⁸ Pt ¹⁹¹	GI(LLI)	300
⁷⁸ Pt ^{193m}	GI(LLI)	3,000
⁷⁸ Pt ¹⁹³	Kidney	3,000
⁷⁸ Pt ¹⁹⁷	GI(LLI)	300
⁷⁹ Au ¹⁹⁶	GI(LLI)	600
⁷⁹ Au ¹⁹⁸	GI(LLI)	100
⁸¹ Tl ²⁰⁴	GI(LLI)	300
⁸² Pb ²⁰³	GI(LLI)	1,000
⁸³ Bi ²⁰⁶	GI(LLI)	100
⁸³ Bi ²⁰⁷	GI(LLI)	200
⁸¹ Po ²³³	GI(LLI)	300

TABLE IV-2B
 Annual Average Concentrations Yielding 4 Millirem
 per Year for a Two Liter Daily Intake
 (Half-life less than 24 hours)

Radionuclide	Critical Organ	C ₁ (pCi/l)
⁹ F ¹⁸	GI(SI)	2,000
¹⁴ Si ³¹	GI(S)	3,000
¹⁷ Cl ³⁸	GI(S)	1,000

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19K42	GI(S)	900
23Mn56	GI(LLI)	300
27Co58m	GI(LLI)	300
28Ni68	GI(LLI)	300
29Cu64	GI(LLI)	900
30Zn69m	GI(LLI)	200
30Zn69	GI(S)	6,000
31Ga72	GI(LLI)	100
38Sr85m	Total Body	900
38Sr91	GI(LLI)	200
38Sr92	GI(ULI)	200
39Y91m	GI(SI)	9,000
39Y92	GI(ULI)	200
39Y93	GI(LLI)	90
40Zr97	GI(LLI)	60
41Nb97	GI(ULI)	3,000
43Tc96m	GI(LLI)	30,000
43Tc99m	GI(ULI)	20,000
44Rh106	GI(ULI)	300
45Rh103m	GI(S)	30,000
49In113m	GI(ULI)	3,000
49In114m	GI(LLI)	60
49In116m	GI(ULI)	1,000
53I132	Thyroid	90
53I128	Thyroid	10
53I134	Thyroid	100
53I126	Thyroid	30
55Cs134m	Total Body	80
59Pr142	GI(LLI)	90
60Nd149	GI(LLI)	900
63Eu152	GI(LLI)	200
64Gd159	GI(LLI)	200
66Dy165	GI(LLI)	1,000
68Er171	GI(ULI)	300
74W187	GI(LLI)	200
75Re188	GI(LLI)	200
76Os191m	GI(LLI)	9,000
77Ir194	GI(LLI)	90
78Pt197m	GI(ULI)	3,000
81Tl202	GI(LLI)	300

ATTACHMENT 2 -- DERIVED PREVENTIVE RESPONSE LEVELS FOR DRINKING WATER (FEMA REP-13)

This Attachment 2 consists of two tables from FEMA REP-13, Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 - Water and Non-Dairy Food Pathway, FEMA, May, 1990.

1. Table 2. Early Emergency Phase Derived Preventive Response Levels for Drinking Water (Five Day Ingestion Period).
2. Table 3. Long-Term Derived Preventive Response Levels for Drinking Water (One Year Ingestion Period).

Early Emergency Phase
Derived Preventive Response Levels for Drinking Water
(Five Day Ingestion Period)^a

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)
I-131	Th	1.2E-1 ^e	1.1E-1	4.5E-2	2.5E-2
I-132	Th	1.2E+1	1.4E+1	4.9E+0	3.5E-1
I-133	Th	2.4E+0	2.6E+0	9.1E-1	5.8E-1
Rb-86	Lv	2.6E+0	5.6E+0	1.9E+0	7.1E-1
Cs-134	Lv	7.4E-1	3.6E-1	1.9E-1	9.4E-1
Cs-136	Lv	2.2E+0	2.4E+0	1.3E+0	9.3E-1
Cs-137	Lv	8.2E-1	4.8E-1	2.2E-1	1.6E+0
Te-127m	Kd	1.8E+0	1.9E+0	8.8E-1	7.8E-1
Te-131m	GI	2.4E+0	3.1E+0	2.9E+0	4.4E+0
Te-132	GI	1.0E+0	1.6E+0	2.5E+0	2.7E+0
Sb-127 ^f	GI	1.1E+0	1.7E+0	2.6E+0	4.8E+0
Sr-89	Bo	4.3E+0	1.7E-1	5.6E-2	5.9E-1
Sr-90	Bo	7.1E-2	8.6E-3	4.2E-3	4.5E-2
Ba-140	GI	1.4E+0	1.9E+0	9.8E-1	7.4E-1
Mo-99	Kd	9.1E+0	9.4E+0	4.6E+0	5.9E+0
Ru-103	GI	2.4E+0	3.5E+0	3.9E+0	6.4E+0
Ru-106 ^f	GI	2.8E-1	3.8E-1	3.9E-1	6.1E-1
Rh-105 ^f	GI	1.2E+1	1.8E+1	2.9E+1	5.4E+1
Co-58	GI	3.4E+0	5.5E+0	7.0E+0	1.3E+1
Co-60	GI	1.2E+0	2.0E+0	2.4E+0	4.3E+0
Y-90	GI	4.9E-1	6.3E-1	6.1E-1	9.3E-1
Y-91	GI	6.6E-1	8.9E-1	9.2E-1	1.4E+0
Zr-95	GI	1.7E+0	2.4E+0	2.8E+0	4.6E+0
Zr-97	GI	3.4E+0	4.0E+0	3.3E+0	4.9E+0
Nb-95	GI	2.5E+0	3.8E+0	4.6E+0	8.0E+0
La-140	GI	6.1E-1	8.3E-1	8.2E-1	1.3E+0
Ce-141	GI	2.2E+0	3.0E+0	3.0E+0	4.7E+0
Ce-143	GI	4.0E+0	5.1E+0	4.7E+0	7.1E+0
Ce-144	GI	3.0E-1	4.1E-1	4.2E-1	6.5E-1
Pr-143	GI	1.4E+0	1.9E+0	1.9E+0	2.9E+0
Nd-147	GI	1.7E+0	2.2E+0	2.3E+0	3.6E+0
Np-239 ^f	GI	4.5E+0	5.8E+0	5.5E+0	8.4E+0
Pu-238 ^f	Bo	7.5E-3	9.9E-3	4.8E-3	6.9E-3
Pu-239 ^f	Bo	6.4E-3	8.4E-3	3.4E-3	5.8E-3
Pu-240 ^f	Bo	6.4E-3	8.4E-3	3.4E-3	5.8E-3
Pu-241 ^f	Bo	3.1E-1	4.0E-1	2.0E-1	2.8E-1
Am-241 ^f	Bo	1.2E-3	2.0E-2	7.8E-4	1.1E-3
Cm-242 ^f	Bo	5.9E-2	7.8E-2	3.8E-2	5.3E-2
Cm-244 ^f	Bo	2.5E-3	3.2E-3	1.6E-3	2.3E-3

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)

a Assumes a contaminated water ingestion period equivalent to the shorter time interval of the radionuclide mean lifetime or 5 days (see Appendix A). Water is ingested at the rates given in Reference 9 for the maximum exposed individual.

b The derived response level for each radionuclide is capable of producing the preventive PAG dose. Therefore, if more than one radionuclide is present in the sample, the sum of ratios technique must be used to estimate the individual radionuclide concentrations that are permissible, e.g.

$$\frac{\text{Conc A}}{\text{Response Level A}} + \dots + \frac{\text{Conc X}}{\text{Response Level X}} = \leq 1.$$

c Th=thyroid, Lv=liver, Kd=kidney, Bo=bone, Wb=whole body, GI=gastro-intestinal tract. These are the critical organs for the corresponding radionuclides.

d Calculated concentrations may vary if calculation assumptions concerning ingestion rates and dose conversion factors are different from those presented in Reference 9.

e $1.2\text{E-1} = 1.2 \times 10^{-1} = 0.12.$

f Adult dose conversion factors (DCF's) were obtained from ICRP-30; 10, 11, 12 dose conversion factors for other age groups were estimated by multiplying these adult DCF's by DCF ratios ($\frac{\text{other age group}}{\text{adult}}$) presented in Reference 9 for other nuclides having similar critical organs and retention times.

Long-Term Derived Preventive Response Levels for Drinking Water^a
(One Year Ingestion Period)

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)
I-131	Th	6.3E-2 ^e	5.7E-2	2.4E-2	1.3E-2
I-132	Th	1.2E+1	1.4E+1	4.9E+0	3.5E-1
I-133	Th	2.4E+0	2.6E+0	9.1E-1	5.8E-1
Rb-86	Lv	6.4E-1	1.4E+0	4.7E-1	1.8E-1
Cs-134	Lv	1.2E-2	5.8E-3	3.0E-3	1.5E-2
Cs-136	Lv	7.6E-1	8.2E-1	4.3E-1	3.2E-1
Cs-137	Lv	1.1E-2	6.6E-3	3.0E-3	2.2E-2
Te-127m	Kd	8.5E-2	8.5E-2	4.0E-2	3.6E-2
Te-129	Kd	4.0E+4	3.1E+4	9.1E+2	5.2E+2
Te-131m	GI	2.4E+0	3.1E+0	2.9E+0	4.4E+0
Te-132	GI	1.0E+0	1.6E+0	2.5E+0	2.7E+0
Sb-127 ^f	GI	9.8E-1	1.5E+0	2.4E+0	4.4E+0
Sr-89	Bo	4.1E-1	1.6E-2	5.3E-3	5.6E-2
Sr-90	Bo	9.9E-4	1.2E-4	5.8E-5	6.2E-4
Ba-140	GI	4.7E-1	6.5E-1	3.4E-1	2.6E-1
Mo-99	Kd	9.1E+0	9.4E+0	4.6E+0	5.9E+0
Ru-103	GI	3.0E-1	4.3E-1	4.9E-1	7.9E-1
Ru-106	GI	5.1E-3	6.9E-3	7.2E-3	1.1E-2
Rh-105 ^f	GI	1.2E+1	1.8E+1	2.9E+1	5.4E+1
Co-58	GI	2.4E-1	3.8E-1	4.9E-1	8.8E-1
Co-60	GI	1.8E-2	2.8E-2	3.6E-2	6.3E-2
Y-90	GI	6.8E-3	8.8E-3	8.5E-3	1.3E-2
Y-91	GI	5.5E-2	7.5E-2	7.7E-2	1.2E-1
Zr-95	GI	1.3E-1	1.9E-1	2.1E-1	3.5E-1
Zr-97	GI	3.4E+0	4.0E+0	3.3E+0	4.9E+0
La-140	GI	2.1E-1	2.9E-1	2.9E-1	4.5E-1
Ce-141	GI	3.2E-1	4.4E-1	4.5E-1	7.0E-1
Ce-143	GI	4.0E+0	5.1E+0	4.7E+0	7.1E+0
Ce-144	GI	5.9E-3	7.9E-3	8.2E-3	1.3E-2
Pr-143	GI	4.6E-1	6.1E-1	6.2E-1	9.6E-1
Nd-147	GI	6.5E-1	8.9E-1	9.1E-1	1.4E+0
Np-239	GI	4.5E+0	5.8E+0	5.5E+0	8.4E+0
Pu-238 ^f	Bo	1.0E-4	1.4E-4	6.5E-5	9.6E-5
Pu-239 ^f	Bo	8.8E-5	1.2E-4	5.4E-5	8.0E-5
Pu-240 ^f	Bo	8.8E-5	1.2E-4	5.4E-5	8.0E-5
Pu-241 ^f	Bo	4.4E-3	5.6E-3	2.8E-3	4.0E-3
Am-241 ^f	Bo	1.7E-5	2.2E-5	1.1E-5	1.5E-5
Cm-242 ^f	Bo	2.1E-3	2.7E-3	1.3E-3	1.8E-3
Cm-244 ^f	Bo	3.5E-5	4.5E-5	2.2E-5	3.2E-5

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^d			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)

^a Assumes a contaminated water ingestion period equivalent to the shorter time interval of the radionuclide mean lifetime or 365 days (see Appendix A). Water is ingested at the rates given in Reference 9 for the maximum exposed individual.

^b The derived response level for each radionuclide is capable of producing the preventive PAG dose. Therefore, if more than one radionuclide is present in the sample, the sum of ratios technique must be used to estimate the individual radionuclide concentrations that are permissible, e.g.

$$\frac{\text{Conc A}}{\text{Response Level A}} + \dots + \frac{\text{Conc X}}{\text{Response Level X}} = \leq 1.$$

^c Th=thyroid, Lv=liver, Kd=kidney, Bo=bone, Wb=whole body, GI=gastro-intestinal tract. These are the critical organs for the corresponding radionuclides.

^d Calculated concentrations may vary if calculation assumptions concerning ingestion rates and dose conversion factors are different from those presented in Reference 9.

^e $6.3\text{E-}2 = 6.3 \times 10^{-2} = 0.063.$

^f Adult dose conversion factors (DCF's) were obtained from ICRP-30; 10, 11, 12 dose conversion factors for other age groups were estimated by multiplying these adult DCF's by DCF ratios ($\frac{\text{other age group}}{\text{adult}}$) presented in Reference 9 for other nuclides having similar critical organs and retention times.

EMERGENCY FACILITY OPERATIONS

PURPOSE:

The purpose of this procedure is to provide general instructions and forms for BRP staff when assigned to the State Emergency Operations Center (SEOC), utility Emergency Operations Facility (EOF), utility Technical Support Center (TSC) the Radiological Assessment Center (RAC) and/or the Radiological Emergency Response Vehicle (R3V) in the event of an incident or accident at a nuclear power plant. Field Team Operations are detailed in BRP-ER-6.01, "Field Team Operations". The Radiological Assessment Center is the backup facility BRP staff if the SEOC is not available.

CONTENTS:

LOG KEEPING
CHECKLISTS
FIELD TEAM CONTROL

SECTION 1
SECTION 2
SECTION 3

SECTION 1: LOG KEEPING

All of the emergency positions that are staffed by BRP personnel at each of the emergency facilities should keep a running log of events and communications made and received. Attachment 1, "Pennsylvania DEP – Bureau of Radiation Protection Emergency Response Log Sheet" should be used.

SECTION 2: CHECKLISTS

Each of the emergency positions has a checklist that should be started when the individual assigned to that position starts the assignment. All of the checklists are in Attachment 2.

SECTION 3: FIELD TEAM CONTROL

The Field Team Coordinator in coordination with the Field Team Communicator(s) will document field team activities using the following :

1. BRP Field Team Message Log: Attachment 3

This will be used to document messages between field teams and communicators, classification changes and instructions given to field teams.

2. BRP Field Team Data Log: Attachment 4

This form is used to document survey and air sample results.

3. BRP Field Team Exposure Tracking: Attachment 5

This form is used to document field team members exposure and the administration of KI.

4. BRP Field Teams Tracking: Attachment 6

This form is an aid to the Field Team Coordinator and Communicators to track the location and status of the field teams.

RADIOLOGICAL ASSESSMENT DIRECTOR CHECKLIST

Upon Arrival at EOC:

- _____ Begin a written log of activities.
- _____ Contact PEMA Operations, the affected licensee and the Technical Assessment Manager at the EOF regarding plant status, emergency classification status, radiological conditions, and metrological data.
- _____ Review the declared Emergency Action Level (EAL) in the licensee emergency plan.
- _____ Confirm with PEMA watch officer that the loop has been closed between the licensee, BRP, and PEMA.
- _____ Obtain and evaluate licensee PAR. If no licensee PAR has been issued, determine if the situation warrants BRP developing a PAR. If BRP PAR is developed, communicate the PAR to PEMA and Governor (or his/her designee).
- _____ Consult with the Radiological Assessment Manager to determine if a request for federal assistance is needed.
- _____ Consult with the Technical Assessment Manager at the EOF to ensure he/she is aware of actions being considered at the EOC.
- _____ Brief PEMA and EOC staff on event status. Briefing topics that can be included are:
 - Station and Unit (ie PBAPS-2)
 - Emergency Classification
 - Plant Status
 - Radiological Conditions (including release pathways and magnitude)
 - Metrological Data
 - Federal Assistance Requested and Status
 - Plan of Action

Continuing EOC Operations:

- _____ Direct BRP emergency response activities.
- _____ Provide periodic update briefings to PEMA and EOC staff on briefing items listed above every 60 minutes, or when the emergency classification changes.
- _____ Obtain and evaluate licensee PAR. If no licensee PAR has been issued, determine if the situation warrants BRP developing a PAR. If BRP PAR is developed, communicate the PAR to PEMA and Governor (or his/her designee).
- _____ If the event escalates in severity, discuss with Radiological Assessment Manager if request for federal assistance is needed.
- _____ Maintain a written log of activities.

Actions at Specific Emergency Classifications and for Non-Routine Radiological Releases:

Alert:

- _____ Review declared EAL in licensee emergency plan. Consult with Technical Assessment Manager on EAL and plant status.
- _____ Determine if BRP Field Monitoring Teams should be mobilized, consulting with Radiological Assessment Manager.
- _____ Brief EOC staff on emergency classification and event status.

Site Area Emergency:

- _____ Review the declared EAL in the licensee emergency plan. Consult with Technical Assessment Manager on EAL and plant status.
- _____ Direct mobilization of BRP Field Monitoring Teams, if not done at Alert.
- _____ Discuss monitoring strategy of BRP Field Monitoring Teams with Radiological Assessment Manager.
- _____ Discuss with Radiological Assessment Manager the need to place dairy animals on stored feed (see Section 8.1.2.2.1.1 of BRP Emergency Plan). Ensure recommendation is communicated to PA Department of Agriculture.
- _____ Brief PEMA and EOC staff on emergency classification and event status.

General Emergency:

- _____ Review the declared EAL in the licensee emergency plan. Consult with Technical Assessment Manager on EAL and plant status.
- _____ Obtain and evaluate licensee Protective Action Recommendation (PAR). Develop BRP PAR and communicate to PEMA and Governor (or his/her designee).
- _____ Discuss with Radiological Assessment Manager recommending or modifying recommendation to place dairy animals on stored feed (see Section 8.1.2.2.1.1 of BRP Emergency Plan). Ensure recommendation and modifications are communicated to PA Department of Agriculture.
- _____ Discuss with Radiological Assessment Manager a recommendation that KI be distributed and taken by persons in the 10 mile EPZ. Ensure recommendation is communicated to the PA Department of Health.
- _____ Brief PEMA and EOC staff on emergency classification and event status.

Non-Routine Radiological Releases:

- _____ Discuss BRP Field Monitoring Team monitoring strategy with Radiological Assessment Manager. Obtain up-to-date field monitoring data.

- _____ Consult with Technical Assessment Manager on plant status and anticipated duration and magnitude of release.

- _____ Inform PEMA when release has started and keep them informed on release status.

- _____ Discuss with Radiological Assessment Manager recommending or modifying recommendation to place dairy animals on stored feed (see Section 8.1.2.2.1.1 of BRP Emergency Plan). Ensure recommendation and modifications are communicated to PA Department of Agriculture.

- _____ Review BRP and licensee dose projections.

- _____ Obtain and evaluate licensee PAR. If no licensee PAR has been issued, determine if the situation warrants BRP developing a PAR. If BRP PAR is developed, communicate the PAR to PEMA and Governor (or his/her designee).

RADIOLOGICAL ASSESSMENT MANAGER CHECKLIST

Upon Arrival at EOC:

- ___ Begin a written log of activities.
- ___ Contact Radiological Assessment Director, BRP-EOF staff and affected licensee Health Physics staff regarding plant status, emergency classification status, radiological conditions, and metrological data.
- ___ Review the declared Emergency Action Level (EAL) in the licensee emergency plan.
- ___ Brief Radiological Assessment Director on plant status, emergency classification status, radiological conditions, and metrological data.
- ___ Obtain and evaluate licensee PAR. If no licensee PAR has been issued, consult with Radiological Assessment Director to determine if the situation warrants BRP developing a PAR.
- ___ Consult with Radiological Assessment Director to determine if a request for federal assistance is needed.
- ___ Brief BRP staff at the EOC on event status. Briefing topics that can be included are:
 - Station and Unit (ie PBAPS-2)
 - Emergency Classification
 - Plant Status
 - Radiological Conditions (including release pathways and magnitude)
 - Metrological Data
 - Federal Assistance Requested and Status
 - Plan of Action

Continuing EOC Operations:

- ___ Direct all BRP Radiological Assessment activities.
- ___ Maintain oversight of all BRP staff activities at the EOC.
- ___ Provide periodic update briefings to BRP staff at the EOC on briefing items listed above every 60 minutes, or if the emergency classification changes.
- ___ Evaluate all radiological field team data and dose projections.
- ___ Provide Radiological Assessment Director with updates of radiological assessment.
- ___ If the event escalates in severity, discuss with Radiological Assessment Director if request for federal assistance is needed.
- ___ Provide Field Team Coordinator with updated information on plant status, emergency classification status, radiological conditions, metrological data, and protective action information. Provide guidance to Field Team Coordinator on field monitoring team

monitoring strategy and priorities.

___ Maintain a written log of activities.

Actions at Specific Emergency Classifications and for Non-Routine Radiological Releases:

Alert:

___ Review declared EAL in licensee emergency plan.

___ Consult with Radiological Assessment Director to determine if BRP Field Monitoring Teams should be mobilized.

___ Brief BRP EOC staff on emergency classification and event status.

Site Area Emergency:

___ Review the declared EAL in the licensee emergency plan.

___ Consult with Radiological Assessment Director on mobilization of BRP Field Monitoring Teams, if not done at Alert.

___ Discuss monitoring strategy of BRP Field Monitoring Teams with Radiological Assessment Director.

___ Discuss with Radiological Assessment Director the need to place dairy animals on stored feed (see Section 8.1.2.2.1.1 of BRP Emergency Plan). Ensure recommendation is communicated to PA Department of Agriculture.

___ Brief BRP EOC staff on emergency classification and event status.

General Emergency:

___ Review the declared EAL in the licensee emergency plan.

___ Obtain and evaluate licensee Protective Action Recommendation (PAR). Consult with Radiological Assessment Director on development of BRP PAR.

___ Discuss with Radiological Assessment Director recommending or modifying recommendation to place dairy animals on stored feed (see Section 8.1.2.2.1.1 of BRP Emergency Plan). Ensure recommendation and modifications are communicated to PA Department of Agriculture.

___ Discuss with Radiological Assessment Director a recommendation that KI be distributed and taken by persons in the 10 mile EPZ. Ensure recommendation is communicated to the PA Department of Health.

___ Brief BRP EOC staff on emergency classification and event status.

Non-Routine Radiological Releases:

- _____ Discuss BRP Field Monitoring Team monitoring strategy with Radiological Assessment Director. Provide guidance to Field Team Coordinator on field monitoring team monitoring strategy and priorities. Obtain up-to-date field monitoring data.

- _____ Inform the Radiological Assessment Director when release has started and keep him informed of release status.

- _____ Discuss with Radiological Assessment Director recommending or modifying recommendation to place dairy animals on stored feed (see Section 8.1.2.2.1.1 of BRP Emergency Plan). Ensure recommendation and modifications are communicated to PA Department of Agriculture.

- _____ Review BRP and licensee dose projections.

- _____ Obtain and evaluate licensee PAR. If no licensee PAR has been issued, determine if the situation warrants BRP developing a PAR, base on release magnitude. Consult with Radiological Assessment Director on development of BRP PAR.

TECHNICAL ASSESSMENT MANAGER CHECKLIST

Upon Arrival at EOF:

- ___ Begin a written log of activities.
- ___ Contact licensee nuclear engineering staff, BRP Site Lead Nuclear Safety Specialist at TSC, and BRP EOF support staff for briefing on plant status, emergency classification status, radiological conditions, and metrological data.
- ___ Review the declared Emergency Action Level (EAL) in the licensee emergency plan.
- ___ Confirm with Radiological Assessment Director that the loop has been closed between the licensee, BRP and PEMA.
- ___ Brief Radiological Assessment Director on plant status and emergency classification status, radiological conditions, and metrological data.
- ___ Contact BRP nuclear safety staff at the EOC and provide them with a briefing.
- ___ Coordinate continual monitoring of plant status and emergency classification status with nuclear safety staff at TSC.

Continuing EOF Operations:

- ___ Direct all BRP activities at the EOF and TSC.
- ___ Provide periodic update briefings to BRP staff at the EOF every 60 minutes, or if emergency classification changes.
- ___ Provide Radiological Assessment Director with updates of plant status and information received during licensee briefings on emergency status.
- ___ Notify Radiological Assessment Director of changes in emergency classification and brief on basis for change. Review the declared EAL in licensee emergency plan.
- ___ Obtain and evaluate licensee Protective Action Recommendations (PARs). Communicate licensee PARs to Radiological Assessment Director. Advise Radiological Assessment Director on the need to implement PARs.
- ___ Serves as BRP liaison with the licensee and NRC representatives at the EOF.
- ___ Maintains a written log of activities.

DATA EVALUATION COORDINATOR CHECKLIST

Upon Arrival at EOC:

- _____ Begin a written log of activities.
- _____ Obtain briefing from Radiological Assessment Manager on plant status, emergency classification status, radiological conditions, and metrological data.
- _____ Assign duties to the BRP-EOC Health Physics staff.
- _____ Establish contact with BRP-EOF. Confirm commercial / dedicated telephone numbers for exchange of information.

Continuing EOC Operations:

- _____ Review all incoming BRP and licensee dose projections, field team data and R3V radiological data, and compare with PAGs.
- _____ Keep Radiological Assessment Manager briefed on meteorological data, licensee field team data, BRP field team data, licensee dose projections, and other incoming information.
- _____ Supervise work of EOC Support Staff and Radiation Measurements Laboratory Liaison.
- _____ Provide information on Protective Action Recommendations (PARs) to BRP-EOF. (Evacuation / Shelter, Emergency Worker and Public KI, Agricultural PARs, etc.).
- _____ Review BRP and licensee dose projections and discuss with Radiological Assessment Manager.
- _____ Compare BRP Dose Projections and Licensee Dose Projections. Investigate when they differ by a factor of 10 or more.
- _____ Maintain a written log of activities.

LEAD NUCLEAR SAFETY SPECIALIST CHECKLIST

Upon Arrival at TSC:

- _____ Begin a written log of activities.
- _____ Contact licensee nuclear engineering staff to receive a briefing on plant status and emergency classification status.
- _____ As applicable, call and brief Technical Assessment Manager on plant status and emergency classification status.
- _____ ONLY if directed by Technical Assessment Manager, contact nuclear safety personnel at the EOC and provide them with a briefing.
- _____ Monitor plant and plant system status as directed by the Technical Assessment Manager.

Continuing TSC Operations:

- _____ Continue monitoring of plant status and emergency classification status.
- _____ Attend licensee update briefings.
- _____ Provide periodic update briefings to Technical Assessment Manager at the EOF. If the Technical Assessment Manager is not available, update Nuclear Safety Specialist at EOC.
- _____ Maintain a written log of all activities.

EOC NUCLEAR SAFETY SPECIALIST CHECKLIST

Upon Arrival at EOC:

- ___ Begin a written log of activities.
- ___ Establish contact with the Technical Assessment Manager at the EOF to receive a briefing on plant status and emergency classification status. If Technical Assessment Manager is not available, contact BRP Site Lead Nuclear Safety Specialist at TSC to receive briefing on plant status and emergency classification status.
- ___ Verify that dedicated phone lines to the affected plant are operational.
- ___ If not already performed by Technical Assessment Manager, provide a briefing to the Radiological Assessment Director and Radiological Assessment Manager.
- ___ Log onto the ERDS computer and/or Licensee Plant Data System computer and determine if plant parameters for the affected unit are on line.
- ___ Monitor plant and plant system status as directed.

Continuing EOC Operations:

- ___ Perform additional duties assigned by the Technical Assessment Manager.
- ___ Continue monitoring of plant status via ERDS and Licensee Plant Data System, and maintains communications with BRP personnel at the EOF.
- ___ Receive updates regarding licensee briefings provided by Technical Assessment Manager.
- ___ Maintain a written log of all activities.

EOF SUPPORT STAFF CHECKLIST

Upon Arrival at EOF:

- _____ Begin a written log of activities.
- _____ Receive briefing from licensees' Dose Assessment Group Manager or equivalent on radiological conditions and metrological data. Brief Technical Assessment Manager.
- _____ Verify that commercial / dedicated telephone lines function properly.
- _____ Establish contact with BRP staff at the EOC.
- _____ Brief Radiological Assessment Manager on radiological conditions and metrological data.

Continuing EOF Operations:

- _____ Ensure BRP attends licensee briefing.
- _____ Ensure that BRP staff at the EOF and EOC have established constant communications.
- _____ Discuss and evaluate licensee dose projections with licensee and Radiological Assessment Manager at the EOC at the direction of the Technical Assessment Manager.
Provide licensee dose projections to EOC.
- _____ Review licensee field team data and provide that data to EOC.
- _____ Discuss and evaluates licensee Protective Action Recommendations (PARS) with licensee, Technical Assessment Manager.
- _____ Assist Radiological Assessment Director, Radiological Assessment Manager and Technical Assessment Manager as required.
- _____ Maintain a written log of activities.

FIELD TEAM COORDINATOR CHECKLIST

Upon Arrival at EOC or R3V:

- ___ Begin a written log of activities.
- ___ Receive briefing from Radiological Assessment Manager on plant status, emergency classification status, radiological conditions, and meteorological data.
- ___ Set up 10 mile EPZ map of affected plant and prepare to dispatch field teams to appropriate monitoring locations.
- ___ Ensure that Field Team Communicator(s) have set up their work area and established communication with field teams via satellite phones (primary) or alternate method. Verify communication checks with primary and backup communications have been performed.
- ___ Co-ordinate with Radiological Assessment Manager in positioning and selection of initial monitoring locations for field teams.

Continuing EOC or R3V Operations:

- ___ Supervise Field Team Communicator activities.
- ___ Coordinate BRP field team monitoring activities with Radiological Assessment Manager.
- ___ Dispatch BRP field teams to appropriate monitoring locations and continue tracking the plume.
- ___ Plot BRP field team locations on map and track feed back (e.g. dose rate, air samples) from teams.
- ___ Ensure that BRP field teams monitor their exposure and stay within procedural limits.
- ___ Ensure that BRP field teams remain updated on changes in plant status, emergency classification status, radiological conditions, metrological data, and protective actions.
- ___ Provide Data Evaluation Coordinator with updates on BRP field team measurements.
- ___ Maintain a written log of activities.

NOTE: It is not necessary to repeat data that is transmitted automatically to the R3V and EOC.

FIELD TEAM COMMUNICATOR CHECKLIST

Upon Arrival at EOC or R3V:

- ___ Begin a written log of activities.
- ___ Receive briefing from Field Team Coordinator on plant status, emergency classification status, radiological conditions, and meteorological data.
- ___ Set up 10 mile EPZ map of affected plant.
- ___ Ensure appropriate BRP E Plan implementing procedure tracking forms are available.
- ___ Ensure that communication with field teams via satellite phones (primary) or alternate method.
- ___ Co-ordinate with Field Team Coordinator for positioning of BRP field teams and relaying information regarding initial staging and monitoring locations.

Continuing EOC or R3V Operations:

- ___ Establish predetermined "call in" times for field teams and measures to be taken if communications are lost.
- ___ Co-ordinate BRP field team monitoring activities with Field Team Coordinator.
- ___ Relay information from Field Team Coordinator regarding changes in monitoring locations, plant status, emergency classification status, dose tracking, KI administration and other pertinent information.
- ___ Document appropriate field team data (e.g. team locations, times, and other pertinent information) on forms contained in Attachment 3.
- ___ Maintain a written log of activities.

NOTE: It is not necessary to repeat data that is transmitted automatically to the R3V and EOC.

DOSE PROJECTIONS CALCULATOR CHECKLIST

Upon Arrival at EOC:

- ___ Begin a written log of activities.
- ___ Receive briefing from Data Evaluation Coordinator or Radiological Assessment Manager regarding plant status, emergency classification status, radiological conditions, and metrological data.
- ___ Obtain meteorological data from status board or EOF Technical Assessment Manager.
- ___ Ensure RASCAL is functioning properly then notify Data Evaluation Coordinator.
- ___ If RASCAL is **not** functioning properly, notify Data Evaluation Coordinator that hand dose calculations will be made in accordance with applicable BRP E Plan procedures .
- ___ Contact Technical Assessment Manager OR EOF Support Staff at EOF and obtain data for initial dose calculations by telephone or fax.

Continuing EOC Operations:

- ___ Perform updated dose calculations.
- ___ Print out dose calculation results and notify Data Evaluation Coordinator and / or Radiological Assessment Manager of each update.
- ___ Provide dose projections to EOF Technical Assessment Manager as requested.
- ___ Request Technical Assessment Manager or EOF Support Staff for licensee dose projections (if available) and compare with BRP dose projections.
- ___ Investigate and resolve discrepancies in dose comparisons if licensee and BRP projections differ by a factor of 10 or more.
- ___ If directed by Radiological Assessment Manager, upon receipt of BRP field team Iodine sample results, back calculate dose projections for comparison with field team measurements in accordance with applicable BRP Emergency Plan procedures.
- ___ Maintain a written log of all activities.

EMERGENCY PLANNING COORDINATOR CHECKLIST

Upon Arrival at EOC:

- _____ Begin a written log of activities.
- _____ Review BRP staffing for emergency response and augment staffing as needed.
- _____ Verify communications functions as planned and augment communication capabilities as needed.
- _____ Receive briefing from Radiological Assessment Director, Technical Assessment Manager, and Radiological Assessment Manager.

Continuing EOC Operations:

- _____ Ensure compliance with BRP Emergency Plan.
- _____ Advise and assists BRP staff on procedures, methodologies and concepts of operation.
- _____ Evaluate and enhances administrative, communications and logistical support.
- _____ Assist Radiological Assessment Director, Radiological Assessment Manager and Technical Assessment Manager as required.
- _____ Ensure that BRP response activities are properly documented and archived.
- _____ Maintain a written log of activities.

RADIATION MEASUREMENTS LABORATORY LIAISON CHECKLIST

Upon Arrival at the Radiation Measurements Laboratory (Evan Press):

- _____ Begin a written log of activities.
- _____ Receive briefing from Data Evaluation Coordinator or Radiological Assessment Manager regarding plant status, emergency classification status, and radiological conditions.

Continuing Radiation Measurements Laboratory Activities:

- _____ Review sample results for all emergency event related environmental samples analyzed at RML. Verify Sample Control and Chain of Custody is in compliance with BRP-ER-6.07, "Sample Control and Chain of Custody" procedure.
- _____ Provide sample analysis results to Data Evaluation Coordinator and / or Radiological Assessment Manager at the State EOC.
- _____ Advise RML staff on sampling priorities and through put of samples as established by the Radiological Assessment Manager.
- _____ Assist RML staff with implementation of contamination control procedures and sample storage.
- _____ Coordinate efforts of state and federal agencies involved in procuring and analyzing environmental samples.
- _____ Maintain a written log of all activities.

EOC SUPPORT STAFF CHECKLIST

Upon Arrival at EOC:

- ___ Begin a written log of activities.
- ___ Receive briefing from Data Evaluation Coordinator on plant status, emergency classification status, radiological conditions, and meteorological data.
- ___ Position status boards, forms and filing trays as needed for collecting and tracking meteorological data, emergency classification status changes and other emergency related information.
- ___ Ensure that fax machines are fully functional.
- ___ If not already done, ensure that telephone communications between the EOC and affected plant TSC and / EOF are available (include names and call back numbers for BRP contacts).

If assigned PEIRS entry position

- ___ Log onto PEIRS System and verify that system is functioning properly.
- ___ Enter "outgoing" BRP messages and open "incoming" messages for BRP Liaison.

Examples as follows:

Staffing and / or change in staffing levels for BRP E Plan positions at the EOC and EOF
Meteorological information updates
Field team locations and survey information.
Public Action Recommendations
- ___ Verify completion of PEIRS System "BRP Checklist" items as appropriate, consistent with emergency classification level.
- ___ Ensure that messages are reviewed by Radiological Assessment Manager and / or Data Evaluation Coordinator when appropriate.
- ___ Maintain a written log of activities.

Continuing EOC Operations:

- ___ Ensure that all documents generated are stamped "DRILL", if appropriate.
- ___ Update status board(s) with appropriate information.
- ___ Provide entry data for PEIRS "outgoing" messages from BRP as appropriate.
- ___ Check incoming faxes and route to appropriate individual(s).
- ___ Maintain a written log of activities.

ATTACHMENT 6: BRP FIELD TEAMS TRACKING

TEAM DESIGNATION	A		B	
	Location	Status	Location	Status
1 st Location				
2 nd Location				
3 rd Location				
4 th Location				
5 th Location				
6 th Location				
7 th Location				
8 th Location				
9 th Location				
10 th Location				
11 th Location				
12 th Location				

Status Codes -----

Dispatched - →

At Location - ↔

Departed - ●

PLANT STATUS

Affected Plant / Unit: _____

Date / Time of Reactor Shutdown: _____

Emergency Classification:

Unusual Event: Date / Time _____ Reason: _____

Alert Date / Time _____ Reason: _____

Site Area Emergency Date / Time _____ Reason: _____

General Emergency Date / Time _____ Reason: _____

Protective Action Recommendations:

Date / Time _____ Recommendation: _____

Date / Time _____ Recommendation: _____

Date / Time _____ Recommendation: _____

Protective Action Decision:

Date / Time _____ Recommendation: _____

Date / Time _____ Recommendation: _____

InSpector 1000 Operation

1.0 Introduction:

The InSpector 1000 operates in 4 modes:

- Dose Mode- In this mode the instrument displays instantaneous dose rate and, depending upon the display type selected, cumulative dose, input count rate and other information can also be displayed. The Dose Mode is the default mode, *i.e.*, upon startup, the InSpector 1000 will begin operating in the Dose Mode.
- Locator Mode- In this mode the instrument charts moment-by-moment count rate for the purpose of locating areas of elevated radiation intensity (e.g., location of hidden sources, areas of higher contamination, etc.)
- Nuclide Identification (NID) Mode- In this mode the instrument performs identification of radioisotopes using the nuclide library selected from those stored in the unit's memory.
- Spectroscopy Mode- In this mode the instrument functions as a hand-held multi-channel analyzer. It has the capability to obtain and store spectra, identify peaks and perform nuclide identification.

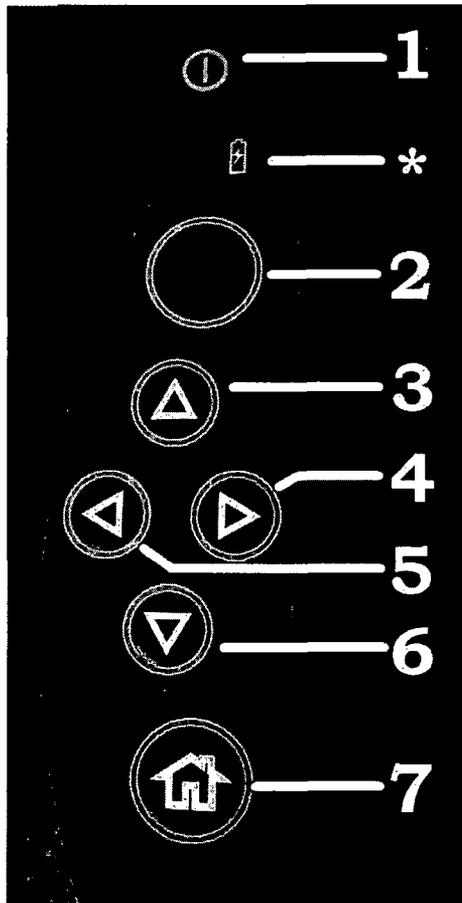


2.0 Features:

- The InSpector 1000 consists of a battery powered hand-held unit with a detachable 2x2 stabilized NaI(Tl) detector probe.
- The hand-held unit is also equipped with an internal G-M detector that is utilized for dose rate indication if the dose rate exceeds a preset level. At radiation intensities greater than 1000 mrem/hr the unit de-energizes the NaI(Tl) detector to avoid damage. The internal G-M detector will not saturate at dose rates below 100,000 mrad per hour
- The face of the hand-held unit provides the color touchscreen and 7 "hard-keys" for energizing the unit and changing modes. The color touchscreen, in addition to displaying mode-dependent output, provides "soft-keys" that allow specific features to be selected or settings to be changed.

- Audio alerts and warnings are provided for the purpose of alerting the user when specified dose rates or cumulative doses have been exceeded.

3.0 Accessing Functions:



3.1 Hard-Keys:

- 1. Power:** Cycles the InInspector On/Off
- * Charge:** Lit when battery is being charged
- 2. Enter:** Has several functions- for example:
 - In Dose Mode- changes to Locator Mode.
 - In Locator Mode- changes to NID Mode.
- 3. Up:** Enters the Main Menu; in Main Menu, changes the display mode or selects next menu level.
- 4. Right:** In menu, moves to the right.
- 5. Left:** In menu, moves to the left.
- 6. Down:** In menu, moves down 1 menu level; in main menu, returns to the selected mode.
- 7. Home:** Returns to the Home Mode (Dose Display) from any other mode.

3.2 Soft-Keys: Soft-keys are “keys” that appear on the touchscreen to allow access to various features and functions. Most soft-keys can be pressed by tapping the touchscreen where the key appears. Soft-keys that allow for fine control (e.g., virtual keyboard) may require the use of a stylus, pencil eraser, pen cap or fingernail for proper control.

3.3 Menus: There are 2 ways to navigate through menus:

- Pressing the arrow hard-keys.
- Tapping the menu soft-keys on the touchscreen.

3.3.1 Pressing the **UP** hard-key displays the 1st menu level. This level has a soft-key for each of the InInspector 1000’s operating modes.

3.3.2 Tapping one of the 4 soft-keys switches the InInspector 1000 to that mode.

3.3.3 Three of the mode buttons (DOSE, LOCATOR and NID) show a legend in italics. Tapping the button that corresponds to the current mode cycles the display through its available configurations.

- 3.3.4 An upward pointing triangle (▲), such as the one on the SPEC soft-key indicates that there is another menu level associated with that soft-key. Tapping this soft-key (or pressing the **UP** hard-key while this soft-key is highlighted) displays the next menu level. The path to this menu level is displayed in the lower left hand corner of the menu.
 - 3.3.5 Right (▶) or left (◀) pointing triangles on menu soft-keys indicate that there are additional menu choices in that direction. Tapping one of these soft-keys will display the additional menu choices.
 - 3.3.6 The menu can be exited by pressing the **DOWN** hard-key until the menu disappears or by pressing the **HOME** hard-key.
- 3.4 **Backlight:** The display backlight is activated by pressing any hard-key (except Power) or by tapping the touchscreen. The backlight will remain lit for a preset time and then turn off to save battery power.

4.0 Startup/Shutdown:

4.1 Startup

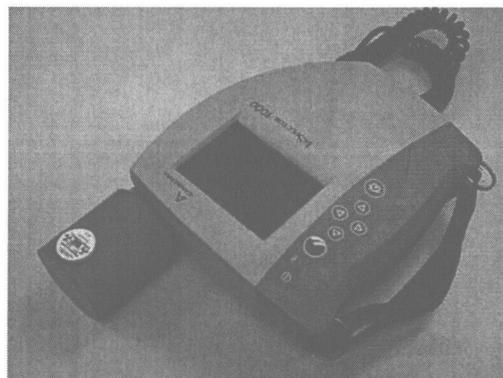
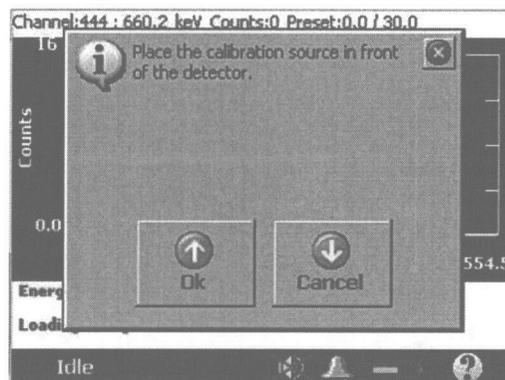
- 4.1.1 To turn on the InSpector 1000, press the **POWER** key at the top of the keypad, to the left of the touchscreen.
- 4.1.2 After pressing the power key, the startup process will take up to 30 seconds to complete.
- 4.1.3 **Annunciator:** On startup the annunciator will begin clicking. It can be disabled by tapping the speaker icon on the lower edge of the touchscreen. When disabled the speaker icon appears "X'ed" out.



- 4.1.4 **Probe stabilization:** Upon startup the stabilized NaI(Tl) detector probe will perform a self-stabilization. The purpose of stabilization is to minimize drift to ensure that detected photon energies are properly reported regardless of environmental conditions (i.e., temperature changes). While stabilization is in progress the instrument displays the screen shown below and the blue LED on the probe will blink. When stabilization is completed, the LED will glow steadily. If, during use, stabilization is lost (e.g., due to ambient temperature changes), any data acquisition in progress will be temporarily suspended and will resume after the instrument has re-stabilized.



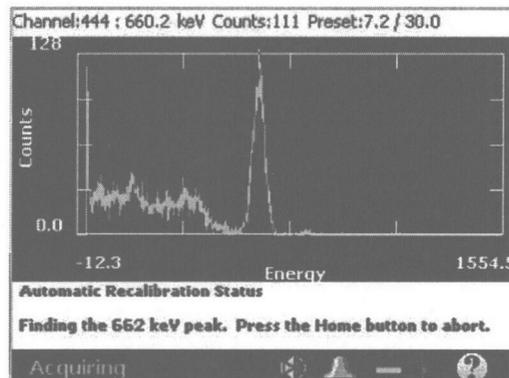
- 4.1.5 Auto Energy Calibration (forced):** If the probe was changed since the InSpector 1000 was most recently used, the InSpector 1000 will prompt the user to perform an energy calibration.
- Allow the unit to warm up for 5 to 10 minutes prior to performing the energy calibration.
 - The InSpector 1000 will prompt the user to place the calibration source in front of the detector (see photo below). The calibration source is a Cs-137 "button" source with an activity of approx. 1 μ Ci or less. If a button source is used, its orientation is not critical.



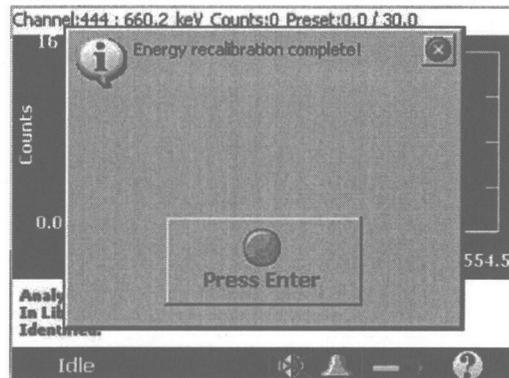
- After placing the source on the detector, tap the **OK** soft-key on the touchscreen.

Note: Soft-keys can be tapped with a stylus, pencil eraser, pen cap or your fingernail. Take care not to scratch the touchscreen surface.

- The InSpector 1000 will obtain a spectrum for a preset time.



- If errors occur during energy calibration (e.g., no peak found or multiple peaks found) the InSpector 1000 will report the problem and suggest corrective action. Errors can result from attempting to calibrate using a source with greater than 1 μCi of Cs-137 or from attempting to calibrate in a high background area (e.g., greater than 500 cps in Locator Mode).
- When the energy calibration is successfully completed, the unit will display “Energy recalibration complete.”



- Press either the **ENTER** hard-key (green circle) or the “Press Enter” soft-key on the touchscreen to continue.
- After calibration the unit will switch to its “Home” mode, i.e., Dose mode.

4.1.6 Auto Energy Calibration (user initiated): An auto energy calibration should be performed periodically (e.g., daily) when the instrument is in use and can be performed at any other time the user desires as follows:

- Allow the unit to warm up for 5 to 10 minutes prior to performing the energy calibration.
- From any mode press the **UP** hard-key and tap the SPEC soft-key.
- Tap the **NEXT** soft-key.
- Tap the **CALIBRATE** soft-key.

- Tap the **ENERGY** soft-key.
- Tap the **AUTO RECAL** soft-key.
- Follow the steps outlined in **4.1.5** above.

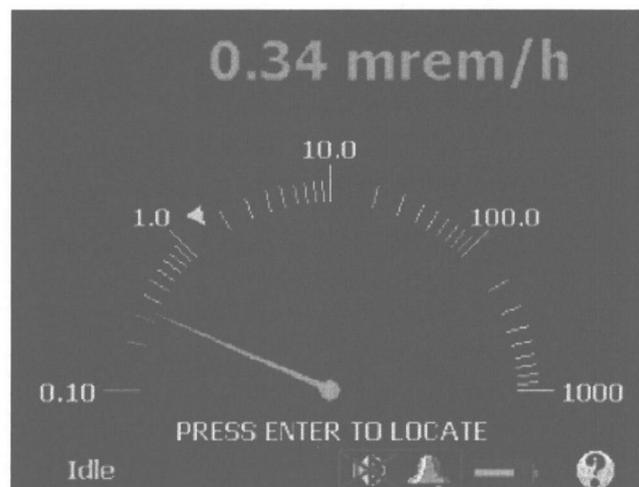
4.2 Battery Charging

- 4.2.1** The InSpector 1000 is powered by an internal rechargeable battery pack that is rated to provide power to the unit for approximately 12 hours of continuous operation.
- 4.2.2** The InSpector 1000 will alert the user to the need for battery charging by an audible alarm and a visual battery meter located in the lower right-hand corner of the touchscreen.
- 4.2.3** To charge the InSpector 1000 internal battery pack, plug the charger into an AC outlet and plug the charging cable into the InSpector 1000 "DC PWR" jack.
- Approximately 3 hours of charge time is required to recharge a fully discharged battery if the unit remains de-energized during charging.
 - Approximately 6 hours of charge time is required to recharge a fully discharged battery if the unit is in use during charging

4.3 Shutdown

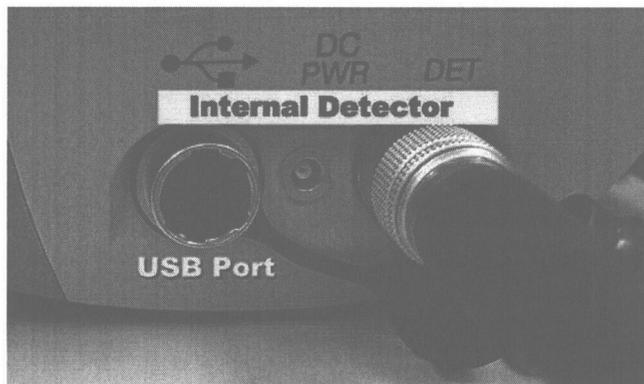
- 4.3.1** To turn off the InSpector 1000, press and hold the **POWER** key at the top of the keypad for approximately 5 seconds until the touchscreen reports that the unit is unloading the software.
- 4.3.2** If the unit "locks up" and will not respond to key inputs, the unit can normally be shutdown by pressing the power button for approximately 15 seconds.

5.0 Dose Mode:



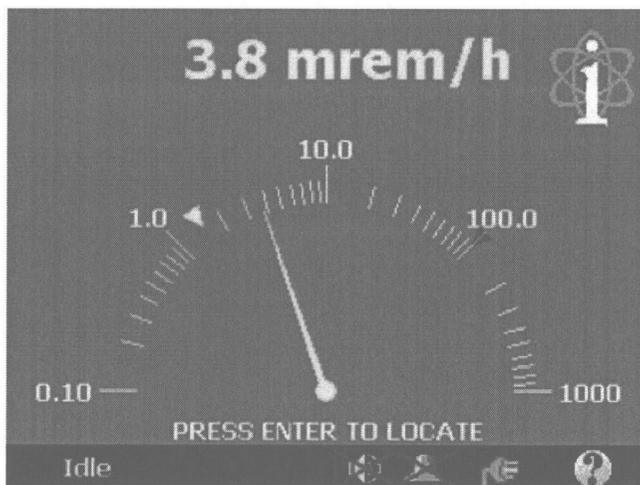
- 5.1 Detectors:** The InSpector 1000 is equipped with two detectors- a detachable NaI(Tl) detector and an internal G-M detector.

- 5.1.1 The detachable NaI(Tl) detector probe is used for all functions at dose rates below a preset level. At dose rates above the preset level, the detachable probe is used for the Locator, NID and Spectroscopy functions and the internal G-M detector is used for dose rate indication. The photo below shows the approximate location of the internal detector.



- 5.1.2 **Caution:** Do not attempt to obtain "contact" dose rate readings with the detachable probe if the dose rate warning set point (described below) has been exceeded. At dose rates slightly above the dose rate warning set point, the unit begins to provide dose rate indication based on the internal detector, not the detachable probe.

5.2 Alerts:



- 5.2.1 The dose rate warning set point is indicated by a yellow marker on the dial. This set point is slightly below the level at which the dose rate indication switches to the internal detector.
- 5.2.2 The dose rate alarm set point is indicated by a red marker on the dial.
- 5.2.3 Cumulative dose warning and alarm set points are provided at 25 and 100 mrem respectively. These set points can be adjusted via the setup menu (see the InSpector 1000 calib. and maint. procedure for instructions).
- 5.2.4 If the warning or alarm values for dose rate or cumulative dose are exceeded, the user is alerted in several ways.

- If the audio alert is enabled, it will sound. The warning sound is intermittent; the alarm sound is continuous.
- If a warning level is exceeded, the background will alternate between black and gold (see sample screen above).
- If an alarm level is exceeded, the background will alternate between black and maroon.
- For dose rate alerts the dose rate needle or bar (depending on display mode) will change to yellow (warning) or red (alarm).
- The audio alert can be disabled by tapping the bell shaped icon on the touchscreen. When disabled the audio alert icon appears "X'ed" out.

5.2.5 The user is alerted to a low battery condition by a warning bell sounding at a 2-second interval.

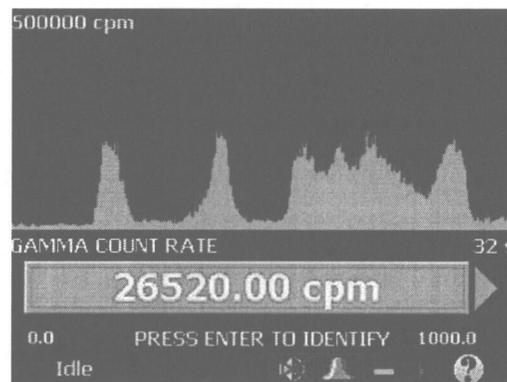
5.3 Default Dose Mode: The default Dose Mode displays dose rate in mrem/hr in both digital and "log dial" format.

5.4 Changing Display Modes: To change display modes, press the **UP** hard-key and tap the **DOSE** soft-key. Each tap of the **DOSE** soft-key will cycle the display through its modes: *i.e.*, linear dial, simple, composite, ebar, and log dial.

5.5 Locate Mode: To switch to the locate mode, press the **ENTER** hard-key (green circle). Operation in this mode is covered in the next section.

5.6 Home Key: From any mode of operation, the unit can be switched to the Dose Mode simply by pressing the **HOME** hard-key.

6.0 Locator Mode:



6.1 The **LOCATOR** mode can be used to scan an area with the InSpector 1000's probe to locate sources of elevated radiation or contamination. Operation in this mode is limited to gamma fields within the usable range of the attached probe.

6.2 There are 2 ways to switch to the **LOCATOR** mode:

- From the **DOSE** mode, press the **ENTER** hard-key.
- From any mode, press the **UP** hard-key to display the 1st level menu and tap the **LOCATOR** soft-key.

6.3 When the **LOCATOR** mode is selected, it displays a moving graph and a digital reading of the detector count rate.

- The most recent data appears at the right hand side of the display and moves to the left as time advances.

- The horizontal axis is calibrated in time. The width of the display, in seconds, is shown in the lower right hand corner of the graph.

7.0 Nuclide Identification (NID) Mode:

◀ Previous/Next Page 1 of 2

Nuclide	mrem/h	* μ Ci	Conf(%)
CD-109	7.34e-004	30.048	99.953
SN-113	0.055	29.308	98.017
CS-137	0.061	13.750	93.987
CO-60	0.131	7.887	88.785

Dose Rate 
0.40 mrem/h

(GENIECE)\CAMFILES\Multi_Gamma_Std.NLB

Press Enter to start a new NID

Idle 

7.1 The **NID** mode provides the ability to identify individual radionuclides in real-time.

7.2 The **NID** mode can be accessed by several methods:

- Press the **ENTER** hard-key from the **Locator** mode
OR,
- Press the **UP** hard-key to open the main menu.
Select **NID** mode by pressing the **Right** hard-key until **NID** is highlighted.
Press the **ENTER** hard-key
OR,
- Press the **UP** hard-key to open the main menu.
Select **NID** mode by tapping the **NID** soft-key on the touchscreen.

7.3 To begin the **NID** process, press the **ENTER** hard-key. The InInspector 1000 will begin acquiring a preset time and then will analyze the data.

7.3.1 If a saved spectrum file is already open, it must be closed prior to beginning the **NID** process. Use the following steps to close an open spectrum file.

- Press the **UP** hard-key to open the main menu.
- Tap the **SPEC** soft-key on the touchscreen.
- Tap the **FILE** soft-key on the touchscreen.
- Tap the **CLOSE** soft-key on the touchscreen.

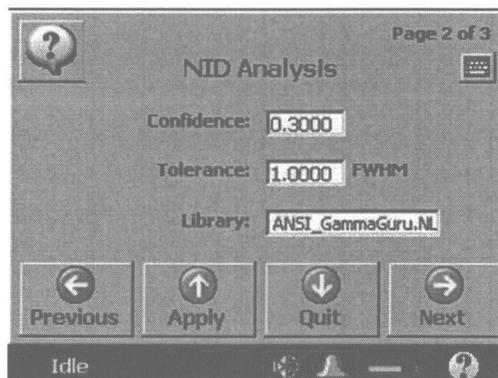
7.4 After completing its analysis, the InInspector 1000 will display any identified radionuclides in a table.

Note: Activity estimates are based on a point source at a distance of 20 to 25 cm (8 to 10 inches). Other source geometries and/or distances will not provide accurate activity estimates.

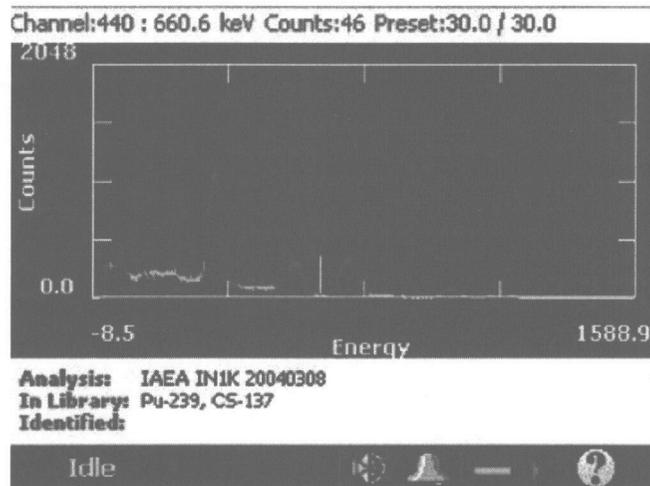
7.5 The display also indicates:

- Current dose rate in digital and bar graph format (if composite display is selected in setup).
- The nuclide library currently in use by the InInspector 1000 to identify nuclides.

- 7.6 The spectrum resulting from the current radionuclide identification can be saved in the InSpector 1000's memory by pressing the **ENTER** hard-key.
- 7.6.1 The user is prompted by the message: "Press Enter to Save Spectrum" on the display.
- 7.6.2 Saved spectra are assigned a file name representing the file's date/time stamp using the following convention: "YYYYMMDDHHMMSS.cnf." For example: file name 20050826145818.cnf is a spectrum obtained in year 2005, on August 26th at 14:58 hrs and 18 seconds.
- 7.6.3 The InSpector 1000's internal memory is of sufficient size to allow storage of approximately 256 spectra.
- 7.7 **Nuclide Libraries:**
- 7.7.1 The InSpector 1000 is capable of storing and utilizing various nuclide libraries. Several libraries are supplied with the unit and custom libraries can be developed for special situations.
- 7.7.2 To change the library that the InSpector 1000 uses for nuclide identification:
- Hold down the **HOME** hard-key and press the **ENTER** hard-key.
 - Tap the **NEXT** soft-key.
 - Tap the **SPEC SETUP** soft-key.
 - Tap the **NEXT** soft-key. The **NID Analysis** screen will appear on the display.
 - Tap the displayed **Library** so that it is highlighted.
 - Using the **UP** or **DOWN** hard-keys scroll through the available libraries until the desired library is found.
 - Tap the **APPLY** soft-key, then tap the **QUIT** soft-key. The selected library will now be used for **NID** mode.



8.0 Spectroscopy Mode:



8.1 In the **Spectroscopy** mode the unit functions as a hand-held multi-channel analyzer (MCA).

8.2 The **Spectroscopy** mode can be accessed by two methods:

- Press the **UP** hard-key to open the main menu.
Select **Spectroscopy** mode by pressing the **Right** hard-key until **Spectroscopy** is highlighted.
Press the **ENTER** hard-key
OR,
- Press the **UP** hard-key to open the main menu.
Select **Spectroscopy** mode by tapping the **Spectroscopy** soft-key on the touchscreen.

8.3 **Spectrum Display Features and Functions:**

8.3.1 **Top line-** the top line of the display provides information such as cursor channel/energy, channel counts, count time, and region of interest integral and area.

8.3.2 **Cursor-** the cursor is displayed as a small vertical white line on top of the spectrum line. It can be positioned by tapping on the touchscreen in the desired location or by pressing the **RIGHT** or **LEFT** hard-keys.

8.3.3 **Information Section-** an information section can be displayed below the spectrum. Choices are:

- **roi-** if the cursor is in an ROI, information specific to that ROI is displayed.
- **calibration-** calibration information and efficiency at the cursor position are displayed.
- **time-** date/time, percent dead time and elapsed and preset times for the spectrum are displayed.
- **display-** start and end channel numbers and corresponding energies, vertical full scale and, if the cursor is in an ROI, its net and total CPS are displayed.
- **nuclide-** displays:
 - The analysis sequence file (ASF) used,
 - Nuclides in the ASF library that correspond to the cursor position and
 - Any identified nuclides at the cursor position.

- **sample**- user-entered ID for the sample, sample date/time, etc. are displayed.
- **none**- no information is displayed; the spectrum graph is enlarged to fill the available screen area.

The type of information displayed is selected by the following sequence:

- Press the **UP** hard-key to activate the menu.
- Tap the **SPEC** soft-key.
- Tap the **NEXT** soft-key.
- Tap the **INFO** soft-key or the **ENTER** hard-key until the type of information desired is shown in italics in the lower portion of the **INFO** soft-key.
- Press the **DOWN** hard-key until the menu disappears.

8.3.4 Energy vs. Region of Interest (ROI)- the information displayed in the top line can be toggled between channel/photon energy and ROI by pressing the **DOWN** hard-key.

- When channel/photon energy information is displayed, the cursor moves one channel right or left each time the corresponding hard-keys is pressed.
- When ROI information is displayed, the cursor jumps from one ROI to the next, right or left, each time the corresponding hard-keys is pressed.

Note: ROI's displayed in blue have been associated with a nuclide in the current library. ROI's displayed in red contain an unidentified photopeak.

- When **nuclide** information is selected for display in the information section (per step 8.3.3, above) and the cursor position corresponds to a nuclide in the current library, the nuclide is listed as being in the library. If the nuclide listed for the cursor position has been identified in the sample by the InSpector 1000, it will also be listed as "identified."

8.4 To Acquire and Save a Spectrum:

8.4.1 If a saved spectrum file is already open, it must be closed before a new spectrum can be acquired. Use the following steps to close an open spectrum file.

- Press the **UP** hard-key to open the main menu.
- Tap the **SPEC** soft-key on the touchscreen.
- Tap the **FILE** soft-key on the touchscreen.
- Tap the **CLOSE** soft-key on the touchscreen.

8.4.2 Position the object to be analyzed near the detector as appropriate.

8.4.3 Press the **DOWN** hard-key until the menu is cleared, if needed.

8.4.4 Press the **ENTER** hard-key.

8.4.5 Tap the **NEW** soft-key to start acquiring a spectrum without saving the current one (if any exists) OR tap the **SAVE/NEW** soft-key to save the current spectrum and begin acquiring a new one.

8.4.6 The InSpector 1000 will obtain and display the spectrum and attempt to identify any radionuclides present using nuclide library specified in the current analysis sequence file.

8.4.7 The spectrum can be saved to the InSpector 1000's memory as follows:

- Tap the **UP** soft-key.
- Tap the **SPEC** soft-key.
- Tap the **FILE** soft-key.
- Tap the **SAVE** soft-key.

Note: The InSpector 1000 will assign a unique file name to each saved spectrum. The file name represents the file's date/time and the file extension for spectra (*i.e.*, cnf) using the following convention: "YYYYMMDDHHMMSS.cnf." For example, file name 20050826145818.cnf is a spectrum obtained in year 2005, on August 26th at 14:58 hrs and 18 seconds.

8.4.8 The InSpector 1000's internal memory is of sufficient size to allow storage of approximately 256 spectra.

8.5 To View and Analyze a Saved Spectrum:

Note: If a saved spectrum is already being viewed, it will have to be closed before another spectrum can be opened.

8.5.1 A saved spectrum can be viewed as follows:

- Access the Spectroscopy menu per step 8.2, above, then,
- Tap the **FILE** soft-key.
- Tap the **OPEN** soft-key.
- Tap the **SPECTRUM** soft-key.
- Highlight the file name of the desired spectrum by scrolling using the **UP/DOWN** hard-keys. Additional screens of file names, if any, can be accessed by using the **RIGHT/LEFT** hard-keys.
- Press the **ENTER** hard-key.

8.5.2 A saved spectrum that has been opened per 8.5.1, above, can be analyzed as follows:

- Access the Spectroscopy menu per step 8.2, above, then,
- Tap the **NEXT** soft-key.
- Tap the **ANALYZE** soft-key.
- Press the **ENTER** hard-key.
- Information from the analysis can be viewed in the information section of the display.

8.5.3 A spectrum that has been analyzed per 8.5.2, above, can be saved as a new spectrum with the new analysis information as follows:

- Access the Spectroscopy menu per step 8.2, above, then,
- Tap the **FILE** soft-key.
- Tap the **SAVE** soft-key.

8.6 Entering Sample Information:

The screenshot shows a 'Sample Information' dialog box with the following fields and values:

Field	Value
ID	00000001
Quantity	1
Collector Name	Whitehead, J
Location	TMI ESE-21

Buttons: Ok, Cancel

- 8.6.1 Information specific to a sample or spectrum can be entered prior to or after analyzing a sample or acquiring a spectrum. The information is saved with the spectrum in InInspector 1000's memory. Enter information as follows:
- To enter information prior to analyzing a sample or acquiring a spectrum, perform the steps below then acquire and save the spectrum per step 8.4, above.
 - To enter information after analyzing a sample or acquiring a spectrum, open the spectrum file per step 8.5, above, then perform the steps below.
 - In the Spectroscopy mode, press the **UP** hard-key to access the menu.
 - Tap the **NEXT** soft-key, if needed, to bring the **SAMPLE INFO** soft-key into view.
 - Tap the **SAMPLE INFO** soft-key.
 - Tap in the **ID** field and then tap the keyboard icon.

Note: The keyboard window can be moved so that it does not obscure fields by touching and dragging the banner at the top of the keyboard.

- Enter the sample **ID** information (8 characters maximum).
- If a sample quantity (e.g., in cc's for an air sample) is desired, enter the value (6 characters maximum) in the **Quantity** field.
- Tap the **Collector Name** field and enter your name.
- Tap the **Location** field and enter the sample location.
- Tap the keyboard icon to dismiss the keyboard
- Tap **OK**.
- This information will be associated with all spectra subsequently obtained.
- Sample information such as **ID** and **Location** can be updated as needed.

8.7 Analysis Sequence Files:

- 8.7.1 An analysis sequence file (ASF) is a procedure used by the InInspector 1000 to analyze data obtained in the spectroscopy mode. The default ASF in the InInspector 1000 is "GammaGuru.ASF."

8.7.2 A different ASF can be selected if needed for a specific situation. Available ASF files include:

- GammaGuru
- Nal_Analysis-Full (allows background subtraction)
- Nal_Analysis-Library (allows background subtraction)
- Nal_Analysis (allows background subtraction)
- Nal_PeakAnal

8.7.3 To select a different ASF:

- Access the Spectroscopy menu per step 8.2, above, then,
- Tap the **FILE** soft-key.
- Tap the **OPEN** soft-key.
- Tap the **ANALYSIS SEQUENCE** soft-key.

Note: The current ASF is marked by an asterisk (*) in the far right hand side of the screen.

- Highlight the file name of the desired ASF by scrolling using the **UP** or **DOWN** hard-keys. Additional screens of file names, if any, can be accessed by using the **RIGHT/LEFT** hard-keys.
- Press the **ENTER** hard-key.
- Tap the **OK** soft-key.
- The selected ASF will be used for future analyses.

8.8 Background Subtraction:

8.8.1 The InSpector 1000 allows the user to select a file to be used as background and subtracted from subsequent results.

8.8.2 Three Nal_Analysis ASF files supplied with the InSpector 1000 (see 8.7.2, above) contain the provision for background subtraction. One of these ASF files (or a locally written ASF that includes the provision for background subtraction) must be selected if the background subtraction feature is to be used.

8.8.3 To select a file to use for background subtraction:

- In the Spectroscopy mode, press the **UP** hard-key to access the menu.
- Tap the **SPEC** soft-key.
- Tap the **BKG** soft-key.

Note: If the **BKG** soft-key is dimmed, the selected ASF does not contain the provision for background subtraction.

- To collect a background spectrum, tap **COLLECT**, then **OK**. When the InSpector 1000 has completed counting, Tap **OK** to save the spectrum and set it as background. Tap **Cancel** to quit.
- To select an existing background spectrum file for subtraction, tap **SELECT**, then tap in the file name box and use the **UP/DOWN** buttons until the desired file name is visible. Then tap **OK**. Tap **Cancel** to leave the background file unchanged.

Note: Selecting "<None>" from the Background Subtraction dialog box will result in no background subtraction.

- Until changed, all further analysis will have the selected file subtracted from the results.

DEDICATED FIELD TEAM RESPONSE VEHICLE (DFTR VEHICLE) OPERATION

PURPOSE:

The purpose of this procedure is to describe the method of operation and maintenance of the radiation monitoring, mechanical, and communications equipment in the Dedicated Field Team Response Vehicles (DFTR Vehicles).

CONTENTS:

GENERAL INFORMATION	SECTION 1
EQUIPMENT OPERATION	SECTION 2
CALIBRATION	SECTION 3
MAINTENANCE	SECTION 4
MECHANICAL AND COMMUNICATIONS EQUIPMENT OPERATIONAL CHECK PROCEDURES	APPENDIX A
RADIATION MONITORING EQUIPMENT OPERATIONAL CHECK PROCEDURES	APPENDIX B
DFTR VEHICLE RADIATION MONITORING EQUIPMENT OPERATIONAL CHECKS	ATTACHEMENT 1

SECTION 1: GENERAL INFORMATION

Each BRP Regional Office has two Dedicated Field Team Response Vehicles (DFTR Vehicles) to carry portable field monitoring equipment. BRP Headquarters has one DFTR Vehicle to carry portable field monitoring equipment. These DFTR Vehicles are equipped with:

- Installed on-board FH 40 dose rate meter with FHZ 612 wide range GM probe for gamma measurements (10 uR/hr to 1000 R/hr)
- Satellite uplink capability to transmit the on-board GM detector gamma measurements and GPS location to remote locations, such as the EOC and R3V, for display on ViewPoint.
- Installed satellite phone
- 800 Mhz radio (when available)

The DFTR Vehicles are Ford F-150 pick-up trucks with extended cabs and seating for four. They have four wheel drive. The DFTR Vehicles are equipped with specially designed pull-out bed platforms to hold field monitoring equipment. They are equipped with flashing lights and a siren for emergency response activities.

SECTION 2: EQUIPMENT OPERATION

A. Installed FH 40 Dose Rate Meter and CNET 1500 Remote Display Indicator:

The DFTR Vehicles are equipped with an installed on-board ambient radiation monitor. The monitor used is a FH 40 dose rate meter with a FHZ 612 GM probe. The FHZ 612 has two internal GM detectors:

Low range: 10 uR/hr to 800 mR/hr

High range: 400 mR/hr to 1000 R/hr

The detectors are auto ranging, and switch automatically based on the radiation levels encountered. The FHZ 612 probe is mounted on the forward bulkhead in the bed of the truck.

The FH 40 dose rate meter is installed in the cab of the truck. It provides a digital readout of radiation levels.

The FH 40 is connected to a CNET 1500 Remote Display Indicator. The CNET 1500 control unit is mounted in the cab of the truck. It provides for the transmission of data collected by the FH 40 to remote locations (such as the R3V or State EOC) via a satellite link. The satellite antenna is mounted on the roof of the truck. The CNET 1500 is controlled by a key switch.

1. FH 40 and CNET 1500 Connection Explanation:

The FH 40 is connected directly to battery power allowing the unit to operate with or without the truck engine running. The CNET1500 overpacks (the grey communications box located underneath the back seat) operates off of switched power. Its purpose is to allow the data collected by the FH 40 to be transmitted to the command and control vehicles either via radio or satellite. It requires either the vehicle's engine to be running or the vehicles start switch to be switched to the run mode to operate.

The 3" x 4" black CNET 1500 Remote Display Indicator (See Figure 1) is connected to the grey communications box. The CNET 1500 Remote Display Indicator will display fault lights for the different parts of the system.

- The green Power LED tells you the system has power when lit.
- The green Status LED indicates all of the installed systems components are powered on and are communicating to CNET1500.
- The 5 red LED's indicate communication errors with the system indicated.
(Communication Errors are internal to the system and do not include wireless connection errors with other vehicles).
- The key switch is used to turn on the satellite communications. In the ON mode the data will transmit every 5 minutes. In the Fast/Test mode the data is transmitted every 30 seconds. (Data will transmit via 2.4GHz radio when in range of the command vehicle and switch to the satellite when not in range. Radio range is up to 1.5 miles direct line of sight.)

Under normal operations the green Power and Status LED's should be the only ones lit unless the satellite unit is turned off. Refer to the Troubleshooting addendum in the Matrix ESP Manual for more information.

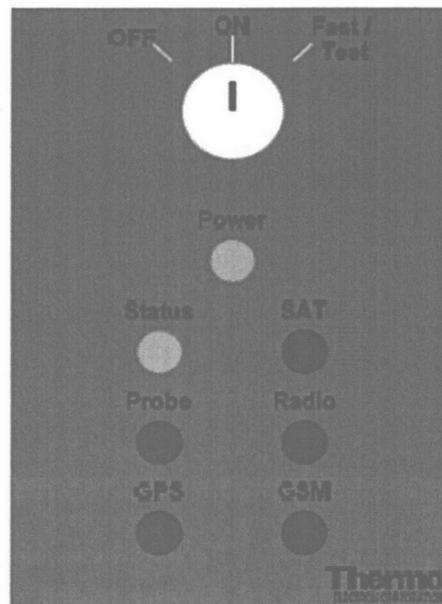
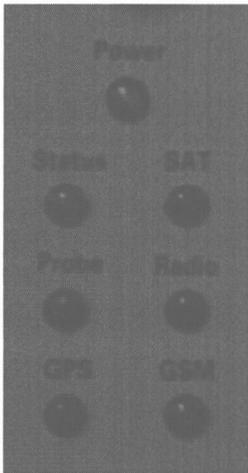


Fig.1 CNET1500 Remote Display Indicator.

LED STATUS INDICATORS AND CONNECTORS



Power LED – The “Power” LED will turn green when the unit is switched on. The LED should remain lit as long as the ESP is in the “On” or “Test/Fast” mode.

Status LED – The “Status” LED will be lit once the ESP unit has started, has validated a good GPS signal, and a satellite or Thermo radio signal can be established. The “Status” LED also requires the radiation probe to be operational, and able to provide a valid checksum measurement to be transmitted over the satellite or radio.

SAT LED – The “SAT (elite)” LED indicates two conditions with regards to the ESP Probe. If the LED is lit a continuous red, this indicates that the ESP Probe cannot establish a link with the satellite terminal on the unit. If the LED is flashing, this indicates the satellite terminal is operating properly, and the ESP probe is transmitting data via satellite communications.

Probe LED – The Radiation “Probe” LED indicates two conditions during operation. If the LED is lit red continuously, this indicates that the probe is not communicating to the CNET-1500 controller, and radiation data cannot be read. If the LED is flashing, this indicates the CNET-1500 is communicating and reading radiation measurements from the FHZ 621 radiation probe for transmission to the central monitoring facility via satellite or radio.

Radio LED – The “Radio” LED indicates two conditions during operation. If the LED is lit red continuously, this indicates the Radio is not communicating to the CNET-1500 controller, and data cannot be sent over the internal Thermo Radio transceiver. If the LED is flashing, this indicates the CNET-1500 is communicating and sending radiation measurements from the FHZ 621 radiation probe to be transmitted to the central monitoring facility via the Thermo Radio network.

GPS LED – The “GPS” LED indicates two conditions during operation. If the LED is lit red continuously, this indicates the GPS is not receiving signals from the satellites or the satellite terminal is not communicating to the CNET-1500 controller. If the LED is flashing, this indicates the GPS is receiving signal and is communicating to the CNET-1500 controller.

GSM/Cellular LED – (Optional) the “GSM” LED indicates two conditions during operation. If the LED is lit red continuously, this indicates that GSM modem communications is not communicating to the CNET-1500 controller and radiation data cannot be sent. If the LED is flashing, this indicates the GSM modem is communicating to the CNET-1500 and radiation measurements from the FHZ 621 radiation probe are being transmitted to the central monitoring facility via GSM modem radio.

2. FH 40 Operation:

a. Start-up:

1. Start Vehicle
2. Turn 'ON' FH 40 by pressing and releasing the On/Off button on the FH 40. The unit will run a self-test function automatically, momentarily displaying all the selectable functions on the display and briefly emitting a loud tone. Rate meter mode is the default display after the self-test.
3. Set the FH 40 Auto Send Function by repeatedly pressing the Function Key until the SEND menu is displayed at the bottom of the display. The number '1' should be displayed in the upper right corner of the display. If the number '1' is not displayed in the upper right corner of the display go to Step (a) below.

NOTE: If the number '1' is not displayed, Step (a) must be performed within a few seconds, or the display switches back to its base mode and the value remains unchanged.

a. With SEND displayed, Press the UP Arrow/Light button or Down Arrow/Sound generator button until the number '1' is displayed in the upper right corner of the display and then press the Function button to store the value.

4. Turn key on CNET 1500 Remote Display Unit to 'FAST/TEST' (Ensure satellite unit has a clear unobstructed view of the sky for proper operation)
5. Conduct an operational check of the FH 40 and CNET 1500 using the procedure in Appendix B, 'Radiation Monitoring Equipment Operational Check Procedures'.
6. Verify through communications with R3V that unit is transmitting
7. Turn switch on CNET 1500 Remote Display Unit to 'ON' if planning to use and transmit data, otherwise turn switch to 'OFF'.

The unit will output data every 1 second thru the Optical Data Interface cable. Removing power from the unit will cause the SEND function to default back to 0 which disables the SEND function. (This should not happen during normal operations since unit is directly wired to battery.) Refer to the FH 40 Manual for more information.

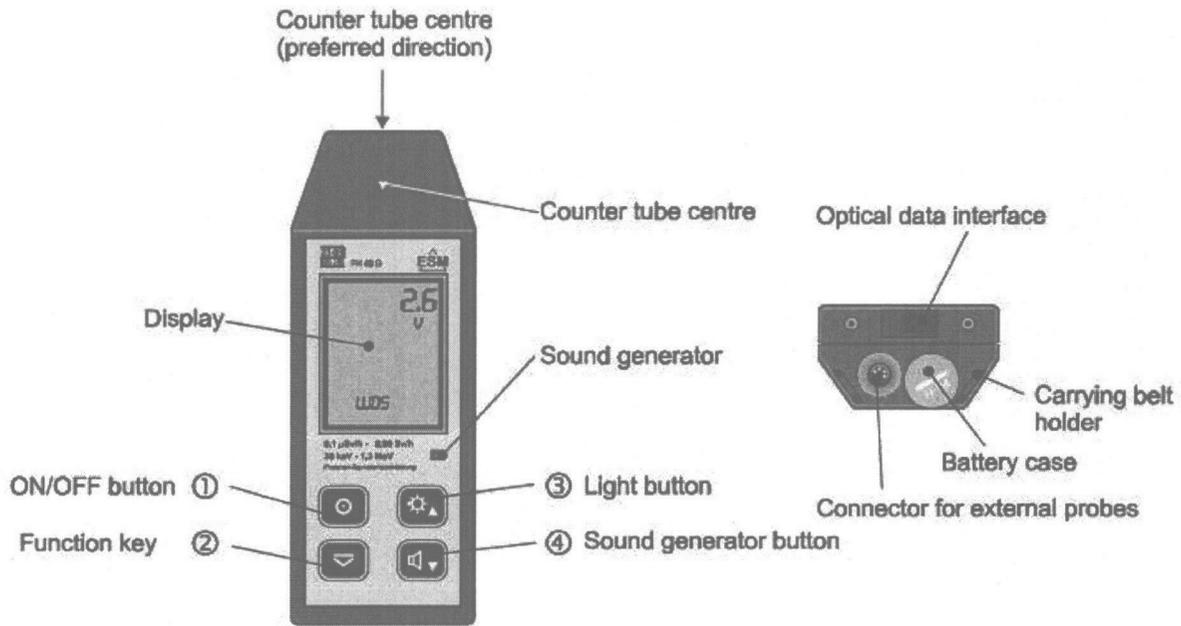


Figure 2 Overview of the control elements and device connections

b. Shutdown:

1. Turn key on CNET 1500 Remote Display Indicator to 'OFF'.
2. Turn 'OFF' FH 40 unit.

B. Mechanical Equipment Operation:

1. Red Lights and Siren:

The red emergency lights and siren on the DFTR Vehicles are to be used only in an actual emergency and with the authorization of a supervisor.

The red lights and siren are operated from switches on the middle console of the DFTR Vehicle.

C. Communications Equipment Operation:

1. Satellite Phones:

Each DFTR Vehicle is equipped with a satellite phone. The phones are in a cradle with a handset. While the phone remains in the cradle, it uses an antenna mounted on the roof of the DFTR Vehicle.

a. Start-up:

1. Press the 'PWR' button on the satellite phone face.
2. Use satellite phones in accordance with instructions found in the "BRP Emergency Telephone Directory", BRP-ER-5A.

b. Shutdown:

1. Press the 'PWR' button on the satellite phone face.

SECTION 3: CALIBRATION

Calibration of the installed on-board radiation monitoring instruments on the DFTR Vehicles will be conducted **annually or at a frequency directed by the BRP Bureau Director, or after repair of an instrument.** Records of calibration will be maintained by the BRP Central Office in Harrisburg, and copies will be provided to the Regional Offices.

SECTION 4: MAINTENANCE

Maintenance of equipment shall be performed per the manufacturer's directions, and when a problem with the equipment is found. If questions arise about maintenance, contact the BRP Emergency Response Section Chief.

**APPENDIX A: MECHANICAL AND COMMUNICATIONS EQUIPMENT
OPERATIONAL CHECK PROCEDURES**

Operational checks of mechanical and communications equipment should be conducted **monthly**.

A. Mechanical Equipment:

1. Engine of DFTR Vehicles should be run and vehicles driven at least 20 miles per month.
2. Test red emergency lights and siren each month.
3. Check the following each month:
 - a. Tire Pressure
 - b. Fuel level
 - c. Oil level
 - d. Coolant level

B. Communications Equipment:

1. Test satellite phone operation each month.

APPENDIX B: RADIATION MONITORING EQUIPMENT OPERATIONAL CHECK PROCEDURES

Operational checks may include:

1. Physical inspection
2. Battery check
3. Calibration due date
4. Response/source check.

Operational checks are performed on radiation monitoring equipment **quarterly and prior to use.**

Perform the quarterly operational checks of the radiation monitoring equipment in conjunction with the monthly operational checks of the mechanical, AC electrical, and communications equipment. This will ensure that all systems are operating, and that power is available for all equipment.

Do not use an instrument if it fails an operational check. Place the instrument out-of-service and notify the Regional Program Manager and the DEP Emergency Response Section as soon as possible. When performing operational checks, complete Attachment 1, "DFTR Vehicle Radiation Monitoring Equipment Operational Checks" form. Keep a copy of the completed form. Forward a copy of the completed form to the BRP Emergency Response Section Chief.

A. Performance of Operational and Source Checks on DFTR Vehicle FH 40 and CNET 1500:

a. Start-up:

1. Start Vehicle
2. Turn 'ON' FH 40 by pressing and releasing the On/Off button on the FH 40. The unit will run a self-test function automatically, momentarily displaying all the selectable functions on the display and briefly emitting a loud tone. Rate meter mode is the default display after the self-test.
3. Set the FH 40 Auto Send Function by repeatedly pressing the Function Key until the SEND menu is displayed at the bottom of the display. The number '1' should be displayed in the upper right corner of the display. If the number '1' is not displayed in the upper right corner of the display go to Step (a) below.

NOTE: If the number '1' is not displayed, Step (a) must be performed within a few seconds, or the display switches back to its base mode and the value remains unchanged.

- a. With SEND displayed, Press the UP Arrow/Light button or Down Arrow/Sound generator button until the number 1 is displayed in the upper right corner of the display and then press the Function button to store the value.
4. Turn key on CNET 1500 Remote Display Unit to 'FAST/TEST' (Ensure satellite unit has a clear unobstructed view of the sky for proper operation)
 5. Conduct a source check of the FH 40/FHZ 612:
 - a. Place 10 uCi Cs-137 source on yellow centerline of FHZ 612 low range detector (labeled 0.1 uSv/hr ... 8 mSv/hr and 10 uR/hr ... 800 mR/hr).
The source should be placed on top of the probe. The label of the source should face out.
 - b. On the FH 40, read the radiation level. The reading should fall into the range given for the FHZ 612 probe.

NOTE: The high range detector in the FHZ 612 does not activate until dose rates of 400 mR/hr and above are encountered. The source check does not activate the high range detector.

6. Verify through communications with R3V that unit is transmitting
7. Turn switch on CNET 1500 Remote Display Unit to 'ON' if planning to use and transmit data, otherwise turn switch to 'OFF'.

The unit will output data every 1 second thru the Optical Data Interface cable. Removing power from the unit will cause the SEND function to default back to 0 which disables the SEND function. (This should not happen during normal operations since unit is directly wired to battery.) Refer to the FH 40 Manual for more information.

- b. Shutdown:
 1. Turn key on CNET 1500 Remote Display Indicator to 'OFF'.
 2. Turn 'OFF' FH 40 unit.

**ATTACHMENT 1: DFTR VEHICLE RADIATION MONITORING EQUIPMENT
OPERATIONAL CHECKS**

QUARTER (1st, 2nd, etc.) _____ YEAR _____

VEHICLE LICENSE # _____ Region/Field Team _____

FHZ 612 Probe Serial Number: _____

Calibration Due Date: _____

Operational Check:	FH 40:	SAT	UNSAT	(Circle One)
	CNET 1500	SAT	UNSAT	

Source Check:	FHZ 612	SAT	UNSAT
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Notes:

Completed By: _____

Date: _____

ATTACHMENT 1 (from EPA400 R92-001)

**Table 5-1 Dose Conversion Factors (DCF) and Derived Response Levels (DRL):
 Combined^a Exposure Pathways During the Early Phase of a Nuclear
 Incident^b**

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$	DRL ^c $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$
H-3	7.7E+01	1.3E-02
C-14	2.5E+03	4.0E-04
Na-22	1.9E+04	5.3E-05
Na-24	7.3E+03	1.4E-04
P-32	1.9E+04	5.4E-05
P-33	2.8E+03	3.6E-04
S-35	3.0E+03	3.4E-04
Cl-36	2.6E+04	3.8E-05
K-40	1.6E+04	6.5E-05
K-42	2.0E+03	5.1E-04
Ca-45	8.0E+03	1.8E-04
Sc-46	4.4E+04	2.3E-05
Ti-44	1.2E+06	8.2E-07
V-48	2.4E+04	4.2E-05
Cr-51	5.5E+02	1.8E-03
Mn-54	1.2E+04	8.5E-05
Mn-56	1.8E+03	5.7E-04
Fe-55	3.2E+03	3.1E-04
Fe-59	2.3E+04	4.4E-05
Co-58	1.7E+04	5.7E-05
Co-60	2.7E+05	3.7E-06
Ni-63	7.6E+03	1.3E-04
Cu-64	5.9E+02	1.7E-03
Zn-65	2.7E+04	3.7E-05
Ge-68	6.2E+04	1.6E-05
Se-75	1.2E+04	8.3E-05
Kr-85	1.3E+00	7.8E-01
Kr-85m	9.3E+01	1.1E-02
Kr-87	5.1E+02	2.0E-03
Kr-88	1.3E+03	7.8E-04

Table 5-1, Continued

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-2} \cdot \text{h}$	DRL ^c $\mu\text{Ci} \cdot \text{cm}^{-2} \cdot \text{h}$
Kr-89	1.2E+03	8.6E-04
Rb-86	8.8E+03	1.2E-04
Rb-88	5.2E+02	1.9E-03
Rb-89	1.4E+03	7.3E-04
Sr-89	5.0E+04	2.0E-05
Sr-90	1.6E+06	6.4E-07
Sr-91	2.4E+03	4.2E-04
Y-90	1.0E+04	9.9E-05
Y-91	5.9E+04	1.7E-05
Zr-93	3.9E+05	2.6E-06
Zr-95	3.2E+04	3.2E-05
Zr-97	5.5E+03	1.8E-04
Nb-94	5.0E+05	2.0E-06
Nb-95	1.0E+04	9.7E-05
Mo-99	5.2E+03	1.9E-04
Tc-99	1.0E+04	1.0E-04
Tc-99m	1.7E+02	6.0E-03
Ru-103	1.3E+04	7.7E-05
Ru-105	1.2E+03	8.2E-04
Ru/Rh-106 ^d	5.7E+05	1.7E-06
Pd-109	1.8E+03	7.6E-04
Ag-110m	9.8E+04	1.0E-05
Cd-109	1.4E+05	7.3E-06
Cd-113m	1.8E+06	5.5E-07
In-114m	1.1E+05	9.4E-06
Sn-113	1.3E+04	7.8E-05
Sn-123	3.9E+04	2.6E-05
Sn-125	2.0E+04	5.1E-05
Sn-126	1.2E+05	8.4E-06
Sb-124	3.8E+04	2.6E-05

Table 5-1, Continued

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$	DRL ^c $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$
Sb-126	2.6E+04	3.9E-05
Sb-127	9.5E+03	1.1E-04
Sb-129	2.0E+03	5.0E-04
Te-127m	2.6E+04	3.9E-05
Te-129	1.4E+02	7.0E-03
Te-129m	2.9E+04	3.5E-05
Te-131m	3.6E+03	1.2E-04
Te-132	1.2E+04	8.5E-05
Te/I-132 ^d	2.0E+04	5.0E-05
Te-134	7.0E+02	1.4E-03
I-125	3.0E+04	3.3E-05
I-129	2.1E+05	4.8E-06
I-131	5.3E+04	1.9E-05
I-132 ^e	4.9E+03	2.0E-04
I-133	1.5E+04	6.8E-05
I-134	3.1E+03	3.3E-04
I-135	8.1E+03	1.2E-04
Xe-131m	4.9E+00	2.0E-01
Xe-133	2.0E+01	5.0E-02
Xe-133m	1.7E+01	5.9E-02
Xe-135	1.4E+02	7.0E-03
Xe-135m	2.5E+02	4.1E-03
Xe-137	1.1E+02	9.3E-03
Xe-138	7.2E+02	1.4E-03
Cs-134	6.3E+04	1.6E-05
Cs-136	1.8E+04	5.6E-05
Cs/Ba-137 ^a	4.1E+04	2.4E-05
Cs-138	1.6E+03	6.1E-04
Ba-138	1.1E+04	8.9E-05
Ba-139	2.3E+02	4.4E-03

Table 5-1, Continued

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$	DRL* $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$
Ba-140	5.3E+03	1.9E-04
La-140	1.1E+04	8.8E-05
La-141	7.3E+02	1.4E-03
La-142	2.3E+03	4.3E-04
Ce-141	1.1E+04	9.0E-05
Ce-148	4.7E+03	2.1E-04
Ce-144	4.5E+05	2.2E-06
Ce/Pr-144 ^d	4.5E+05	2.2E+06
Nd-147	8.8E+03	1.1E-04
Pm-145	3.7E+04	2.7E-05
Pm-147	4.7E+04	2.1E-05
Pm-149	3.6E+03	2.8E-04
Pm-151	2.8E+03	3.5E-04
Sm-151	3.6E+04	2.8E-05
Eu-152	2.7E+05	3.8E-06
Eu-154	3.5E+05	2.9E-06
Eu-155	5.0E+04	2.0E-05
Gd-153	2.9E+04	3.4E-05
Tb-160	3.5E+04	2.9E-05
Ho-166m	9.4E+05	1.1E-06
Tm-170	3.2E+04	3.2E-05
Yb-169	1.1E+04	8.9E-05
Hf-181	2.1E+04	4.8E-05
Ta-182	6.0E+04	1.7E-05
W-187	1.7E+03	6.0E-04
Ir-192	3.8E+04	2.7E-05
Au-198	5.2E+03	1.9E-04
Hg-203	9.9E+03	1.0E-04
Tl-204	2.9E+03	3.5E-04
Pb-210	1.6E+07	6.1E-08

Table 5-1, Continued

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$	DRL ^c $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$
Bi-207	8.1E+04	3.2E-05
Bi-210	1.9E+04	5.3E-05
Po-210	1.1E+07	8.9E-08
Ra-226	1.0E+07	9.7E-08
Ac-227	8.0E+09	1.2E-10
Ac-228	3.7E+05	2.7E-08
Th-227	1.9E+07	5.2E-08
Th-228	4.1E+08	2.4E-09
Th-230	8.9E+08	2.6E-09
Th-232	2.0E+09	5.1E-10
Pa-231	1.5E+09	6.5E-10
U-232	7.9E+08	1.3E-09
U-233	1.6E+08	6.2E-09
U-234	1.6E+08	6.3E-09
U-235	1.5E+08	6.8E-09
U-236	1.5E+08	6.6E-09
U-238	1.4E+08	7.0E-09
U-240	2.7E+03	3.7E-04
Np-237	6.5E+08	1.5E-09
Np-239	3.6E+03	2.8E-04
Pu-236	1.7E+08	5.8E-09
Pu-238	4.7E+08	2.1E-09
Pu-239	5.2E+08	1.9E-09
Pu-240	5.2E+08	1.9E-09
Pu-241	9.9E+06	1.0E-07
Pu-242	4.9E+08	2.0E-09
Am-241	5.3E+08	1.9E-09
Am-242m	5.1E+08	2.0E-09
Am-243	5.3E+08	1.9E-09
Cm-242	2.1E+07	4.8E-08

Table 5-1, Continued

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$	DRL ^c $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$
Cm-243	3.7E+08	2.7E-09
Cm-244	3.0E+08	3.4E-09
Cm-245	5.5E+08	1.8E-09
Cm-246	5.4E+08	1.9E-09
Cf-252	1.9E+08	5.3E-09

^aSum of doses from external exposure and inhalation from the plume, and external exposure from deposition. "Dose" means the sum of effective dose equivalent from external radiation and committed effective dose equivalent from intake.

^bSee footnote a to Table 5-4 for assumptions on inhalation and footnote b to Table 5-5 for assumptions on deposition velocity. The quantity $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$ refers to the time-integrated air concentration at one meter height.

^cFor 1 rem committed effective dose equivalent.

^dThe contribution from the short-lived daughter is included in the factors for the parent radionuclide.

^eThese factors should only be used in situations where I-132 appears without the parent radionuclide.

ATTACHMENT 2

Table 5-2 Dose Conversion Factors (DCF) and Derived Response Levels (DRL)
 Corresponding to a 5 rem Dose Equivalent to the Thyroid from Inhalation
 of Radioiodine

Radionuclide	DCF rem per $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$	DRL* $\mu\text{Ci} \cdot \text{cm}^{-3} \cdot \text{h}$
Te/I-132 ^b	2.9E+05	1.8E-05
I-125	9.6E+05	5.2E-06
I-129	8.9E+06	7.2E-07
I-131	1.3E+06	3.9E-06
I-132	7.7E+03	6.5E-04
I-133	2.2E+05	2.8E-05
I-134	1.8E+03	3.9E-03
I-135	3.8E+04	1.8E-04

*For a 5 rem committed dose equivalent to the thyroid.

^bThe contribution from the short-lived daughter is included in the factors for the parent radionuclide.

Table 7-2 Exposure Rate and Effective Dose Equivalent (Corrected for Radioactive Decay) due to an Initial Concentration of 1 pCi/m² on Ground Surface

Radionuclide	Half-life (hours)	Initial exposure ^a rate at 1 m (mR/h per pCi/m ²)	Integrated dose (weathering factor not included) ^b		
			year one (mrem per pCi/m ²)	year two (mrem per pCi/m ²)	0-50 years (mrem per pCi/m ²)
Zr-95	1.54E+03	1.2E-08	3.8E-05	8.0E-07	3.9E-05
Nb-95	8.41E+02	1.3E-08	(b)	(b)	(b)
Ru-103	9.44E+02	8.2E-09	7.8E-06	0	7.8E-06
Ru-106	8.84E+03	3.4E-09	1.5E-05	7.6E-06	3.0E-05
Te-132	7.82E+01	4.0E-09	3.3E-06	0	3.3E-06
I-131	1.93E+02	6.6E-09	1.3E-06	0	1.3E-06
I-132	2.30E+00	3.7E-08	(b)	(b)	(b)
I-133	2.08E+01	1.0E-08	2.1E-07	0	2.1E-07
I-135	6.61E+00	2.4E-08	1.6E-07	0	1.6E-07
Cs-134	1.81E+04	2.6E-08	1.3E-04	9.6E-05	4.7E-04
Cs-137	2.65E+05	1.0E-08	6.0E-05	5.9E-05	1.8E-03
Ba-140	3.07E+02	3.2E-09	1.2E-05	0	1.2E-05
La-140	4.02E+01	3.5E-08	(b)	(b)	(b)

^aEstimated exposure rate at 1 meter above contaminated ground surface. Based on data from reference (DO-88).

^bRadionuclides that have short-lived daughters (Zr/Nb-95, Ru/Rh-106, Te/I-132, Cs-137/Ba-137m, Ba/La-140) are assumed to quickly reach equilibrium. The integrated dose factors listed are the effective gamma dose due to the parent and the daughter. Based on data from reference (DO-88).

ATTACHMENT 3

INITIAL MONITORING PLANS

SECTION 1 RESTRICTED ZONES INITIAL
MONITORING PLAN

SECTION 2 AGRICULTURAL PRODUCT
INITIAL MONITORING PLAN

Attachment 1 Initial Milk Sampling and
Analysis Plan

Attachment 2 Initial Agricultural Product
Sampling and Analysis Plan
(Stored Food Crops, Stored
Animal Feeds, Unharvested
Crops, Vegetation,
and Other Items)

SECTION 3 WATER INITIAL MONITORING
PLAN

SECTION 1

RESTRICTED ZONES INITIAL MONITORING PLAN

OBJECTIVE

Describe the monitoring plan for initially determining the extent of restricted zones following an accident at a nuclear power plant that results in significant offsite releases and deposition.

BACKGROUND

Accidents of varying degrees of severity can occur at nuclear power stations in Pennsylvania and in neighboring states. An accident may or may not yield atmospheric releases in excess of the ordinary. Atmospheric releases in excess of the ordinary may or may not include radioactive species which actually contaminate.

Following the completion of emergency phase protective actions and the cessation of uncontrolled releases, the location of restricted zones is determined by BRP. Restricted zones are those areas with ground deposition equal or exceeding the relocation Protective Action Guides, and are areas of controlled access from which the population has been evacuated or relocated. Restricted zones are not necessarily limited to the 10-mile Plume Pathway EPZ.

Additional resources on this topic are found in EPA 400-R-92-001, May 1992, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, Chapters 4 and 7. The Bureau of Radiation Protections' procedures for processing the data collected in the field and analyzed in the laboratory in support of restricted zone boundary determination are described in BRP-ER-8.04, "Reentry, Return, Relocation, and Recovery".

RESTRICTED ZONE INITIAL MONITORING METHODOLOGY

The initial determination after an event is whether or not there has been a radioactive release. This determination is a BRP responsibility, making use of available information. If a radioactive release has occurred, the next aspect for BRP to determine is where deposition has occurred.

Potential and actual deposition areas are identified by BRP at the State EOC using the source term information and meteorological conditions prevailing during plume release; measurements from aircraft; and field monitoring team measurements and samples, and data from laboratory analysis of field team samples. Each of these three sources of information aids BRP in determining the offsite deposition:

a. Source Term Information and Meteorological Conditions Prevailing During Plume Release: The first source of information used in determining deposition is data from the licensee on the severity of the accident, condition of the barriers against escape of contamination, source term information for the release, and meteorological conditions prevailing during the plume release. From this information we know whether a deposition problem is expected, and in general, where it will be. This information is available during and immediately after the incident. Particularly desirable in analyzing this data is the Federal asset, National Atmospheric Release Advisory Capability (NARAC). This is a sophisticated computer program which takes into account release history and wind patterns to predict plume behavior. This computer is physically located at the Lawrence Livermore Laboratory in California. NARAC uses telecommunications for data acquisition and results conveyance. This asset should be available 36-48 hours after the incident.

Also, for an event that is an Incident of National Significance, the resources of the Interagency Modeling and Assessment Center (IMAAC) become available. IMAAC is responsible for production, coordination, and dissemination of consequence predictions for an airborne hazardous material release. IMAAC generates a single Federal prediction of atmospheric dispersions and their consequences utilizing the best available resources from the Federal Government. This asset will be available through the FRMAC.

b. Measurements From Aircraft: A second source of information in determining deposition is the Federal asset, Aerial Measuring System (AMS). AMS uses fixed wing aircraft and helicopters fitted with radiation detectors to describe actual ground depositions. These aircraft fly serpentine patterns over the affected area and develop maps showing deposition patterns. This asset should be available 36-48 hours after the incident.

c. Field Monitoring Team Measurements and Samples, and Data From Laboratory Analysis of Field Team Samples: A third source of information in determining deposition is field monitoring team measurements and samples, and data from laboratory analysis of field team samples. Some information from this source is generated during the plume phase, when BRP field monitoring teams take air samples for iodines and particulates. Additional information from this source is generated after the uncontrolled releases have ceased, by field team monitoring of ambient gamma levels, and by field teams obtaining samples of soil (snow if necessary) and vegetation. The actual radiological analysis of samples will be done by the Radiation Measurements Laboratory in the DEP Bureau of Laboratories. This facility is located in the Evangelical Press Building at Third and Reily Streets in Harrisburg. This laboratory is well equipped for gamma spectroscopy, a non-destructive method for identification and quantification for virtually all reactor produced isotopes. Following a reactor accident, this lab capability will be augmented by Federal assets, including mobile laboratories and federal laboratories nationwide.

The steps in BRP's Restricted Zone Initial Monitoring Plan are:

1. Use the information provided in (a.) above, "Source Term Information and Meteorological Conditions Prevailing During Plume Release", to determine the probable areas of deposition. Also, use the information provided by field team air sampling for iodine and particulates during the plume phase described in (c.) above to obtain a general quantification of the iodine and particulate release. Plot this information on a map.
2. Use the information provided in (b.) above, "Measurements From Aircraft", to determine the deposition pattern from the plume. Plot this information on a map.
3. Deploy the field monitoring teams as described in (c.) above to:
 - i.) Confirm the results of Steps 1 and 2 above by taking ambient gamma measurements.
 - ii.) Obtain samples of soil (or snow) and vegetation for submission to the DEP Radiation Measurements Lab, or other designated laboratory facility.

In deploying the field monitoring teams, it is important that they begin their monitoring and sample collection in areas of low radiation/contamination levels, and work their way inward, toward areas of higher radiation/contamination levels. Upon reaching ambient gamma levels (at waist level, closed window) of 1 mR/hr, field monitoring teams should consult with the BRP Field Team Controller (before Full Federal Activation) or FRMAC (after Full Federal Activation) before proceeding into areas of higher radiation/contamination levels. This precaution is taken to avoid collecting highly contaminated samples, and sending individuals into areas which are highly contaminated. Field monitoring teams should perform ambient gamma measurements and obtain samples of soil (or snow) and vegetation at a sufficient number of locations where deposition occurred and locations where deposition did not occur to allow the confirmation of the areas of deposition,

determination of the isotopic mix of the deposition, the uniformity of the isotopic mix of the deposition, and to allow the delineation of the boundary of the restricted zones. The exact number and location of monitoring locations and sample locations will be determined by BRP based on the information obtained in (a.) and (b.) above, and by the results of field monitoring team ambient gamma readings and results of laboratory analysis of field samples. These field teams involved in restricted zone boundary determination will be staffed by BRP or FRMAC health physics personnel. BRP procedures for obtaining samples of soil (or snow) and vegetation are described in BRP-ER.8.02, "Agricultural Product Sampling Procedures". The samples will be dropped off by the field teams at predetermined locations given by the BRP Field Team Controller (or FRMAC, when established). Transportation of the samples to the laboratory will be coordinated with PEMA. The results of field team ambient gamma monitoring and the results of laboratory analysis of samples should be plotted on a map.

4. Analyze the samples obtained by the field monitoring teams in step 3 above in the laboratory. This will provide the isotopic mix of the deposition and isotopic activities. The laboratory provides analysis data to BRP at the State EOC (or FRMAC, when established).
5. Sample data is then utilized by BRP in accordance with BRP-ER-8.04, "Reentry, Return, Relocation, and Recovery", to determine the gamma exposure rate at the boundary of the restricted zones, and other radiological characteristics of the deposition.
6. Field monitoring teams will perform ambient gamma monitoring to verify the geographic location of the boundaries of the restricted zones. Then, the restricted zones will be enlarged somewhat to allow a buffer zone where enhanced monitoring can be conducted to verify the stability of the deposited material, and to allow for the possible migration of the contamination. The combined restricted/buffer zones will be designated so that the outer edges are defined by roads and other geographic features which can facilitate access control.
7. The results of BRP's analysis of the data and BRP's PARs will be communicated to PEMA at the State EOC as input into the Protective Action Decision making process. PEMA will communicate the PADs to affected areas.
8. It is expected that this Restricted Zones boundary determination will be an intensive effort, lasting a number of days. Upon establishment of the FRMAC, BRP will work closely with the FRMAC staff to complete this effort.

LABORATORY ANALYSIS OF SAMPLES

To determine the radionuclide mix, a sample of soil (or snow) or vegetation or other suitable material is collected from an open area exposed during plume passage and

analyzed by high resolution gamma spectroscopy. (*In situ* gamma spectroscopy may also be used to establish the nuclide mix.) The sample results are reported in terms of activity per sample (pCi/sample).

This analysis is intended to identify the major contributors to the dose from deposited material for periods of the first year after the accident, the second year after the accident, and 0-50 years after the accident. Radionuclides with half-lives ranging from several days (such as I-131) to many years (such as Cs-137) will be identified.

In order to balance the need to process a large number of samples in the laboratory (not only in support of defining the restricted zone boundaries, but also in support of agricultural product and water monitoring), and the need to obtain an accurate description of the isotopes in the deposition and their activities, a short counting time is necessary. A five minute count time should be used for the initial count of soil and vegetation samples analyzed in support of restricted zone boundary determination. A five minute count time will give LLDs at the 95% confidence level for soil and vegetation of: I-131: 170 pCi/kg; Cs-134: 70 pCi/kg; and Cs-137: 57 pCi/kg. (Use of a three minute count time for snow will give similar LLDs.)

Taking into account the sample handling time and the availability of 8 intrinsic germanium detectors at RML, the throughput for gamma spec will be approximately 8-10 samples per hour. If detector capacity is also needed for analysis of samples other than those taken for restricted zone boundary determination, the throughput for samples analyzed for restricted zone boundary determination will be approximately 3 per hour or 72 per day.

Results of samples analyzed at RML will be reported directly to BRP at the State EOC for evaluation.

SECTION 2

AGRICULTURAL PRODUCT INITIAL MONITORING PLAN

OBJECTIVE

Describe the monitoring plan for initially determining the extent of contamination of agricultural products (milk, stored food crops, stored animal feeds, unharvested crops, vegetation, and other items) following an accident at a nuclear power plant that results in significant offsite releases and deposition. Also, to describe the roles and responsibilities of state agencies in the sampling, analysis, interpretation of results, and the development of protective action recommendations for commodities produced and/or consumed in the Commonwealth.

BACKGROUND

Accidents of varying degrees of severity can occur at nuclear power stations in Pennsylvania and in neighboring states. An accident may or may not yield atmospheric releases in excess of the ordinary. Atmospheric releases in excess of the ordinary may or may not include radioactive species which actually contaminate. Of those radioactive species which contaminate surfaces, most do not enter into food chains to any marked extent.

Following a reactor accident, BRP emphasizes the collection and evaluation of cow's milk. This decision is based on several factors. The first reason is that milk is a very sensitive indicator for the presence of fresh fission products in the environment. Another is the fact that a large fraction of cow's milk is marketed fresh, allowing little time for natural decontamination by radioactive decay. Another is that milk is primarily consumed by young individuals who are more sensitive to radiation exposure. Many other commodities are decontaminated during normal processing, but milk cannot be decontaminated in a cost effective way.

The main isotopes which contaminate milk are isotopes of iodine, and isotopes of elements which chemically resemble calcium and potassium. These latter are isotopes of strontium and barium, and cesium. Silage may be contaminated with isotopes of other elements, but only those mentioned above will show up in milk.

Unharvested crops (such as produce) and vegetation may be contaminated with additional isotopes. The severity of this contamination will depend on the specific mix of the release, and the time between the contaminating event and harvest. Stored food crops, stored animal feed, and other items may also be contaminated during the release, or by contaminants working their way up the food chain after a release. The severity of this contamination will depend on the specific mix of the release, and the time between the contaminating event and consumption. For all these items, the presence of I-131 will be of special concern, since this isotope is expected to provide a significant fraction of the dose commitment in the early weeks after an accident. The presence of other, longer lived isotopes, such as Cs-134 and Cs-137 will also be determined by laboratory analysis.

Sampling of agricultural products during and after an accident at a nuclear power plant is required for several reasons:

1. To evaluate a decision that a protective action recommendation should be made, changed, or rescinded.
2. To verify that an area believed to be uncontaminated is, indeed, producing uncontaminated commodities.
3. To evaluate the effectiveness of protective actions, such as use of stored feed, in reducing commodity contamination.

A 50 mile radius Ingestion Pathway Emergency Planning Zone (EPZ) is established around each nuclear power plant. Initial agricultural product monitoring is focused on this area.

Additional resources on this topic are found in:

- FEMA REP-12, September 1987, Guidance on Offsite Emergency Radiation Measurement Systems, Phase 2 -- The Milk Pathway.
- FEMA REP-13, May 1990, Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 -- Water and Non-Dairy Food Pathway
- "Accidental Radioactive Contamination of Human Food and Animal Feeds; Recommendations for State and Local Agencies", US FDA, August 13, 1998.
- PA Department of Agriculture Annex E, "PDA Plan for Nuclear Power Generating Station Incidents"
- BRP-ER-8.01, "Ingestion Pathway Dose Projections"

AGRICULTURAL PRODUCT INITIAL MONITORING METHODOLOGY

The initial determination after an event is whether or not there has been a radioactive release. This determination is a BRP responsibility, making use of available information. If a radioactive release has occurred, the next aspect for BRP to determine is where deposition has occurred.

Potential and actual deposition areas are identified by using the source term information and meteorological conditions prevailing during plume release; measurements from aircraft; and field monitoring team measurements and samples, and data from laboratory analysis of field team samples. Each of these three sources of information aids BRP in determining the offsite deposition:

- a. Source Term Information and Meteorological Conditions Prevailing During Plume Release: The first source of information used in determining deposition is data from the licensee on the severity of the accident, condition of the barriers against escape of contamination, source term information for the release, and meteorological conditions prevailing during the plume release. From this information we know whether a deposition problem is expected, and in general, where it will be. This information is available during and immediately after the incident. Particularly desirable in analyzing this data is the Federal asset, National Atmospheric Release Advisory Capability (NARAC). This is a sophisticated computer program which takes into account release history and wind patterns to predict plume behavior. This computer is physically located at the Lawrence Livermore Laboratory in California. NARAC uses

telecommunications for data acquisition and results conveyance. This asset should be available 36-48 hours after the incident.

Also, for an event that is an Incident of National Significance, the resources of the Interagency Modeling and Assessment Center (IMAAC) become available. IMAAC is responsible for production, coordination, and dissemination of consequence predictions for an airborne hazardous material release. IMAAC generates a single Federal prediction of atmospheric dispersions and their consequences utilizing the best available resources from the Federal Government. This asset will be available through the FRMAC.

b. Measurements From Aircraft: A second source of information in determining deposition is the Federal asset, Aerial Measuring System (AMS). AMS uses fixed wing aircraft and helicopters fitted with radiation detectors to describe actual ground depositions. These aircraft fly serpentine patterns over the affected area and develop maps showing deposition patterns. This asset should be available 36-48 hours after the incident.

c. Field Monitoring Team Measurements and Samples, and Data From Laboratory Analysis of Field Team Samples: A third source of information in determining deposition is field monitoring team measurements and samples, and data from laboratory analysis of field team samples. Some information from this source is generated during the plume phase, when BRP field monitoring teams take air samples for iodines and particulates. Additional information from this source is generated after the uncontrolled releases have ceased, by field team monitoring of ambient gamma levels, and by field teams obtaining samples of soil (snow if necessary) and vegetation. The actual radiological analysis of samples will be done by the Radiation Measurements Laboratory in the DEP Bureau of Laboratories. This facility is located in Harrisburg. This laboratory is well equipped for gamma spectroscopy, a non-destructive method for identification and quantification for virtually all reactor produced isotopes. Following a reactor accident, this lab capability will be augmented by Federal assets, including mobile laboratories and federal laboratories nationwide.

As described in Section 1, "Restricted Zone Initial Monitoring Plan", this effort will result in the determination of the areas of deposition from the plume, and the identification of boundaries of the restricted zones and their buffer zones. Access into restricted zones and their buffer zones will be controlled, due to high levels of contamination and radiation in these areas. Access and travel in areas outside of restricted zones and their buffer zones will not be controlled for radiological purposes.

Once BRP has determined the areas affected by deposition, the steps in BRP's Agricultural Product Initial Monitoring Plan are:

1. BRP uses the information provided in (a.), (b.), and (c.) above to map the deposition pattern (see also Section 1, "Restricted Zone Initial Monitoring Plan").
2. The PDA in the EOC will monitor this effort and be prepared to provide "land use" information to the BRP to use in the process of determining the impact of the depositions. The responsibility to determine "land use"

resides with PDA and USDA at the State EOC, and is the essential ingredient in the next step -- development of an agricultural product sampling plan in terms of commodity, location, and frequency by BRP in consultation with PDA. (Note: If the land use is non-agricultural, and sampling of wild game is desired, the PA Game Commission should be consulted. If sampling of non-commercial fish is desired, the PA Fish and Boat Commission should be consulted.)

3. Based on the deposition pattern and "land use" information provided in (1.) and (2.) above, an agricultural product initial monitoring plan will be developed by BRP in consultation with PA Department of Agriculture to obtain samples of agricultural products from those areas affected by plume deposition, and also those areas unaffected by plume deposition. Attachment 1, "Initial Milk Sampling and Analysis Plan", and Attachment 2, "Initial Agricultural Product Sampling Plan (Stored Food Crops, Stored Animal Feeds, Unharvested Crops, Vegetation, and Other Items)" to this section provide guidance on the location and frequency of sampling that is anticipated for these agricultural commodities. It is noted that an important part of the sampling effort is the verification of areas expected to be producing acceptable commodities, that is, commodities that are not affected by the deposition, or are affected only slightly by the deposition. This sampling effort could be large compared with sampling in areas requiring protective actions. It is not anticipated that agricultural product sampling will be conducted in areas where the ambient gamma exposure rate (waist height, closed window) is greater than 1 mR/hr. This precaution is taken to avoid collecting highly contaminated samples, and sending individuals into highly contaminated areas. Agricultural commodities produced in such areas will be too contaminated to be accepted under the PAGs, so sampling in these areas will not contribute to protective action decision making.
4. When the agricultural commodity, location, and frequency for sampling is determined from (3.) above, agricultural product sampling teams will be dispatched to collect samples. From a radiological standpoint, two situations are possible:
 - a. Sampling in the Restricted Zones -- Sampling in the Restricted Zones [including their buffer zones] (or those areas of significant plume deposition if the boundaries of the Restricted Zones have not been clearly established) will require the sample teams operating in these areas to monitor ambient gamma exposure rate readings, since these readings may be greater than 1 mR/hr (the upper limit for sample collection), and to take appropriate radiological exposure and contamination control precautions such as wearing protective clothing, dosimetry, briefing before entering the Restricted Zone, sample collection radiological controls, and monitoring upon leaving a Restricted Zone. Because of these radiological considerations, sample teams operating in the Restricted Zones will be staffed by Health Physics personnel from BRP or the FRMAC. A PDA or USDA staff member, upon

receiving a radiological briefing, dosimetry, and appropriate anti-contamination clothing, may accompany these teams to provide technical support in obtaining the proper samples in a timely manner. These teams will be dispatched from the County EOCs in affected counties until the establishment of the FRMAC, and then from the FRMAC. It is anticipated that sampling in the Restricted Zones will comprise only a small fraction of the sampling to be performed, due to the limited size of the Restricted Zones, the need to avoid sampling in highly contaminated areas (>1 mR/hr gamma exposure rate), and the large territory outside the Restricted Zones that will need to be evaluated. Procedures for these sample teams are found in BRP-ER-8.02, "Agricultural Product Sampling Procedures".

- b. Sampling Outside of Restricted Zones -- Sampling outside of Restricted Zones [which include their buffer zones] (or outside those areas of significant plume deposition if the boundaries of the Restricted Zones have not been clearly established) is expected to comprise the great majority of the sampling effort. Agricultural product sampling outside of Restricted Zones will be conducted by PDA personnel, with supplementary sampling teams provided by USDA if required. (See PDA Emergency Plan.) BRP will provide health physics support for these sampling teams, as required, until establishment of the FRMAC, upon which the FRMAC will take over that role. Radiation and contamination levels outside of Restricted Zones are below the levels which require the sample teams to perform ambient radiation monitoring during their sample collection, or use of protective clothing. Access into areas outside of Restricted Zones is not controlled for radiological purposes. Agricultural product sampling teams operating outside of Restricted Zones will NOT be required to wear protective clothing for radiological contamination control purposes. (Agricultural commodities produced in areas [such as Restricted Zones] so contaminated that protective clothing is required will be too contaminated to be accepted under the PAGs, so sampling in these areas will not contribute to protective action decision making.) Also, agricultural product sampling teams operating outside of Restricted Zones will NOT be instructed to take potassium iodide (KI). The use of KI as a protective action occurs only when airborne radioiodine concentrations are sufficient to give a dose of 5 rem to the child thyroid. (Agricultural products produced in areas with this level of radioiodine contamination will be many times the PAG, so sampling in these areas will not contribute to protective action decision making.)

For both cases (a.) and (b.) above, the samples will be dropped off at a pre-designated location given by the County EOC (or FRMAC, when established), and transported to the appropriate laboratory for analysis. Transportation will be coordinated with PEMA.

5. The samples obtained by the agricultural product sampling teams in (4.) above are analyzed in the laboratory. This will provide the isotopic activities contained in the samples. The laboratory provides analysis data to BRP at the State EOC (or FRMAC, when established).
6. Sample data is then utilized in BRP-ER-8.01, "Ingestion Pathway Dose Projections", to determine if Protective Action Guides (PAGs) are exceeded.
7. The results of the sample analyses will be reviewed by BRP, and BRP in consultation with PDA will develop PARs. These PARs will be communicated to PEMA at the State EOC for use in the Protective Action Decision making process. PDA will communicate PADs to affected agricultural product producers.
8. It is expected that this agricultural product sampling effort will be a long term effort, lasting for months, and perhaps years after the incident. Upon establishment of the FRMAC, BRP and PDA will work closely with the FRMAC staff to develop a long-term agricultural product sampling plan.

A summary of the specific responsibilities of PDA and BRP follows:

PENNSYLVANIA DEPARTMENT OF AGRICULTURE (PDA) RESPONSIBILITIES:

1. Interface between the agricultural community and the Commonwealth. (Community means growers and processors.)
2. Interface between the US Department of Agriculture and the Commonwealth.
3. Consult with BRP to develop sampling plans in terms of commodity, location, and frequency.
4. Collect samples in accordance with plan developed with BRP.
5. Coordinate with PEMA for the transportation of samples to the DEP Bureau of Laboratories' Radiation Measurements Laboratory.
6. Consult with BRP in the development, delivery, revision, and lifting of protective action recommendations for ingestion.
7. Develop and maintain current maps and listings for the location of farms, along with information on the crop and livestock activity at individual farms within the 50 mile Ingestion EPZ.
8. Develop and maintain current information on food processors, particularly those using fresh fluid milk produced in the 50 mile Ingestion EPZ.

DEP BUREAU OF RADIATION PROTECTION RESPONSIBILITIES:

1. Provide for the identification of areas expected to be capable of yielding contaminated commodities.

2. Consult with the PA Department of Agriculture in developing the sampling plan in terms of commodity, location, and frequency.
3. Instruct the Radiation Measurements Laboratory as to the analytic requirements for the various samples, in terms of isotopic analysis and analytic sensitivity.
4. Instruct the Radiation Measurements Laboratory concerning analytic priorities.
5. Interpret the analytic results and make dose projections.
6. Consult with the PA Department of Agriculture in the development, delivery, revision, and lifting of protective action recommendations for ingestion.
7. Consult with the US Department of Health and Human Services regarding the applicability of Food and Drug Administration ingestion PAGs.
8. Provide for health physics support and radio equipped vehicles for PDA field sampling staff, as appropriate to the situation.

LABORATORY ANALYSIS OF SAMPLES

To determine the radionuclides present in the samples and their concentrations, samples are analyzed by high resolution gamma spectroscopy.

Specific information on the laboratory analysis of samples is contained in the two attachments which accompany this section:

- Attachment 1: Initial Milk Sampling and Analysis Plan
- Attachment 2: Initial Agricultural Product Sampling and Analysis Plan (Stored Food Crops, Stored Animal Feeds, Unharvested Crops, Vegetation, and Other Items)

The results of analysis of samples will be conveyed directly from the laboratory to BRP for interpretation.

ATTACHMENT 1

INITIAL MILK SAMPLING AND ANALYSIS PLAN

Sampling and analysis of milk is necessary to evaluate the effectiveness of protective actions, to evaluate ingestion pathway dose commitment, and to verify that areas producing contaminated milk have been identified.

FIELD OPERATIONS

BRP is responsible for development of a milk sampling plan, in consultation with the PA Department of Agriculture.

Milk sampling teams operating outside Restricted Zones will be staffed by PA Department of Agriculture personnel, with supplementary sampling teams provided by USDA. BRP will provide health physics support, if required, until establishment of the FRMAC.

Milk sampling teams operating in the Restricted Zones will be staffed by health physicists from BRP or FRMAC. (PAD or USDA personnel may accompany these teams to provide technical support in obtaining the necessary samples in a timely manner, if necessary.)

SAMPLING AREAS AND FREQUENCIES

Milk Producers

Following the implementation of a PAR for dairy animals, the effectiveness of the action is evaluated by sampling at the individual milk producers in the plume path to the distance specified in the PAR. These dairy farms will be identified by the PA Department of Agriculture using plume information from BRP.

The first sample should represent the first milking after the start of a release. These farms should each continue to be sampled on alternate days until one month after the cessation of uncontrolled releases. At that time, if nuclides are still present in milk, the sampling schedule and the database will be reevaluated for continuation.

Milk Processors

Verification that significant milk contamination is confined to the identified milk producers in the plume path is done through sampling at fresh milk processing plants supplied by farms within the PAR distance. These processors will be identified by the PA Department of Agriculture.

Sampling at the processing plants will begin on the second or third day after the start of a release. These processors will be sampled twice per week until one month after uncontrolled releases cease. At that time, if nuclides are still present in milk at the processor, the sampling schedule and the database will be reevaluated for continuation.

SAMPLE ANALYSIS

Gamma Spectroscopy LLD

The proposed LLD for I-131 using intrinsic germanium is 64 pCi/l. The LLD used is the 95% LLD at 4.66 sigma in the instrument background count. Consumption of 64 pCi/l milk by a newborn infant will yield a thyroid dose commitment of about one millirem. This LLD for I-131 is also low enough to detect similar concentrations of Cs-137 and Cs-134, which in turn represent very small fractions of a millirem.

Strontium/Cesium Ratio

Gamma spectroscopy will not detect the pure beta emitters, Sr-89 and Sr-90. Their concentrations are determined separately by chemical separation and beta counting. Strontium analyses are very labor intensive and require a long turn-around time due to the need to ingrow Y-90 for Sr-90 determination.

Isotopes of cesium will be very detectable in samples which contain strontium. Strontium concentrations can be inferred from cesium gamma data following the development of Sr/Cs ratios. Development of these ratios should be considered when the total cesium concentration in milk reaches 1000 pCi/l. The ratios are determined by analyzing selected samples for Sr-89 and Sr-90 by separation and beta counting, and the cesiums by gamma spectroscopy, and calculating the ratios of the isotopes.

Decay corrections for Sr-89 will be require periodically. The analyses should also be repeated for later samples to reconstruct the ratio to account for physical and chemical differences in the behavior of the two elements in the environment.

Analysis Time

Using the proposed I-131 LLD of 64 pCi/l, the instrument counting time using intrinsic germanium detectors will be three minutes. Taking into account the sampling handling time and the availability of 8 intrinsic germanium detectors, the throughput for gamma spec will be approximately 8 to 10 samples per hour. If detector capacity is also needed for analysis of samples other than milk, the throughput will be approximately 3 milk samples per hour or 72 per day.

Analysis Results

Results of samples analyzed by RML will be reported directly to BRP for evaluation.

SAMPLING AND ANALYSIS OF ANIMAL FEED

FDA PAGs for milk protection include response levels for fresh forage. These values are included in Figures 8-1 and 8-2 (preventive and emergency PAGs for milk). It is very unlikely that forage/vegetation sampling will be used by BRP for developing milk PARs. Forage sampling can be used, however, in the decision to remove pasturing restrictions. Forage samples will be collected only from acreage actually used for pasture and only during the pasturing season.

ATTACHMENT 2

INITIAL AGRICULTURAL PRODUCT SAMPLING AND ANALYSIS PLAN

(Stored Food Crops, Stored Animal Feeds, Unharvested Crops, Vegetation, and Other Items)

Sampling and analysis of agricultural products is necessary to evaluate the effectiveness of protective actions, to evaluate ingestion pathway dose commitment, and to verify that areas producing contaminated agricultural products have been identified. This attachment covers: stored food crops, stored animal feeds, unharvested crops, vegetation, and other items. Milk and fresh forage is covered under Attachment 1, "Initial Milk Sampling and Analysis Plan".

FIELD OPERATIONS

BRP is responsible for developing an agricultural product sampling plan, in consultation with the PA Department of Agriculture.

Agricultural product sampling teams operating outside Restricted Zones will be staffed by PA Department of Agriculture personnel, with supplementary sampling teams provided by USDA. BRP will provide health physics support for agricultural product sampling teams, if required, until establishment of the FRMAC.

Agricultural product sampling teams operating in the Restricted Zones will be staffed by health physicists from BRP or FRMAC. (PDA or USDA personnel may accompany these teams to provide technical support in obtaining the necessary samples in a timely manner, if necessary.)

SAMPLING AREAS AND FREQUENCIES

Agricultural Product Producers

Following the implementation of a PAR for agricultural products, the effectiveness of the action is evaluated by sampling at individual agricultural product producers in the plume path to the distance specified in the PAR. These agricultural producers will be identified by the PA Department of Agriculture using plume information provided by BRP. If the number of locations and agricultural items which could be sampled is greater than the sampling and analysis resources permit, the most critical (ie those near harvest) will be sampled first, and a representative sample of other items will be taken, as resources permit. Additional sampling and analysis resources will then be requested from the USDA and FRMAC.

The sampling should begin after uncontrolled releases from the plant have ceased. Agricultural producers should be sampled weekly until one month after the cessation of uncontrolled releases. At that time, if nuclides are still present in the agricultural products, the sampling schedule and database will be reevaluated for continuation.

Agricultural Product Processors

Verification that significant agricultural product contamination is confined to the identified producers in the plume path is done through sampling at agricultural product processing plants supplied by farms within the PAR distance. These processors will be identified by the PA Department of Agriculture.

Sampling at the processing plants will begin after uncontrolled releases from the plant have ceased. These processors will be sampled once per week until one month after uncontrolled releases cease. At that time, if nuclides are still present in the agricultural products at the processor, the sampling schedule and the database will be reevaluated for continuation.

SAMPLE ANALYSIS

Gamma Spectroscopy LLD

The proposed LLD for I-131 analysis using intrinsic germanium is 170 pCi/kg. The LLD used is the 95% LLD at 4.66 sigma in the instrument background count. Consumption of 170 pCi/kg agricultural products by a child will yield a thyroid dose commitment of about eight millirem. This LLD for I-131 is also low enough to detect similar concentrations of Cs-137 and Cs-134, which in turn represent fractions of a millirem.

Strontium/Cesium Ratio

Gamma spectroscopy will not detect the pure beta emitters, Sr-89 and Sr-90. Their concentrations are determined separately by chemical separation and beta counting. Strontium analyses are very labor intensive and require a long turn-around time due to the need to ingrow Y-90 for Sr-90 determination.

Isotopes of cesium will be very detectable in samples which contain strontium. Strontium concentrations can be inferred from cesium gamma data following the development of Sr/Cs ratios. Development of these ratios should be considered when the total cesium concentration in agricultural products reaches 1000 pCi/kg. The ratios are determined by analyzing selected samples for Sr-89 and Sr-90 by separation and beta counting, and the cesiums by gamma spectroscopy, and calculating the ratios of the isotopes.

Decay corrections for Sr-89 will be required periodically. The analyses should also be repeated for later samples to reconstruct the ratio to account for physical and chemical differences in the behavior of the two elements in the environment.

Analysis Time

Using the proposed I-131 LLD of 170 pCi/kg, the instrument counting time using intrinsic germanium detectors will be five minutes. Taking into account the sampling handling time and availability of 8 intrinsic germanium detectors, the throughput for gamma spec will be approximately 8 to 10 samples per hour. If detector capacity is needed for analysis of other samples, the throughput will be approximately 3 agricultural product samples per hour or 72 per day.

Analysis Results

Results of samples analyzed by RML will be reported directly to BRP for evaluation.

SECTION 3

WATER INITIAL MONITORING PLAN

OBJECTIVE

Describe the monitoring plan for initially determining the extent of contamination of surface and ground water following an accident at a nuclear power plant that results in significant offsite releases. Also, to describe the roles and responsibilities of DEP agencies in the sampling, analysis, interpretation of results, and the development of protective action recommendations for water consumed in the Commonwealth.

BACKGROUND

Accidents of varying degrees of severity can occur at nuclear power stations in Pennsylvania and in neighboring states. An accident may or may not yield atmospheric or liquid releases in excess of the ordinary. Atmospheric or liquid releases may or may not include radioactive species which actually contaminate. Water can become contaminated from liquid releases from the plant, from deposition of airborne activity from an airborne release, and from runoff from contaminated land areas.

Sampling of surface and ground water during and after an accident at a nuclear power plant is required for several reasons:

1. To evaluate a decision that a protective action should be imposed, changed, or rescinded.
2. To verify that water believed to be uncontaminated is, indeed, uncontaminated.
3. To evaluate the effectiveness of protective actions, such as shutting intakes of public water supply facilities receiving water from a contaminated water source, in reducing the consumption of contaminated water.

A 50 mile radius Ingestion Pathway Emergency Planning Zone (EPZ) is established around each nuclear power plant. Initial water monitoring is focused on this area.

Additional resources on this topic are found in:

- FEMA REP-13, May 1990, Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 -- Water and Non-Dairy Food Pathway
- National Interim Primary Drinking Water Regulations, EPA 570/9-76-003.U.S EPA 1976.
- BRP-ER-8.01, "Ingestion Pathway Dose Projections"
- BRP-ER-6.06, "Estimation of Liquid Release Consequences to Downstream Water Users"
- Commonwealth of Pennsylvania Department of Environmental Protection Emergency Operations Plan, Annex E, Nuclear Power Plant Incidents.

WATER INITIAL MONITORING METHODOLOGY

The initial determination after an event is whether or not there has been a radioactive release. This determination is a BRP responsibility, making use of available information. If a radioactive release has occurred, the next aspect for BRP to determine is where deposition has occurred. If the release is a liquid release into a waterway, BRP will identify the waterway affected.

Airborne Release

Potential and actual deposition areas from an airborne release are identified by using the source term information and meteorological conditions prevailing during plume release, measurements from aircraft, and field monitoring team measurements and samples and data from laboratory analysis of field team samples. Each of these three sources of information aids BRP in determining the offsite deposition:

a. Source Term Information and Meteorological Conditions Prevailing During Plume Release: The first source of information used in determining deposition is data from the licensee on the severity of the accident, condition of the barriers against escape of contamination, source term information for the release, and meteorological conditions prevailing during the plume release. From this information we know whether a deposition problem is expected, and in general, where it will be. This information is available during and immediately after the incident. Particularly desirable in analyzing this data is the Federal asset, National Atmospheric Release Advisory Capability (NARAC). This is a sophisticated computer program which takes into account release history and wind patterns to predict plume behavior. This computer is physically located at the Lawrence Livermore Laboratory in California. NARAC uses telecommunications for data acquisition and results conveyance. This asset should be available 36-48 hours after the incident.

Also, for an event that is an Incident of National Significance, the resources of the Interagency Modeling and Assessment Center (IMAAC) become available. IMAAC is responsible for production, coordination, and dissemination of consequence predictions for an airborne hazardous material release. IMAAC generates a single Federal prediction of atmospheric dispersions and their consequences utilizing the best available resources from the Federal Government. This asset will be available through the FRMAC.

b. Measurements From Aircraft: A second source of information in determining deposition is the Federal asset, Aerial Measuring System (AMS). AMS uses fixed wing aircraft and helicopters fitted with radiation detectors to describe actual ground depositions. These aircraft fly serpentine patterns over the affected area and develop maps showing deposition patterns. This asset should be available 36-48 hours after the incident.

c. Field Monitoring Team Measurements and Samples and Data From Laboratory Analysis of Field Team Samples: A third source of information in determining deposition is field monitoring team measurements and samples, and data from laboratory analysis of field team samples. Some information from this source is generated during the plume phase, when BRP field monitoring teams

take air samples for iodines and particulates. Additional information from this source is generated after the uncontrolled releases have ceased, by field team monitoring of ambient gamma levels, and by field teams obtaining samples of soil (snow if necessary) and vegetation. The actual radiological analysis of samples will be done by the Radiation Measurements Laboratory in the DEP Bureau of Laboratories. This facility is located in the Evangelical Press Building at Third and Reily Streets in Harrisburg. This laboratory is well equipped for gamma spectroscopy, a non-destructive method for identification and quantification for virtually all reactor produced isotopes. Following a reactor accident, this lab capability will be augmented by Federal assets, including mobile laboratories and federal laboratories nationwide.

As described in Section 1, "Restricted Zone Initial Monitoring Plan", this effort will result in the determination of the areas of deposition from the plume, and the identification of boundaries of the Restricted Zones and their buffer zones. Access into Restricted Zones and their buffer zones will be controlled, due to high levels of contamination and radiation in these areas. Access and travel in areas outside of Restricted Zones and their buffer zones is not controlled for radiological purposes.

Liquid Release

If the release is a liquid release into a waterway, BRP, in consultation with the licensee will identify the waterway affected, and receive from the licensee an estimation of the composition and quantity of the release.

Once BRP has identified the areas affected by the airborne deposition or the liquid release, the steps in the Water Initial Monitoring Plan are:

Airborne Release

1. BRP uses the information provided in (a.), (b.), and (c.) above to map the deposition pattern (see also Section 1, "Restricted Zone Initial Monitoring Plan").
2. The DEP Emergency Preparedness Liaison Officer (EPLO) in the State EOC (who is typically the DEP Emergency Response Program Director [ERPD]) will monitor this effort. The ERPD, in consultation with the DEP regional Emergency Response, Water Supply Management (public water supplies), and Water Quality Protection (surface and ground water supplies) programs, will determine the water supplies impacted by the deposition.
3. Based on the deposition pattern and the identified public, surface, and ground water supplies identified, an initial water monitoring plan is developed by BRP in consultation with the DEP EPLO at the State EOC to obtain samples of public water supplies, surface, and ground water from those areas affected by the plume deposition, and also those areas unaffected by plume deposition. Public water supplies identified by DEP regional Water Supply Management staff

in the areas affected by plume deposition should be sampled immediately after the cessation of uncontrolled releases from the plant, and on alternate days thereafter until one month after the cessation of uncontrolled releases. At that time, if nuclides are still present in the water, the sampling schedule and database will be reevaluated for continuation. Also, surface and ground water supplies identified by DEP regional Water Quality Protection staff in the areas affected by plume deposition should be sampled. Surface and ground water samples should be obtained from these supplies (or a representative sample of these supplies if they are too numerous to individually sample) immediately after the cessation of uncontrolled releases from the plant, and weekly thereafter until one month after the cessation of uncontrolled releases. At that time, if nuclides are still present in the water, the sampling schedule and database will be reevaluated for continuation. For public, surface, and ground water supplies in areas not affected by plume deposition, a sampling scheme will be developed to verify that these water supplies are indeed uncontaminated. Based on the resources available, samples of a representative number of these water supplies will be obtained. This sampling effort could be large compared with sampling in areas affected by plume deposition. It is not anticipated that water sampling will be conducted in areas where the ambient gamma exposure rate (waist height, closed window) is greater than 1 mR/hr. This precaution is taken to avoid collecting highly contaminated samples, and sending individuals into highly contaminated areas. Water in these areas will be too contaminated to be acceptable under the PAGs, so sampling in these areas will not contribute to the protective action decision making.

4. When the public, surface, and ground water location and frequency for sampling is determined, water sampling teams will be dispatched to collect the samples. From a radiological standpoint, two situations are possible:
 - a. Sampling in Restricted Zones -- Sampling in Restricted Zones [including their buffer zones] (or those areas of significant plume deposition if the boundaries of the Restricted Zones have not been clearly established) will require sample teams operating in these areas to monitor ambient gamma exposure rate readings, since these readings may be greater than 1 mR/hr (the upper limit for sample collection), and to take appropriate radiological exposure and contamination control precautions such as wearing protective clothing, dosimetry, briefing before entering the Restricted Zone, sample collection radiological controls, and monitoring upon leaving the Restricted Zone. Because of these radiological considerations, sample teams operating in Restricted Zones will be staffed by health physics personnel from BRP or the FRMAC.

A DEP regional Emergency Response Team member from the Water Supply Management or Water Quality Protection programs, upon receiving radiological briefing, dosimetry, and appropriate anticontamination clothing, may accompany these teams to provide technical support in obtaining the proper samples in a timely manner. These teams will be dispatched from the DEP Regional Office(s) in the affected area (or FRMAC, upon establishment of the FRMAC), as described in BRP-ER-8.03, "Water Sampling Procedures", and operate as described in this procedure. It is anticipated that sampling in the Restricted Zones will comprise only a small fraction of the sampling to be performed, due to the limited size of the Restricted Zones, and the need to avoid sampling in highly contaminated areas (>1 mR/hr gamma exposure rate), and the large territory outside the Restricted Zones that will need to be evaluated.

- b. Sampling outside of Restricted Zones -- Sampling outside of Restricted Zones [which include their buffer zones] (or outside those areas of significant plume deposition if the boundaries of the Restricted Zones have not been clearly established), is expected to comprise the great majority of the sampling effort. Public water supply sampling outside of Restricted Zones will be conducted by DEP Regional Water Supply Management personnel, as described in the DEP Emergency Operations Plan. Surface and Ground water sampling outside of Restricted Zones will be conducted by DEP Regional Water Quality Protection personnel, as described in the DEP Emergency Operations Plan. The DEP personnel may be supplemented by EPA staff, if needed. BRP will provide health physics support for these sampling teams, as required, until establishment of the FRMAC, upon which the FRMAC will take over that role. Radiation and contamination levels outside of Restricted Zones are below the levels which require the sample teams to perform ambient radiation monitoring during the sample collection, or use protective clothing. Access into areas outside of Restricted Zones is not controlled for radiological purposes. Water sampling teams operating outside of Restricted Zones will NOT be required to wear protective clothing for radiological contamination control purposes.

(Water in areas [such as Restricted Zones] so contaminated that protective clothing is required will be too contaminated to be acceptable under the PAGs, so sampling in these areas will not contribute to protective action decision making.) Also, water sampling teams operating outside of Restricted Zones will NOT be instructed to take potassium iodide (KI). The use of KI as a protective action occurs only when airborne radioiodine concentrations are sufficient to give a dose of 5 rem to the child thyroid. (Water in areas with this level of radioiodine contamination will be many times the PAG, so sampling will not contribute to the protective action decision making.)

For both cases (a.) and (b.) above, the samples will be dropped off at a predesignated location provided by DEP (or FRMAC, when established), and transported to the appropriate lab for analysis. Transportation will be coordinated with PEMA.

5. The samples obtained by the water sampling teams in (4.) above are analyzed in the laboratory. This will provide the isotopic activities contained in the samples. The laboratory provides analysis data to BRP at the State EOC (or FRMAC, when established).
6. Sample data is then utilized in BRP-ER-8.01, "Ingestion Pathway Dose Projections" to determine if PAGs have been exceeded.
7. The results of sample analyses will be reviewed by BRP, and BRP in consultation the DEP EPLO will determine what PARs are necessary. These PARs will be communicated by BRP and the DEP EPLO to PEMA at the State EOC for input into the Protective Action Decision making process. The DEP EPLO will relay Protective Action Decisions to DEP offices for communication to affected water users.
8. It is expected that this water sampling effort will be a long term effort, lasting for months, and perhaps years after the incident. Upon establishment of the FRMAC, BRP and DEP will work closely with the FRMAC staff to develop a long-term water sampling plan.

Liquid Release

1. BRP uses the information provided by the licensee to identify the affected waterway.
2. The DEP EPLO in the State EOC will monitor this effort. The EPLO, in consultation with the DEP regional Emergency Response, Water Supply Management (public water supplies), and Water Quality Protection (surface and ground water supplies) programs will determine the downstream water supplies impacted by the release.
3. Based on the identified public, surface, and ground water supplies identified, an initial water monitoring plan is developed by BRP in consultation with the DEP EPLO at the State EOC to obtain samples of water supplies affected by the liquid release. Water supplies affected by the release should be sampled as soon as the release is realized, and daily thereafter until one week after the release is terminated. At that time, if nuclides are still present in the water, the sampling schedule and database will be reevaluated for continuation.
4. When the affected water supplies have been identified and the sampling frequency is determined, water sampling teams will be dispatched to collect the samples. Water sampling teams will be composed of DEP Regional Water Supply Management, Water Quality Protection, and Emergency Response Team members, and operate as described in DEP Emergency Operations Plan. These teams may be supplemented by EPA teams, if required. BRP will provide health physics support for these sampling teams, as required, until establishment of the FRMAC, when the FRMAC will take over that role.
5. The samples obtained by the water sampling teams in (4.) above are analyzed in the DEP Radiation Measurements Laboratory. This will provide the isotopic activities contained in the samples. This information is then used in BRP-ER-6.06, "Estimation of Liquid Release Consequences to Downstream Water Users". BRP will consult with the DEP EPLO to determine the necessary PARs. These PARs will then be communicated by BRP and the DEP EPLO to PEMA for input into the Protective Action Decision making process. The DEP EPLO at the State EOC will communicate Protective Action Decisions to DEP offices for communication to affected water users.

LABORATORY ANALYSIS OF SAMPLES

Initial analysis of water samples from an airborne release at a nuclear power plant will focus on identification of the presence and activity of I-131 in the samples, since this isotope is expected to produce a significant fraction of the dose commitment in the early weeks after an accident. If the release is a liquid release, information from the licensee on the isotopes in the release will be used to determine the isotopes of concern.

Gamma Spectroscopy LLD

The proposed LLD for I-131 analysis using intrinsic germanium is 64 pCi/l. The LLD used is the 95% LLD at 4.66 sigma in the instrument background count. Consumption of water with 64 pCi/l by a newborn infant will yield a thyroid dose commitment of about 3.8 millirem. This LLD for I-131 is also low enough to detect similar concentrations of Cs-137 and Cs-134, which in turn represent very small fractions of a millirem.

Strontium/Cesium Ratio

Gamma spectroscopy will not detect the pure beta emitters, Sr-89 and Sr-90. Their concentrations are determined separately by chemical separation and beta counting. Strontium analyses are very labor intensive and require a long turn-around time due to the need to ingrow Y-90 for Sr-90 determination.

Isotopes of cesium will be very detectable in samples which contain strontium. Strontium concentrations can be inferred from cesium gamma data following the development of Sr/Cs ratios. Development of these ratios should be considered when the total cesium concentration in agricultural products reaches 1000 pCi/l. The ratios are determined by analyzing selected samples for Sr-89 and Sr-90 by separation and beta counting, and the cesiums by gamma spectroscopy, and calculating the ratios of the isotopes.

Decay corrections for Sr-89 will be required periodically. The analyses should also be repeated for later samples to reconstruct the ratio to account for physical and chemical differences in the behavior of the two elements in the environment.

Analysis Time

Using the proposed I-131 LLD of 64 pCi/l, the instrument counting time using intrinsic germanium detectors will be three minutes. Taking into account the sampling handling time and availability of 8 intrinsic germanium detectors, the throughput for gamma spec will be approximately 8 to 10 samples per hour. If detector capacity is also needed for analysis of samples other than water, the throughput will be approximately 3 water samples per hour or 72 per day.

Analysis Results

Results of samples analyzed by RML will be reported directly to BRP for evaluation.

7.0 PROTECTIVE RESPONSE

This section summarizes protective action guidance for the general public. Appropriate protective actions are discussed and criteria is established for initiation and lifting of protective actions. The section also includes a discussion of dose limits and exposure control for emergency workers.

7.1 INCIDENT PHASE

Radiation incidents and the resulting offsite consequences are divided into three phases; emergency (early), intermediate, and recovery (late). The three phases are defined in terms of implementation and completion of protective actions. A given incident may include none of these phases or all three phases. The phases may also overlap to some degree.

The emergency (early) phase begins with the recognition that protective actions are necessary for the protection of offsite populations against direct exposure from the plume. It continues through the completion of the protective actions.

The intermediate phase begins with the cessation of uncontrolled releases. It continues through the collection and assessment of monitoring information to determine if additional protective actions are needed due to ground deposition, and until these additional protective actions are completed. The intermediate phase also includes those radiological determinations necessary for lifting of emergency phase protective actions.

The recovery (late) phase begins with efforts to reduce offsite contamination to acceptable levels for unrestricted use. It continues through the completion of all offsite recovery operations.

THESE INCIDENT PHASES ARE USED BY BRP SOLELY FOR PURPOSES OF DOSE ACCOUNTING AND APPLICATION OF PROTECTIVE ACTION GUIDANCE. They are not related in any way to the emergency classification system specified in NUREG-0654.

7.2 PROTECTIVE ACTION GUIDES (PAGs)

Protective Action Guides (PAGs) are projected doses to offsite individuals, sufficient to warrant protective actions for their avoidance. PAGs apply to individuals in the general public other than emergency workers. These values are developed during the planning for radiation emergencies and provide guidance for protective action decisions.

The PAGs used in this plan are derived from the USEPA Manual of Protective Action Guides and Protective Actions for Nuclear Incidents (EPA 400-R-92-001), hereinafter called EPA-400.

EPA-400 RECOMMENDS THE USE OF SEPARATE AND DISTINCT PAGS FOR EACH INCIDENT PHASE. The PAGs and appropriate protective actions for each incident phase are discussed in Sections 7.3, 7.4 and 7.6. PAGs and protective actions for the ingestion pathway are discussed separately in Section 8.0. Emergency worker dose limits are discussed in Section 7.5.

7.2.1 WHOLE BODY PAG

EPA-400 redefines the earlier PAGs in terms of ICRP-26 Recommendations of the International Commission on Radiological Protection. The net effect is the consideration of dose from external sources and from internally deposited nuclides in combination.

In nuclear power plant incidents, external dose may arise from cloud shine and immersion from the passing plume, and ground deposition. As recommended in EPA-400, exposure from ground deposition is assumed to last four days. EPA-400 also assumes the external dose to be uniform over the whole body.

For external sources, the individual dose equivalent to each organ is weighted on the basis of relative detriment and summed to determine the total detriment to the individual. The detriment is in terms of risk of fatal late effects. This sum is the **Effective Dose Equivalent, EDE**. It is expressed in rem.

The committed dose equivalent to an internal organ from inhalation, weighted on the basis of relative detriment to the whole body, is the **Committed Effective Dose Equivalent, CEDE**, expressed in rem. The CEDE applies only when the plume contains nuclides which can bioaccumulate, or when the contribution from resuspension is significant.

In the 10CFR20 revision to adopt ICRP-26, NRC introduced the concept of **Total Effective Dose Equivalent, TEDE**, which is the sum of the EDE and CEDE. The TEDE concept is used in this plan to define the whole body PAGs.

$$\text{TEDE} = \text{EDE (plume)} + \text{EDE (ground)} + \text{CEDE (inhaled)}$$

TEDE is age independent.

Incidents at nuclear power stations can produce atmospheric releases consisting of several nuclides. The resulting plume will contain one of the components of TEDE, but not necessarily all three. Dose projections will take into account the fractional contributions of the several nuclides to the total TEDE.

External beta dose to skin and lens of the eye is not specifically addressed in this plan, since external gamma will drive protective actions from immersion and shine during plume passage. Internal beta from inhalation is taken into account in the conversion factors. External beta dose will be specifically considered when certain post-accident maneuvers, such as release of pure beta emitters such as Kr-85, may become necessary.

7.2.2 THYROID PAG

Thyroid protection is provided by taking of potassium iodide, KI. This compound protects the thyroid by saturating the gland with stable iodine, which prevents future uptake of radioactive iodine by the gland.

The greatest benefit comes from taking KI before exposure to radioiodine begins, thereby avoiding about 90% of the uptake and the corresponding CDE. KI is not effective in removing radioiodines already deposited in thyroid, and effectiveness decreases to less than 50% if administration is delayed until 4 hours after acute intake. (NRC RTM-96, Figure J-1). KI also provides no protection to the thyroid from external radiation exposure, nor does it protect other organs from internal exposure from radioiodines in the balance of the body.

The thyroid gland bears a disproportionately high risk for non-fatal cancers and nodules. So as to limit these effects, EPA-400 provides an additional PAG for thyroid uptake of radioiodines by inhalation. This PAG is in terms of Committed Dose Equivalent, CDE, expressed in rem.

Although EPA-400 recommends the adult thyroid as the reference gland for CDE, this plan continues to use the child thyroid as the reference gland for the general public. This approach is more conservative than EPA-400.

In Pennsylvania KI was distributed to citizens that live within the 10 mile EPZ of the five nuclear power plant sites, The Department of Health managed the distribution of the KI and maintains the remaining stockpile of KI to be strategically located in the event of a nuclear power plant accident.

This plan's Thyroid PAG for the General Public, Special Populations and Emergency Workers is :

1. **A General Emergency is declared at a Pennsylvania nuclear power plant,**
-OR-
2. **A projected child thyroid dose of ≥ 5 rem CDE.**

THE ADMINISTRATION OF KI REQUIRES THE APPROVAL OF THE PA SECRETARY OF HEALTH.

7.2.3 DOSE CONVERSION FACTORS AND DERIVED RESPONSE LEVELS

EPA-400 also provides Dose Conversion Factors (DCF) and Derived Response Levels (DRL) for specific nuclides. Dose Conversion Factors are used to convert environmental measurements to dose. Derived Response Levels are specific radionuclide concentrations equivalent to the PAGs.

DCF and/or DRL for the emergency and intermediate phases are discussed in conjunction with the PAGs in Sections 7.3 and 7.4. DRL for the ingestion pathway are discussed in Section 8.0. A procedure for calculation of DCF and DRL is found in the BRP Implementing Procedures.

7.3 EMERGENCY PHASE

The emergency phase begins with the recognition that protective actions are necessary for the protection of offsite populations against plume exposure. This phase continues through the completion of the protective action.

The Emergency Planning Zone (EPZ) for the emergency phase extends to a distance of 10 miles through 360 degrees from a nuclear power plant.

In Pennsylvania, the standing policy for implementation of protective actions in the emergency phase requires the application of the protective actions for the entire EPZ (10 miles and 360 degrees). This means that when a protective action is indicated for any location in the EPZ, that protective action will be applied to the entire EPZ.

Doses received during the emergency phase are separate and distinct from doses incurred during other incident phases, or from the ingestion pathway.

7.3.1 EMERGENCY PHASE PAGs

7.3.1.1 Whole Body PAG

The emergency phase whole body PAG is one rem TEDE for the general population.
This PAG is age-independent.

7.3.1.2 Thyroid PAG

This plan's Thyroid PAG for the General Public, Special Populations and Emergency Workers is :

1. **A General Emergency is declared at a Pennsylvania nuclear power plant,**
-OR-
2. **A projected child thyroid dose of ≥ 5 rem CDE.**

7.3.1.3 Emergency Phase DCFs and DRLs

Emergency phase DCFs and DRLs for whole body (TEDE) are listed in EPA-400 Table 5-1 "Dose Conversion Factors (DCF) and Derived Response Levels (DRL) for Combined Exposure Pathways During the Early Phase of a Nuclear Incident", found in Section 6A, Attachment 1.

The DCFs provided are dose values per unit time-integrated air concentrations, expressed as rem per uCi hour per cc. This means exposure for one hour to a concentration of one uCi per cc of a specific nuclide will commit the whole body dose (TEDE) stated in the guidance.

The DRLs are expressed as uCi hours per cc per one rem (TEDE). This means one rem is committed by exposure to the referenced concentration, in uCi per cc, for one hour. For a whole body PAG of one rem (TEDE), the DRL becomes a surrogate for the whole body PAG.

Emergency phase DCFs and DRLs for the general population thyroid (CDE) are listed in EPA-400 Table 5-2 "Dose Conversion Factors (DCF) and Derived Response Levels (DRL) Corresponding to a 5 Rem Dose Equivalent to the Thyroid from Inhalation of Radioiodine", found in Section 6A. Because this plan uses the child thyroid as the reference organ for the general population, these values must be corrected by a factor of two for child thyroid (double the DCFs and halve the DRLs).

7.3.2 EMERGENCY PHASE PROTECTIVE ACTIONS

7.3.2.1 Evacuation

Evacuation is the protective action of choice when the radiation risk avoided is greater than the risk of the evacuation itself. Evacuation completed prior to the onset of the release eliminates all of the available radiation risk to the population.

Evacuation is the preferred protective action at a projected TEDE (whole body) of 1 rem or a projected CDE (child thyroid) of 5 rem.

7.3.2.2 KI Administration

BRP will recommend to DOH that KI be administered to the general public, emergency workers and special groups when a General Emergency is declared at a Pennsylvania nuclear power plant or a projected child thyroid dose of ≥ 5 rem CDE. The direction to administer KI must be made prior to or at the same time any other protective actions are implemented.

7.3.2.3 Shelter (Special Conditions)

Special conditions may prevent evacuation of all or part of the general public. Examples of special conditions include severe weather, competing disasters, and local physical constraints. Shelter may be the preferred protective action in those instances where timely evacuation is not possible due to special conditions.

Shelter may also be the preferred protective action for those events when the release duration is short compared with the estimated evacuation time, and when ground deposition is not a factor. This means that shelter is indicated for puff releases consisting of noble gases.

Under special conditions, sheltering shall be used at a projected TEDE (whole body) of 1 rem or a projected CDE (child thyroid) of 5 rem. If the initiating condition is the child thyroid, the recommendation to take KI should be issued.

At a projected TEDE (whole body) of 5 rem evacuation is the only protective action option, regardless of special conditions.

The PAGs and protective actions for the general population are summarized in Figure 7.1.

7.3.3 SPECIAL GROUPS

There are certain groups within the general population who are not as mobile as the general population. These special groups include patients in hospitals, residents in long term care facilities, and individuals in correctional facilities. EPA-400 recommends separate PAGs for these special groups.

When a special group cannot be evacuated with the general population, sheltering should begin with the general population PAG. **Sheltering of special groups shall be used at a projected TEDE of 1 rem or a projected CDE of 5 rem to an child thyroid. . If the initiating condition is the child thyroid, the recommendation to take KI should be issued.**

The PAG for evacuation of special groups is a projected TEDE of 5 rem. If the initiating condition is the child thyroid, the recommendation to administer KI should be issued.

Special conditions may render a special group even less mobile. When special conditions preclude evacuation of special groups, the PAG for their evacuation is a projected TEDE of 10 rem.

At a projected TEDE of 10 rem, evacuation of special groups is the only protective action option, regardless of special conditions.

The PAGs and protective actions for special groups are summarized in Figure 7.2.

FIGURE 7.1

**EMERGENCY PHASE PAG DECISION TREE
FOR THE GENERAL POPULATION**

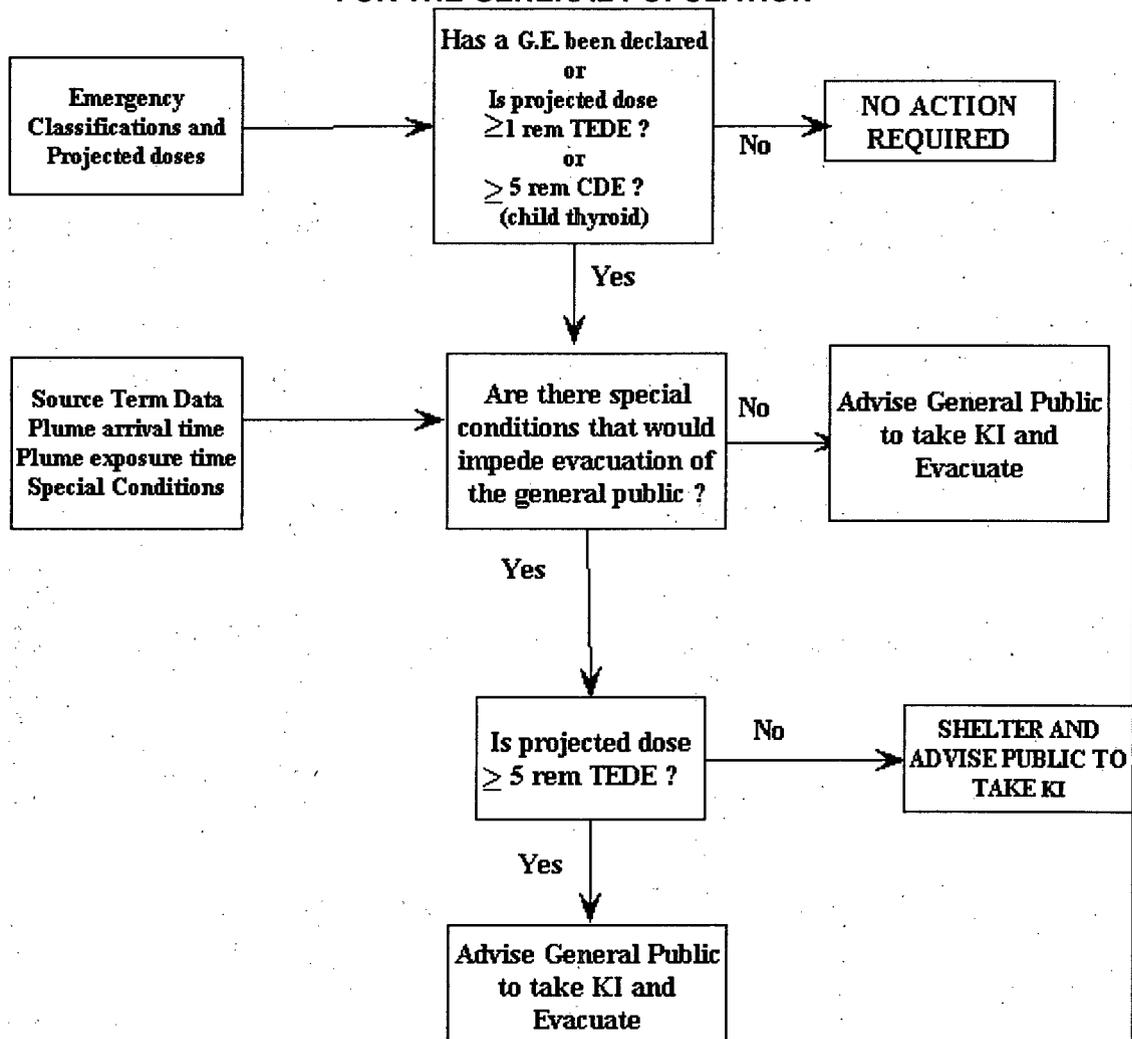
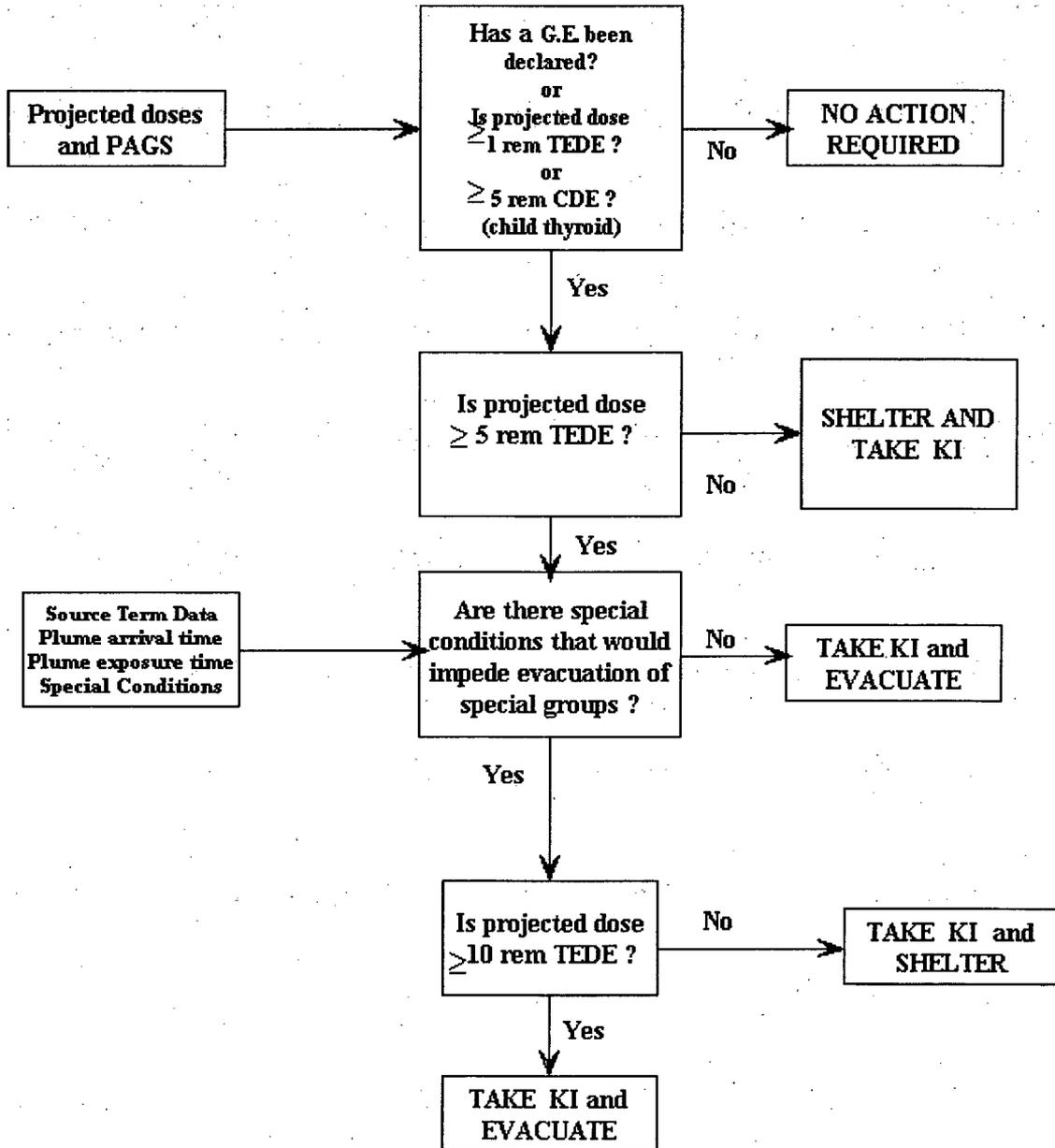


FIGURE 7.2

EMERGENCY PHASE PAG DECISION TREE
FOR SPECIAL GROUPS



7.4 INTERMEDIATE PHASE

The intermediate phase begins with the cessation of uncontrolled releases to the atmosphere. It continues with the identification of areas where additional protective actions, such as relocation, are needed due to ground deposition and until these additional protective actions are completed. The intermediate phase also includes the lifting of emergency phase protective actions.

This phase does not apply to incidents where a precautionary protective action was implemented during the emergency phase, but no significant release actually occurred.

The dominant mode of exposure in the intermediate phase is ground shine from surface deposition, with some contribution from the inhalation of resuspended materials. Doses from ground deposition received during the intermediate phase are separate and distinct from doses incurred during other phases or from the ingestion pathway.

7.4.1 INTERMEDIATE PHASE PAGs

7.4.1.1 Whole Body PAGs

The intermediate phase (relocation) PAG again uses the TEDE concept, with TEDE being the sum of the external exposure from ground deposition (EDE) and internal exposure from inhaled nuclides (CEDE). The TEDE considers whole body detriment in terms of risk of fatal late effects.

The projected TEDE received by an individual in the general population depends on the mix of nuclides on the ground and the effect of radioactive decay.

EPA-400 proposes the use of a projected dose of 2 rem over the first year as the relocation PAG. It further indicates that the projected dose during pregnancy should be limited to 0.5 rem. With the fetus as the limiting population, **this plan uses a projected dose of 0.5 rem TEDE (whole body) over the first year as the relocation PAG.**

EPA-400 also proposes relocation PAGs for the second year, and for the entire period from 0-50 years. As recommended by EPA-400, **the second year relocation PAG is 0.5 rem TEDE and the 50 year relocation PAG is 5 rem TEDE.**

7.4.1.2 Thyroid PAG

A separate PAG for thyroid from inhalation is not considered for this phase since uncontrolled releases will have ceased and resuspension of deposited iodines will not be sufficient to drive a thyroid PAG from inhalation. This position will be verified through environmental monitoring.

7.4.1.3 Dose Conversion Factors

The relocation PAGs are based on dose projections, using the relative contributions from the individual nuclides on the ground to a Dose Conversion Factor (DCF). The DCFs can be used to project dose from any exposure rate, provided the mix of nuclides is the same as that forming the basis of the DCF.

The accident sequence combined with effects of precipitation and wind direction during the release may produce a variety of mixes and patterns of nuclides deposited on the ground. It is important to establish whether the mix is or is not consistent among the various contaminated areas. Each different mix, or situation, requires the development of a specific Dose Conversion Factor (DCF).

To determine the radionuclide mix, a sample of soil or other suitable material from an open area exposed during plume passage is collected and analyzed by high resolution gamma spectroscopy. *In situ* gamma spectroscopy may also be used to establish the nuclide mix. The sample results are reported in terms of activity (pCi).

When the collection of samples for the development of the DCFs extends over several days, the reported nuclide activities are decay corrected to a specific date and time. This permits the definition of a time of reference.

Once the mix of deposited nuclides has been determined, DCFs are then developed using the correction factors given in EPA-400 Table 7-2 "Exposure Rate and Effective Dose Equivalent (Corrected for Radioactive Decay) due to an Initial Concentration of 1pCi/sq.m on Ground Surface", found in Section 6A, Attachment 3. Separate correction factors are given for calculating first year, second year and 50 year DCFs.

To find the exposure rate which corresponds to the relocation PAG, the DCF is divided into the PAG, with a result in terms of mR/hr. This exposure rate represents the outer edge of a Restricted Zone. A procedure for calculation of the DCFs, and exposure rates corresponding to PAGs, is found in the BRP Implementing Procedures.

The DCF used by BRP for the first year dose projection takes into account only the physical half-life of the individual nuclides. DCFs developed at the beginning of the intermediate phase will be reevaluated periodically to verify the effectiveness of removal mechanisms, such as weathering. Projected doses may be revised accordingly, based on results of environmental monitoring.

7.4.2 INTERMEDIATE PHASE PROTECTIVE ACTIONS

Following the completion of emergency phase protective actions and the cessation of significant uncontrolled releases, the location of restricted zones is determined. Restricted zones are those areas with ground deposition equal to or exceeding the relocation PAGs. Restricted zones are not necessarily limited to the 10-mile EPZ.

Potential deposition areas are identified by using the meteorological conditions prevailing during plume release, field monitoring team measurements and data from field team samples. Measurements from aircraft are then used to define the restricted zones, followed by verification from field team ground measurements. A monitoring plan for identification of the restricted zones is found in Section 6B.

Once the radiological characterization is completed, the restricted zones will be enlarged somewhat to allow a buffer zone where enhanced monitoring can be conducted to verify the stability of the deposited material, and to allow for possible migration of the contamination. The combined restricted/buffer zones will be designated so that the outer edges are defined by roads and other features which can facilitate access control.

7.4.2.1 Relocation

In the intermediate phase, protective actions focus on the relocation of the population still residing in the restricted zones. It is important to perform relocation of remaining populations as early as possible, since dose delivery is highest in the early days following release cessation due to the shortlived radioiodine component.

Evacuees from the restricted zones will also be relocated.

7.4.2.2 Controlled Entry

Although full time residence in the restricted zones is not permitted, the zones can be accessed under controlled conditions. Controlled entries may be conducted for protection of valuable property and functions, including law enforcement and fire fighting, securing property, removing property, tending of livestock and control of industrial processes and public utilities.

Controlled entries include the use of access control points, personnel dosimetry, appropriate protective clothing and contamination control practices, along with appropriate record keeping.

Access to the restricted zones is not recommended for pregnant women, except with full advisement of the risk to the fetus. Individuals from the general population accessing the restricted zones are considered to be radiation workers, with an annual occupational limit of 5 rem TEDE. More information on dose limits for radiation workers is found in Section 7.5.

7.4.3 LIFTING OF EMERGENCY PHASE PROTECTIVE ACTIONS

7.4.3.1 Removal of Shelter Restrictions

Sheltering may be used as a precautionary protective action, as protection against a puff release of noble gases, or for protection of special groups or under special conditions.

When shelter is used as a precaution with evacuation never being necessary, the restriction is lifted after an assessment that significant releases requiring further protective actions are not likely.

When shelter is used as protection against a puff release known to consist of noble gases, the restriction is lifted after an assessment that significant releases requiring further protective actions are not likely.

When shelter is used as protection of special groups or under special conditions, and the accident sequence involved release of substantial iodines/particulates, the relocation PAGs are used to determine the need for relocation of the special groups and individuals in special conditions.

7.4.3.2 Return of Evacuees

Controlled return of evacuees to unrestricted zones is conducted in a tiered manner, following verification of the boundaries of the restricted zones. Unrestricted zones are those areas outside the restricted zones. Since unrestricted zones may include contaminated areas, ingestion pathway controls can be in operation in these zones.

Based only on exposure criteria, the first tier of evacuees may return to areas not visited by the plume, and areas near normal background levels (not in excess of twice the normal background in the area before the incident). Natural background in Pennsylvania is generally between 6 and 12 microRoentgen per hour (uR/hr), with some areas considerably higher. For the purpose of this plan, and to facilitate timely return, the first tier of evacuees may return to areas less than 25 uR/hr (0.025 mR/hr).

This first tier area is determined using a combination of knowledge of the accident sequence, meteorological conditions during the release, field team sample data, routine monitoring sample data, and post accident field measurements. This first tier area will be reduced, as necessary, to fit recognizable land features.

The second tier includes those areas with ambient gamma levels from 25 uR/hr to the edge of the restricted zones. Depending on the incident, the ambient gamma level for the edge of the restricted zones will be in the range of 500 - 1000 uR/hr.

This second tier area, which is the balance of the unrestricted zone, is returned to unrestricted use following aerial monitoring with ground verification, and establishment of a monitoring program for verification of dose projections.

The return of any evacuees is preceded by the restoration of services for public health and safety in the area. These include water and sewage treatment systems, public utilities, transportation resources, and police and fire protection.

7.4.4 SURFACE CONTAMINATION CONTROL

This section considers contamination criteria for skin and other surfaces. These criteria assume that the monitoring station doing the evaluation is located in a low background area (background should not exceed 60 cpm if using a CDV-700 or 100 cpm if using an instrument with a pancake detector). The instrument used for the measurement is assumed to be equipped with a thin window (30 mg/sq cm or less) geiger-mueller probe. (A pancake type probe is preferred, if available.) The surface to detector window distance is assumed to be one inch. (Exception: When using a CDV-700 with a side window detector to monitor personnel, the surface to detector window distance is assumed to be one-half inch.) All measurements are "open window". Values used in this plan are taken from PEMA Emergency Management Guidance and Information Circular, "Contamination Monitoring and Decontamination Guidance for Radiological Emergency Response", (No.: C2004-2 or current version).

7.4.4.1 Unconditional Release

The criterion for unconditional release is a count rate of 300 cpm or less when using a CDV-700, or 300 cpm above background or less when using a pancake detector. Any surface which can be made to meet this value, without decontamination or following decontamination, may be released. This criterion applies to persons, animals, vehicles, equipment, and any surface material.

Some decontamination methods for selected materials are listed below:

<u>Material</u>	<u>Decontamination Method</u>
Skin	Flush with water, followed by soap and water, with scrubbing if required.
Clothing	Normal laundering
Smooth Washable Surfaces	Flush with water, followed by soap and water, with scrubbing if required.
Porous Surfaces	Lint removal devices

Waste water from decontamination efforts should be disposed of in the normal way. Solid wastes generated should be bagged and labeled for disposal.

When residual skin contamination cannot be reduced to less than the 300 cpm criterion, individual should be sent to an MS-1 hospital for special evaluation.

7.4.4.2 Release of Animals, Vehicles and Equipment

Following a full decontamination effort, animals and equipment which exceed the unconditional release criterion may be released for unrestricted use if the remaining

contamination is less than 1000 cpm at one inch when using a CDV-700 probe, or 1000 cpm above background at one inch when using a pancake detector. A full decontamination effort assures that the remaining contamination is fixed and will not pose a public health hazard.

When residual contamination on animals, vehicles and equipment cannot be reduced to less than the 1000 cpm criterion, the case is evaluated by the FRMAC.

7.5 EMERGENCY WORKERS

Emergency Workers include several groups of individuals. The most obvious group includes those whose role is protecting public health and safety by facilitating protective actions on behalf of the public. These roles include route alerting, traffic control, county EOC operations, field team monitoring, and evacuation transportation services.

Another group of emergency workers includes those attending to the needs of special groups, for example, hospital and nursing home staff and corrections officials.

Another group includes those whose work is to minimize the loss of valuable functions and property, for example, firefighting, law enforcement, care of livestock, certain industrial controls, and assurance of communications services and public utilities.

For this plan, emergency workers are assumed to be non-pregnant adults.

7.5.1 EMERGENCY WORKER WHOLE BODY DOSE LIMITS

Emergency worker whole body exposure is controlled by dose limits which are retrospective. This means that exposure may continue until a measured dose, or dose limit, is reached. This contrasts with the concept of PAGs, which are based on projected doses beginning from a specific time and extending to a future time.

Emergency worker dose limits used in this plan are taken without modification from EPA-400 Table 2-2 "Guidance on Dose Limits for Workers Performing Emergency Services".

One exception to retrospective dose limits is dose estimation for planned actions by emergency workers.

7.5.1.1 Emergency Phase Dose Limits

The emergency phase dose limits include all radiation dose incurred by an individual as a result of the incident during the emergency phase.

Radiation doses received by emergency workers during the emergency phase are considered to be once-in-a-lifetime doses. These doses are separate and distinct from exposures received during subsequent incident phases, or from the ingestion pathway.

The Emergency Worker Dose Limit is 5 rem TEDE for the emergency phase. As Low As Reasonably Achievable (ALARA) principles apply.

Some situations during the emergency phase may justify higher limits for emergency workers. These include conditions which prevent the rotation of workers, such as fast moving incidents where the need to facilitate an evacuation is urgent. Other examples are the protection of valuable property, such as livestock, or lifesaving activities.

The Emergency Worker Dose Limit for the protection of valuable property, valuable functions and care of special groups is 10 rem TEDE for the emergency phase. This value applies only when lower doses are not achievable through rotation of workers or other dose reduction methods.

The Emergency Worker Dose Limit for lifesaving or the protection of large populations is 25 rem TEDE. When the condition is the protection of large populations, the collective dose avoided by the large population must be significantly larger than the collective dose incurred by the emergency workers involved.

The dose to emergency workers may exceed 25 rem TEDE under certain conditions. These conditions include lifesaving or the avoidance of extensive exposure of large populations. In this condition, the emergency worker shall be a volunteer with full awareness of the risks of acute and late effects of the dose.

The CDE to any organ shall not exceed 10 times the corresponding TEDE.

7.5.1.2 Intermediate and Recovery Phase Dose Limits

EPA-400 dose limits for the control of emergency worker exposure no longer apply at the end of the emergency phase with the completion of protective action implementation. During the Intermediate and Recovery Phases, all workers associated with response activities become radiation workers, in accordance with 10CFR20.

Radiation workers have an annual occupational exposure limit of 5 rem TEDE.

7.5.2 EMERGENCY WORKER EXPOSURE CONTROL

7.5.2.1 Emergency Worker Dosimetry

Since emergency worker exposure is controlled retrospectively, some means of active monitoring is required. Monitoring of external exposure from the plume and ground deposition (EDE) is effected through the use of direct reading dosimeters (DRDs) and thermoluminescent dosimeters (TLDs). The internal exposure from inhalation (CEDE) cannot be measured with a direct reading dosimeter or a TLD.

Adjustment or correction of DRD readings to account for internal exposure from inhalation (CEDE) is not necessary in situations where the plume is absent from the point of interest, or the plume contains no iodines or particulates.

However, in situations where the internal exposure from inhalation is significant (CEDE > 10 % of the TEDE), the exposure measured by the dosimeters will under-report the total whole body exposure. For these situations, DRD readings must be corrected by a ratio calculated from dose projections provided by the utility, or measurements of the radionuclide mix in the plume. For these situations, this will be accomplished as follows:

Until evacuation of the general public is complete, the monitoring and control of emergency worker dose will be based only on the gamma radiation exposure as measured by a direct reading dosimeter without regard to additional dose that may be received from inhalation. Emergency workers entering the plume after evacuation of the general public has been completed will be assigned a predetermined administrative dose limit, stated in terms of external radiation dose only, that is lower than the maximum TEDE dose recommended by the EPA for the class of emergency response activity to be performed. The TEDE calculation for emergency workers who have taken KI will not include the contribution from thyroid dose due to the inhalation of radioiodine, as that contribution will be minimal if KI is administered prior to exposure. The lower administrative dose limit will account for: (1.) radiation dose already received by workers; and, (2.) the calculated ratio of external dose to the TEDE. The basis of this calculated ratio will be dose projections provided by the licensee; or measurements of the radionuclide mix in the plume. The licensee is responsible for determining the calculated ratio, and providing it to BRP.

Using the calculated ratio, BRP will determine the appropriate DRD reading that corresponds to the maximum TEDE dose recommended by the EPA for the class of emergency response activity to be performed. BRP will communicate the calculated ratio and the maximum TEDE dose recommended by the EPA for the class of emergency response activity to be performed to PEMA. PEMA will disseminate this information to the emergency workers in the affected areas.

7.6 RECOVERY PHASE

The recovery phase begins with efforts to reduce offsite contamination to acceptable levels for unrestricted use. It continues through the completion of all offsite recovery operations.

This phase applies only to incidents with releases of long-lived nuclides (half-life > 1 year) to offsite areas sufficient to require relocation. Certain accident conditions may release short-lived nuclides, such as radioiodines and tellurium, in sufficient quantity to drive relocation. However, in light of the short half-lives involved, recovery is effected by radioactive decay.

The dominant mode of exposure in the recovery phase is ground shine from surface deposition, with some contribution from inhalation of resuspended surface contamination.

At the start of the recovery phase, the edges of the Restricted Zones have been identified and secured. The major considerations in this phase are the operation of a long-term surveillance program to verify the control of exposure to the general population, and systematic decontamination of affected areas.

7.6.1 RECOVERY PHASE ORGANIZATION

Entry into the recovery phase will require a reorganization of the BRP response activities for the long term. FRMAC operations will continue for some time following the start of the recovery phase, but cannot be expected to last indefinitely. Similarly, attention must return to other BRP responsibilities.

The proposed organization consists of individual BRP staff or small working groups focusing on specific aspects of the recovery operation. The individuals and/or work group will be directed by the Radiological Assessment Manager. The individual or the leader of the work group assigned to address each specific issue is expected to be the BRP authority on that issue. The complexity of recovery operations will require considerable interaction between work groups and with BRP management.

The focus on specific recovery issues should begin as early as possible in FRMAC operations, and continue through the completion of the recovery phase. Considerable FRMAC support will be needed for the design and start-up of these activities. These operations will be most intense in the early weeks to months of the recovery phase.

Following is a listing of specific recovery issues to be addressed:

Emergency Worker Dosimetry

This focus addresses the compilation, evaluation and storage of emergency worker dosimetry data and invivo bioassay data. This focus will require the most effort beginning at the completion of emergency phase protective actions. Included is the design and implementation of the dosimetry program for emergency workers operating in the capacity of radiation workers after the emergency phase. In addition, this focus evaluates the exposure aspects of emergency workers who need to access the Restricted Zones for real emergencies. This activity will require considerable interaction with the affected counties and municipalities.

Restricted Zone Control

This focus addresses all aspects of controlled access to the Restricted Zones by individuals in the general population. This includes health physics coverage of the access control points, monitoring of property removed from the Restricted Zones, and personnel dosimetry for individuals to be admitted to the Restricted Zones. This focus will require the most attention in the early weeks of the recovery and will require considerable interaction with individuals in the general population.

Long-Term Environmental Monitoring

This focus addresses the design and operation of the long-term environmental monitoring program to characterize the deposition, taking into account the changes in the mix and configuration of contaminants acted on by radioactive decay and weathering. Included is evaluation of data from aerial surveillance, ground probing and the routine monitoring program. This focus determines when the boundaries of Restricted Zones are to be moved. It evaluates the data to determine the TEDE to individuals in the area and periodically reevaluates dose projections for the Restricted Zones. It also compiles the monitoring results into periodic reports.

Agriculture

This focus attends to all issues involving the ingestion pathways. These include imposition and removal of agricultural embargoes, disposition of contaminated farm animals, guidance to farmers and food processors, contamination of surface water supplies, home gardeners, and hunting and fishing considerations. This activity will require considerable interactions with the PA Department of Agriculture, the PA Fish and Boat Commission, and the PA Game Commission.

Remediation

This focus begins with the development of detailed decontamination criteria. It follows the progress of the decontamination efforts through to their completion. This activity will require considerable interaction with the decon community, and with the contracting agencies.

Population Dose Assessment

This focus compiles the environmental data from the emergency phase, emergency worker dosimetry data and in vivo bioassay data, and develops the population dose assessment report. Heavy dependence is placed on the FRMAC for report generation.

7.6.2 RECOVERY PHASE PAGs

Separate protective action guides for the Recovery Phase have not been developed. (EPA-400 holds the chapter for discussion of Recovery Phase PAGs in reserve). In the interim, it would appear reasonable to extend the dose considerations from the Intermediate Phase to the Recovery Phase.

7.6.2.1 Whole Body PAGs

The PAGs continue to use the TEDE concept, with TEDE being the sum of the external exposure from ground deposition (EDE) and the internal exposure from inhaled resuspended nuclides (CEDE).

The PAGs for the recovery phase are a continuation of the intermediate phase PAGs, i.e. a **projected dose of 0.5 rem TEDE in the first year and in the second year, and a total of 5 rem TEDE over the period of 0 to 50 years.**

The dominant nuclides remaining after the second year will be Cs-137, Cs-134, and Sr-90. For the long term the major contributors to external exposure (EDE) will be Cs-134 and Cs-137. Inhalation exposure (CEDE) is evaluated with special attention to Sr-90.

7.6.2.2 Thyroid PAG

A separate PAG for thyroid from inhalation is not considered for this phase since uncontrolled releases will have ceased and resuspension of deposited iodines will not be sufficient to drive a thyroid PAG from inhalation. This position will be verified through environmental monitoring.

7.6.3 RECOVERY PHASE PROTECTIVE ACTIONS

The major considerations in this phase are the operation of a long term monitoring program to verify the control of exposure of the general population, and the systematic decontamination of the area.

7.6.3.1 Controlled Entry

The continuing protective action for the recovery phase is restricted access to the Restricted Zones through the use of controlled entry, along with monitoring of missions within the zones.

Access to the Restricted Zone is not recommended for pregnant women, due to the risk to the fetus. A description of considerations for controlled entry is found in Section 7.4.2.2.

7.6.3.2 Long-Term Environmental Monitoring

Weathering and radioactive decay will change the size and configuration of the Restricted Zones, even without deliberate intervention. Decontamination efforts will further change the size and shape of the Restricted Zones. Environmental monitoring will be necessary to follow the changes and reevaluate the Restricted Zones as these forces act on the deposition.

Long-term environmental monitoring should pay special attention to low-lying areas which may accumulate contaminants from elsewhere. Attention should also focus on areas with soil having a high ion exchange capacity which may hold cesium depositions tenaciously. Since weathering moves ground deposition into waterways, special attention should be paid to radioactivity accumulations in stream bottom silt, food fish, and the aquatic food chain.

The mix and abundance of the deposited nuclides is expected to change with time, due to radioactive decay. This requires periodic reevaluation of the Dose Conversion Factors (DCF) used to interpret external exposure rates and projected doses for comparison with the PAGs.

Monitoring of air particulate activity will be needed to evaluate the inhalation component (CEDE) in the TEDE, with special attention to the strontiums.

The issuance of TLDs to a selected portion of the general population may be considered as a supplement to the long term monitoring program as a measurement of external exposure (EDE).

7.6.3.3 Decontamination

The basic objective in the recovery phase is the restoration of the Restricted Zones to normal unrestricted use. The nuclide of interest in the decontamination is the gamma emitter, Cs-137. Decontamination efforts to remove this source of ground shine are expected to remove other long lived radionuclides, such as Sr-90.

Decontamination Criteria

The proposed criterion for Cs-137 decontamination of non-agricultural land is the reduction of exposure rates to 500 millirem in the first year after decon. This value is the same as the Relocation PAG. Since decontamination efforts will be concentrated in the first several years post-incident, the annual dose in the following years will decline over the balance of the 50 year interval due to radioactive decay and weathering. The total TEDE over 50 years will be less than 5 rem.

Decontamination Priorities

The first set of priorities for decontamination is the restoration of transportation routes and facilities, and facilities related to public health and safety. Transportation routes include rights of way through Restricted Zones, and roads to health and safety related facilities within the Restricted Zones. Transportation facilities include gas stations, air and rail terminals, and freight terminals. Health and safety related facilities include hospitals and clinics, fire stations, police stations, and water and waste treatment plants.

The second set of priorities for decontamination is the restoration of facilities customary in normal life, including major employment facilities, schools, food stores, and other retail establishments. Also included in this priority is decon of the roads needed to access these facilities.

The third set of priorities is the restoration of private residences. Residential restoration is the last priority because of the necessity to first provide services for public health and safety, and general infrastructure to accommodate the population.

Unrestricted Zone Decontamination

The area outside the Restricted Zones will be available for unrestricted use. However, the Unrestricted Zone will include areas contaminated to some extent. People living in these contaminated areas will be able to reduce their exposure through the use of simple decontamination processes. These processes include good personal hygiene, careful food preparation, the avoidance of activities which generate dust, and the hosing down of roofs and paved areas around the house.

Development of criteria for the discontinuation of these activities is tasked to the FRMAC.

7.6.4 POST INCIDENT DOSE ASSESSMENT

Post incident dose assessment includes both evaluation of the effectiveness of protective actions for the offsite populations during the emergency and intermediate phases (avoided dose), and calculation of the actual dose received. Exposure of emergency workers and the effectiveness of KI administration is also evaluated.

Considerable federal support will be required for this dose assessment. The evaluation of all data considered in the dose assessment and its systematic retention is tasked to the FRMAC, as well as the development of a Population Dose Assessment Report.

Methods of post incident dose assessment include environmental measurements, emergency worker dosimetry and bioassay.

7.6.4.1 Environmental Measurements

This assessment evaluates all field monitoring team data and environmental sampling data generated by the licensee, BRP, and federal agency personnel. It will also use data from existing routine environmental monitoring programs operated by the licensee, BRP, and NRC. Computer modeling outputs from dose projection efforts may also be included.

7.6.4.2 Emergency Worker Dosimetry

This assessment evaluates the results of all emergency worker TLDs and direct-reading dosimeters, and attempts to reconcile direct-reading dosimeters versus TLD data for the workers. TLD results will also be used to determine the effectiveness of emergency worker dose limits in effect during the emergency phase.

7.6.4.3 Bioassay

In vivo bioassay using thyroid counting or whole body counting can be used for post accident dose assessment. The purpose of *in vivo* bioassay for individuals in the general public is the reconciliation of environmental data with actual uptake. The purpose of *in vivo* bioassay for emergency workers and special groups is the demonstration of efficacy of the use of KI. The following criteria apply to the decision to request *in vivo* bioassay through the FRMAC:

Thyroid Counting Criteria (General Public and Special Groups)

The criteria for requesting thyroid counting capability from the FRMAC for the general public and special groups include the Declaration of General Emergency, the actual implementation of protective actions against plume exposure, and actual offsite exposure to a plume containing radioiodine.

If the request for thyroid counting can be met, a suitable sample of individuals in the general public and special groups who were actually exposed to the plume will be requested to volunteer for thyroid counting.

Thyroid Counting Criteria (Emergency Workers)

The criterion for requesting thyroid counting capability from the FRMAC for emergency workers include the Declaration of General Emergency, the actual implementation of protective actions against plume exposure, and actual offsite exposure to a plume containing radioiodine.

If the request can be met, all emergency workers who were actually in the plume will be given the opportunity to have a thyroid count.

Whole Body Counting Criteria

The criterion for a FRMAC request for whole body counting is the occurrence of an accident resulting in the actual release of particulate activity to the atmosphere sufficient to amount to a CEDE of 0.5 rem in offsite areas by plume inhalation.

If the request for whole body counting can be met by the FRMAC, a suitable sample of individuals in the general public and emergency workers and special groups will be offered whole body counting.

7.6.4.4 Confidentiality and Record Retention

All data representing individual radiation exposure is considered to be personal health information, accessible only by the individual and his/her personal physician.

All data representing individual radiation exposure shall be retained by BRP for a period of 30 years.

8.0 INGESTION PATHWAY

The Emergency Planning Zone (EPZ) for the ingestion pathway extends to a radius of 50 miles through 360 degrees from a nuclear power plant. Major potential pathways for ingestion include fresh fluid milk and other food commodities (especially those consumed fresh, such as leafy vegetables and fruit), and public water supply systems using surface water.

This section summarizes the protective action guidance and appropriate protective actions for each major ingestion pathway. Criteria are established for initiation of ingestion protective actions.

Dose commitment resulting from the ingestion pathway is separate and distinct from doses received in other incident phases.

8.1 MILK AND FOOD

8.1.1 MILK AND FOOD PROTECTIVE ACTION GUIDES (PAGs)

The PAGs used for milk and food were developed by HHS/FDA, and published as Accidental Radioactive Contamination of Human Food and Animal Feeds: Recommendations For State And Local Agencies by FDA on August 13, 1998 (FDA 1998). These values are intended to include both the milk and food components of the diet, and represent the dose commitment from ingestion over the entire episode.

FDA guidance is described below.

8.1.1.1 Ingestion Protective Action Guides (PAGs)

A Protective Action Guide is the committed effective dose equivalent (CEDE) or committed dose equivalent (CDE) to an individual tissue or organ that warrants protective action following a release of radionuclides.

The Ingestion Pathway PAGs are:

0.5 rem (5 mSv) committed effective dose equivalent (CEDE),

-or-

5.0 rem (50 mSv) committed dose equivalent (CDE) to an individual tissue or organ, whichever is most limiting.

8.1.1.2 Derived Intervention Levels (DILs)

A Derived Intervention Level (DIL) corresponds to the radionuclide concentration in food present throughout the relevant period of time that, in the absence of any intervention, could lead to an individual receiving a radiation dose equal to the most limiting PAG. The Derived Intervention Levels are found in Figure 8-1. This figure is taken from the FDA guidance. Implementation and use of the DILs for nuclear reactor accidents (and other large scale nuclear events) is described in BRP implementing procedures.

DILs for specific radionuclides have been calculated by FDA taking into account the assumed annual dietary intake by critical segments of the population, the fraction of the food intake assumed to be contaminated, and related factors. DILs for specific radionuclides are calculated using the following equation:

$$\text{DIL (Bq/kg)} = \frac{\text{PAG (mSv)}}{f \times \text{Food Intake (kg)} \times \text{DC (mSv/Bq)}}$$

Where:

DIL = Derived Intervention Level

PAG = Protective Action Guide

DC = Dose coefficient

Food Intake = Quantity of food consumed in an appropriate period of time

f = Fraction of food intake assumed to be contaminated

NOTE: In the FDA 1998 guidance, the SI units are used. Traditional units (such as uCi and rem) can be substituted, with appropriate conversion factors employed.

For each radionuclide of concern, DILs were calculated for six age groups using Protective Action Guides, dose coefficients, and dietary intakes relevant to each radionuclide and age group. The age groups included 3 months, 1 year, 5 years, 10 years, 15 years, and adult (>17 years). The dose coefficients used were from ICRP Publication 56 (ICRP 1989). The DILs were based on the entire diet for each age group, not for individual foods or food groups. The calculation presumed that contamination would occur in thirty percent of the dietary intake. (The expectation was that normally less than ten percent of the annual dietary intake of most members of the population would consist of contaminated food. This ten percent value was then adjusted by a factor of three to account for limited sub-populations that might be more dependent on local food supplies.) An exception was made for I-131 in the diets of the 3-month and 1-year age groups, where the entire intake was assumed to be contaminated. The most limiting of the six age group DILs for the most limiting of the applicable PAGs was selected to be the DIL for that radionuclide. The radionuclides of concern were then classed into radionuclide groups, each having common characteristics (see Figure 8-1).

The FDA DILs provided a large margin of safety for the public because each DIL is set according to a conservatively safe scenario for the most vulnerable group of individuals. In addition, protective action would be taken if radionuclide concentrations were to reach or exceed a DIL at any point in time, even though such concentrations would need to be sustained throughout the relevant extended period of time for the radiation dose to actually reach the PAG. In practice, when FDA DILs are used, radiation doses to the vast majority of the affected public would be very small fractions of the PAG.

For a particular food, the individual radionuclide DILs are to be applied independently. DIL fraction contributions for individual radionuclide groups in a food are not added together. DILs for individual radionuclide groups are based on different critical organs, different critical age groups, and different ingestion characteristics (e.g., length of exposure, fraction of intake assumed contaminated).

Food with concentrations of radionuclides below the DILs is permitted to move in commerce without restriction. Food with concentrations at or above the DILs is not normally permitted into commerce. However, State and local officials have the flexibility

in whether or not to apply restrictions in special circumstances, such as permitting use of food by a population group with a unique dependency on certain food types.

The recommended DILs are for radionuclides expected to deliver the major portion of the radiation dose from ingestion during the first year following an accident.

The principal radionuclides for which DILs were developed for a nuclear reactor accident are: I-131; Cs-134 + Cs-137; Ru-103 + Ru-106.

(NOTE: For a spent fuel accident, the principal radionuclides are: Sr-90; Cs-137; Pu-239 + Am-241.)

The recommended DILs may be applied immediately following an accident. Early identification of other radionuclides that may be present in food is not required. However, the recommended DILs should be evaluated as soon as possible after an accident to ensure that they are appropriate for the situation.

The DILs as stated in FDA 1998 are applicable to foods as prepared for consumption (see Note (b) in Figure 8-1). However, in the interest of protecting the population and in keeping with the existing institutional conservatism in radiation protection, in Pennsylvania the DILs will be applied at whatever point in the production, processing, distribution, or preparation process the sample is taken.

The limiting age groups for the radionuclide DILs listed in Figure 8-1 are:

<u>Radionuclide</u>	<u>Limiting Age Group</u>
Sr-90	15 years
I-131	1 year
Cs group	Adult
Ru-103	3 months
Ru-106	3 months
Pu + Am group	3 months

FIGURE 8-1

Recommended Derived Intervention Level (DIL)
 or Criterion for each Radionuclide Group (Notes a, b)

All Components of the Diet

<u>Radionuclide Group</u>	<u>(Bq/kg)</u>	<u>(pCi/kg)</u>
Sr-90	160	4300
I-131	170	4600
Cs-134 + Cs-137	1200	32,000
Pu-238 + Pu-239 + Am-241	2	54
Ru-103 + Ru-106 (Note c)	$\frac{C-3}{6800} + \frac{C-6}{450} < 1$	$\frac{C-3}{180,000} + \frac{C-6}{12,000} < 1$

Notes:

- (a) The DIL for each radionuclide group (except for Ru-103 + Ru-106) is applied independently (see discussion in FDA 1998, Appendix D). Each DIL applies to the sum of the concentrations of the radionuclides in the group at the time of measurement.
- (b) Applicable to foods as prepared for consumption. For dried or concentrated products such as powdered milk or concentrated juices, adjust by a factor appropriate to reconstitution, and assume reconstitution water is not contaminated. For spices, which are consumed in very small quantities, use a dilution factor of 10.
- (c) Due to the large difference in DILs for Ru-103 and Ru-106, the individual concentrations of Ru-103 and Ru-106 are divided by their respective DILs and then summed. The sum must be less than one. C-3 and C-6 are the concentrations, at the time of measurement, for Ru-103 and Ru-106, respectively (see discussion in FDA 1998, Appendix D).

Reference: FDA 1998.

8.1.2 FRESH FLUID MILK

Although a number of radionuclides can be released to the atmosphere during an incident, only a few are biologically significant in the milk pathway. These include isotopes of iodine; and the potassium congeners, the isotopes of cesium.

Much attention is placed on the protection of fresh fluid milk. The bases for this concern include:

- The pasture-cow-milk-child thyroid pathway is very sensitive to transport of radioiodines. For example, a plume capable of delivering one rem to a child thyroid by inhalation will deliver up to several hundred rem to a child thyroid through ingestion of milk produced by cows grazing on a pasture visited by the plume. This is known as an amplification effect.
- Milk makes up a significant part of the diet of infants and young children.
- The physical and chemical properties of radioiodines tend to make these contaminants more available to the environment than solid nuclides.
- Due to the amplification effect, areas requiring protection of the milk supply may not require protective actions against direct plume exposure. Also, areas requiring protection of the milk supply may be significantly larger than those requiring protective action against direct plume exposure. This is the basis for the Ingestion Planning Zone having a 50 mile radius.
- The population at risk through milk consumption is usually larger than that at risk from direct plume exposure.
- The time between harvest and marketing of milk is several days, allowing little time for removal of Iodine-131 by radioactive decay.

8.1.2.1 Factors Influencing Milk Contamination

The degree of contamination depends on several factors:

- The quantity of radioiodines, particularly I-131, actually released to the atmosphere is a major component for milk contamination. Other iodines

(I-132, I-133, I-134 and I-135) are included in inhalation dose projections but will not significantly contribute to milk contamination, due to their relatively short half-lives. (Assuming equivalent deposition, the intake of I-133 via milk is about 2% of the I-131 intake.)

- Farming practices will affect milk contamination. Dairy animals subsisting greatly on contaminated pasture will produce higher concentrations than similar animals at the same location subsisting on stored feed.
- The occurrence of precipitation during plume passage will increase iodine deposition on pasture due to atmospheric scrubbing.
- For a given pasture contaminated with radioiodines, pastured goats will produce significantly higher milk concentrations than will pastured cows.
- Radionuclides other than iodines may be released to the atmosphere during severe incidents, including isotopes of cesium (Cs-134 and Cs-137), isotopes strontium (Sr-89 and Sr-90), isotopes of ruthenium (Ru-103 and Ru-106), and the iodine precursor, Tellurium-132. For severe incidents, however, protective actions against I-131 contamination in milk will protect the pathway from the other contaminants. An exception to this may be severe accidents involving spent fuel, since the radioiodine in the spent fuel will have decayed to low levels.
- Assuming a one shot deposition, the maximum concentration of iodines in milk will occur in 2 to 4 days; the maximum concentration of cesium in 6 to 8 days.

8.1.2.2 Fresh Fluid Milk Protective Actions

Protective actions for fresh fluid milk will be discussed under two headings: (a.) Protective Actions for Milk Prior to Confirmation of Contamination; and, (b.) Protective Actions for Milk Confirmed to be Contaminated.

8.1.2.2.1 Protective Action for Milk Prior to Confirmation of Contamination

Protective actions which can be taken for fresh fluid milk prior to confirmation of contamination consist of:

- Simple precautionary actions to avoid or reduce the potential for contamination of milk (by moving dairy animals to shelter and

providing protected feed and water), and

- Temporary embargoes to prevent the introduction into commerce of milk which is likely to be contaminated.

Protective actions can be taken before the release or arrival of contamination if there is advance knowledge that radionuclides may accidentally contaminate the environment.

8.1.2.2.1.1 Moving Dairy Animals to Shelter and Providing Protected Feed and Water

The protective action policy in this plan for milk is early intervention to reduce or entirely avoid contamination of fresh fluid milk. This is accomplished by moving dairy animals from pasture to shelter and providing protected feed and water.

In Pennsylvania, the pasturing season runs from May through October, during which time removal from pasture is an important protective action option. However, half of the dairy farms are year-round feed lot operations, where pasturing is not a significant part of the regimen and where sheltering animals and providing them with protected feed and water may become a moot point.

This option is most effective when the action is completed before the actual deposition of iodines on pasturage. Some iodine may be detectable in milk even with the implementation of this option, due to cattle uptake by inhalation. This may amount to a few percent of what would have been seen if pasturing continued.

The viability of this option will depend on the availability of stored feed. Silage is at low ebb in late spring before the first mowing.

The major objective in moving dairy animals to shelter and providing them with protected feed and water is achieving the greatest protection against actual contamination of the product. This requires the timely development of a PAR. The PAR for moving dairy animals to shelter and providing them with protected feed and water will generally be based on dose projections and plant conditions. Field team sample results for airborne iodine may contribute to the decision, but are not required for PAR development.

Moving dairy animals from pasture to shelter and providing them with protected feed and water, to a distance of 10 miles, is indicated when:

**Projected child thyroid CDE from I-131 by inhalation
exceeds one mrem (0.01 mSv) in one hour,**

OR

**Declaration of General Emergency (or Site Area Emergency,
at the discretion of the BRP Radiological Assessment Director).**

Moving dairy animals from pasture to shelter and providing them with protected feed and water, to a distance of 50 miles, is indicated when:

**Projected child thyroid CDE from I-131 by inhalation
exceeds one mrem (0.01 mSv) in one hour at 10 miles,**

OR

**Accident conditions are such that particulates (such as Cs)
may be released to the atmosphere.**

IMPLEMENTATION OF PROTECTIVE ACTIONS FOR DAIRY ANIMALS WILL BE FOLLOWED BY SAMPLING OF MILK PRODUCERS IN THE PLUME PATH TO THE PAR DISTANCE (10 or 50 miles), AND SAMPLING OF MILK PROCESSORS SUPPLIED BY PRODUCERS WITHIN THE PAR DISTANCE. An initial milk sampling and analysis plan is found in Section 6B.

8.1.2.2.1.2 Temporary Embargo

A temporary embargo of milk prevents the consumption of milk that is likely to be contaminated. Distribution and use of possibly contaminated milk is halted until the situation can be evaluated and monitoring and control actions instituted. Temporary embargoes are applied when the radionuclide concentrations are not yet known. Because there is potential for negative impact on the community, justification for this action must

be significant. The embargo should remain in effect at least until results are obtained. A temporary embargo should be issued only upon declaration of General Emergency AND if predictions of the extent and magnitude of the off-site contamination are persuasive. Implementation of a temporary embargo will be in the plume path to the PAR distance (10 or 50 miles).

Temporary embargoes will originate at the milk producer.

8.1.2.2.2 Protective Actions for Milk Confirmed to be Contaminated

Protective actions which should be implemented when the contamination in milk equals or exceeds the DILs consist of:

- Diversion of Contaminated Milk to Processed Food Products, and
- Temporary embargoes to prevent the contaminated milk from being introduced into commerce.

8.1.2.2.2.1 Diversion of Contaminated Milk to Processed Food Products

Diversion of fresh milk to processed food products may be a protective action option in certain situations where milk concentrations exceed the DILs. It is a viable option only when the contaminant is I-131 or a similarly short-lived nuclide. This protective action uses time as a decontaminating mechanism, through radioactive decay. This option will have limited application since processing capacity for large volumes of milk is not always available. The manufacture of processed foods normally uses about 45% of the milk produced in Pennsylvania.

For this option, certain parameters must be known and certain controls must be used. These include:

- The I-131 concentration in the milk, or an upper concentration limit, must be known to calculate the total time required for I-131 removal by radioactive decay.
- The customary storage time of the processed product must be long enough to allow for I-131 decay.

- The process must be sampled to verify that the I-131 is retained in the product expected to be stored, and not inadvertently directed to another product. For example, in cheese making, iodine is understood to become protein bound. The whey should be uncontaminated and could be used in other products. Sampling is needed to verify that this holds for the particular process used.
- The finished product should be radioassayed to verify radiological acceptability.

8.1.2.2.2 Temporary Embargoes to Prevent Contaminated Milk From Being Introduced Into Commerce

A temporary embargo to prevent the introduction into commerce of contaminated milk should be considered when the amount of contamination equals or exceeds the DILs, or when the presence of contamination is confirmed, but the concentrations are not yet known. The temporary embargo would continue until measurements confirm that concentrations are below the DILs.

For milk concentrations equal to or exceeding the DILs for I-131, condemnation and disposal is the protective action, unless adequate processing and storage for I-131 decay become available.

Deliberate dilution or blending to achieve acceptable concentrations is not an option, because this is a violation of the Federal Food, Drug and Cosmetic Act (FDA 1991). Dilution occurring during customary collection practices is not deliberate.

Consideration of condemnation and disposal will be discussed with PA Department of Agriculture, USDA, and HHS/FDA prior to implementation.

8.1.3 FOOD CROPS

Attention to potential food crop contamination will begin when the projected I-131 air concentration in offsite areas is sufficient to produce a projected child thyroid CDE from I-131 by inhalation exceeding one mrem (0.01 mSv) in one hour. ($3.8E-10$ uCi/cc [$1.4E-5$ Bq/cc] in air, averaged over one hour, produces one millirem (0.01 mSv) projected child thyroid CDE by inhalation.)

8.1.3.1 Factors Influencing Food Crop Contamination

During a reactor incident, food crops can become contaminated by foliar deposition (surface contamination) from airborne iodines and particulates, or by uptake by plant roots from soil contaminated by surface deposition.

The degree of food crop contamination is affected by several factors. Protective action options will depend on the following conditions:

- Incidents releasing no plume at all or a plume consisting only of noble gases will not lead to contamination of surfaces, including crops in the field.
- Incidents which release iodines or particulates, and which occur just before harvest, will have the most impact on contamination of non-root crops by way of foliar deposition.
- Accidents which release iodines or particulates, and which occur between harvest and planting (winter), will not lead to foliar deposition. Contamination of food crops may occur by uptake of dissolved particulates through the plant root system, however, iodines will decay away before the succeeding growing season. Some surface contamination on foliage from particulates is also possible as a result of cultivation of the crop.
- Incidents which release iodines and particulates during the growing season may contaminate different kinds of food crops to varying degrees. Root crops are not directly contaminated by foliar deposition. For above-ground crops and fruit in areas of equal ground deposition, the degree of contamination will depend on the footprint of the crop itself.

8.1.3.2 Food Crop Protective Actions

Protective actions for food crops will be discussed under two headings: (a.) Protective Actions for Food Crops Prior to Confirmation of Contamination; and, (b.) Protective Actions for Food Crops Confirmed to be Contaminated.

For incidents occurring during the growing season, environmental monitoring/sampling will focus on identification of food crop acreage with deposition of I-131 and/or particulates. Food crops from these areas will be sampled and assessed at harvest, before proceeding to market. Evaluation of these food crops is tasked to the FRMAC.

For incidents not during the growing season, environmental monitoring/sampling will focus on identification of food crop acreage with deposition of particulates. Evaluation of future agriculture use of this acreage is tasked to the FRMAC.

8.1.3.2.1 Protective Actions for Food Crops Prior to Confirmation of Contamination

Protective actions which can be taken for food crops prior to confirmation of contamination consist of:

- Temporary embargoes to prevent the introduction into commerce of food crops which are likely to be contaminated.

Protective actions can be taken before the release or arrival of contamination if there is advance knowledge that radionuclides may accidentally contaminate the environment.

8.1.3.2.1.1 Temporary Embargo

A temporary embargo of food crops prevents the consumption of food that is likely to be contaminated. Distribution and use of possibly contaminated food crops is halted until the situation can be evaluated and monitoring and control actions instituted. Temporary embargoes are applied when the radionuclide concentrations are not yet known. Because there is the potential for negative impact on the community, justification for this action must be significant. The embargo should remain in effect at least until results are obtained. A temporary embargo should be issued only upon declaration of General Emergency AND if predictions of the extent and magnitude of the off-site contamination are persuasive. Implementation of a temporary embargo will be in the plume path to the PAR distance for milk protective actions (10 or 50 miles).

Temporary embargoes will originate at the producer.

8.1.3.2.2 Protective Actions for Food Crops Confirmed to be Contaminated

Protective actions which should be implemented when the contamination in food crops equals or exceeds the DILs consist of:

- Normal food production and processing actions that reduce the amount of contamination in or on the food to below the DILs, and
- Temporary embargoes to prevent the contaminated food from being introduced into commerce.

8.1.3.2.2.1 Normal Food Production and Processing Actions That Reduce the Amount of Contamination In or On the Food to Below the DILs

Normal food production and processing procedures that could reduce the amount of radioactive contamination in or on the food crops include:

- Diversion of food crops to processed food products: This may be a protective action option when the only contaminant is I-131 or a similarly short-lived nuclide. This protective action uses time as a decontaminating mechanism, through radioactive decay. Food crops should be sampled prior to processing, with a recommended storage time depending on the decay time needed.
- Holding to allow for radioactive decay: This may be a protective action option when the only contaminant is I-131 or a similarly short-lived nuclide. This protective action uses time as a decontaminating mechanism, through radioactive decay. Food crops should be sampled prior to holding, with a recommended storage time depending on the decay time needed.
- Removal of surface contamination by brushing, washing, or peeling: This mechanical mechanism removes contamination from the surface of the food crop. It is quite effective against contamination from foliar deposition. However, it is not effective against internal contamination which occurs by uptake of dissolved particulate through the plant root system into the plant.

8.1.3.2.2.2 Temporary Embargo

A temporary embargo to prevent the introduction into commerce of food from a contaminated area should be considered when the amount of contamination equals or exceeds the DILs or when the presence of contamination is confirmed, but the concentrations are not yet known. The temporary embargo would continue until measurements confirm that concentrations are below the DILs.

For food crops equal to or exceeding the DILs, evaluation of these crops will be tasked to

the FRMAC. Consideration of condemnation and disposal will be discussed with PA Department of Agriculture, USDA, and HHS/FDA prior to implementation.

Deliberate blending of contaminated food with uncontaminated food to achieve acceptable concentrations is not permitted because this is a violation of the Federal Food, Drug, and Cosmetic Act.

8.1.4 MEAT

In certain incident situations, intake of cesium in meat for adults may exceed the milk pathway dose. Therefore, areas with cesium concentrations in milk approaching the DIL should lead to surveillance and protective actions for meat.

8.1.5 ANIMAL FEEDS

Limits on concentrations of radionuclides permitted in animal feeds are not given in FDA 1998. However, protective actions for animal feeds are included in FDA 1998 as measures to reduce or prevent subsequent contamination of human food.

8.1.5.1 Protective Actions for Animal Feeds Prior to Confirmation of Contamination

Protective actions which can be taken within the area likely to be affected and prior to confirmation of contamination consist of:

- Simple precautionary to avoid or reduce the potential for contamination of animal feeds: These include modest adjustment of normal operations prior to arrival of contamination. Typical precautionary actions include covering exposed products, moving animals to shelter, corralling livestock and providing protected feed and water.
- Temporary embargoes to prevent the introduction into commerce of animal feeds which are likely to be contaminated: Distribution and use of possibly contaminated animal feeds is halted until the situation can be evaluated and monitoring and control actions instituted. Temporary embargoes are applied when the concentrations are not yet known. Because there is potential for negative impact on the community, justification for this action must be

significant. The embargo should remain in effect at least until results are obtained. A temporary embargo on animal feeds should be issued only upon declaration of General Emergency and if predictions of the extent and magnitude of the off-site contamination are persuasive. Implementation of a temporary embargo will be in the plume path to the PAR distance for milk protective actions (10 or 50 miles).

Protective actions which can be taken for animal feeds confirmed to be contaminated:

- Protective actions to reduce the impact of contamination in or on animal feeds, including pasture and water, should be taken on a case-by-case basis. Accurately forecasting the transfer of radioactive contamination through the agricultural pathway, from animal feed to human food, is problematic. The forecast is influenced by many factors, such as: the type of feed (e.g., fresh pasture, grain), other intakes (e.g., other feeds, supplements), the chemical form of the radionuclide, medications being administered, the animal species, and the type of resulting human food (e.g., milk, meat, eggs).
- Protective actions that can be taken when animal feeds are contaminated include the substitution of uncontaminated water for contaminated water and the removal of lactating dairy animals and meat animals from contaminated feeds and pasture with substitution of uncontaminated feed. Corraling livestock in an uncontaminated area could also be effective. Evaluation of contaminated animal feeds and animal feed acreage is tasked to the FRMAC.

8.2 DRINKING WATER

During a reactor incident, surface water may become contaminated as a result of the release of incident-related radwaste from the plant. The release may be controlled, as part of a planned maneuver to protect against greater risks, or uncontrolled, as in the case of the rupture or overflow of a liquid radwaste treatment or storage tank. The water supplies at risk are downstream users of the receiving stream.

Water contamination can also occur due to direct deposition of airborne activity on the surface of supply streams, reservoirs, and other uncovered impoundments during plume passage. Surface water supplies in any direction can be impacted by plume deposition.

Runoff from contaminated land areas to supply streams can also lead to contaminated water supplies.

8.2.1 DRINKING WATER PAG ANALOGUES

Protective Action Guides for drinking water have not been formally promulgated by EPA. Guidance on contamination of drinking water by radioactive material of use with this plan is found in: Appendix B of the EPA National Interim Primary Drinking Water Regulations, EPA-570-9/76-003; and in Chapter 2 of the FEMA Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 -- Water and Non-Dairy Food Pathway, FEMA REP-13, May 1990. (Note: FDA 1998 guidance is currently not applied to drinking water, pending EPA review.)

8.2.1.1 Airborne Releases

For airborne releases which result in direct deposition and runoff from contaminated land, the derived preventive response levels for drinking water in FEMA REP-13, Chapter 2 are used, and are applied to finished drinking water. Both early emergency phase and long-term derived preventive response levels for drinking water are provided. The associated dose commitment at the preventive PAG is 0.5 rem (5 mSv) whole body, bone marrow, and other organs, and 1.5 rem (15 mSv) thyroid.

8.2.1.2 Liquid Releases

For liquid releases into surface water during an emergency, PAG analogues related to Appendix B of EPA-570-9/76-003 are used. These analogues were originally developed during the response to the accident at Three Mile Island.

8.2.1.2.1 Controlled Releases

For controlled liquid releases to surface water during the emergency phase, the EPA Appendix B concentrations, referred to as Maximum Contaminant Levels (MCL), will apply in the finished drinking water. The associated dose commitment to any organ is 4 millirem (0.04 mSv) per year.

8.2.1.2.2 Uncontrolled Releases

In these circumstances, the EPA Appendix B concentrations multiplied by 12 will apply to

finished drinking water. This criterion assumes that uptake time will not exceed one year. The associated dose commitment to any organ is 50 millirem (0.5 mSv).

8.2.1.2.3 Crisis Conditions

When no other source of drinking water is available, and the duration of the uptake is 30 days or less, the concentration in finished drinking water may reach 1,000 times the EPA Appendix B concentrations. The associated dose commitment to any organ is 330 millirem (3.3 mSv).

Procedures for calculating the projected dose commitment from drinking water is found in the BRP Implementing Procedures.

8.2.2 DRINKING WATER PROTECTIVE ACTIONS

For liquid releases of radwaste from the plant, the most appropriate protective action available is curtailment of intake at public drinking waters systems during passage of the contaminated water.

For water contamination from direct deposition or rainwater runoff from contaminated area, protective action options are less straightforward. Protective actions must be developed after characterization of deposition patterns and will take into account the operational features of the water treatment and storage facilities in question.

When contamination concentrations in domestic water supplies exceeds the PAGs, the water may still be useful for other purposes, such as firefighting and sanitation. Uses such as bathing, laundering, decontamination, and certain non-food production industrial uses will require evaluation at the time.

INGESTION PATHWAY DOSE PROJECTIONS

PURPOSE:

The purpose of this procedure is to project dose commitment to members of the general public from all components of the diet, as a result of the release of radioisotopes from a nuclear reactor facility, or other large scale radiological event. Decisions on continued consumption of the various diet components can then be made based on the dose commitment projections.

This procedure uses the results of laboratory analysis of milk, food, and water for projection of the dose commitment from the ingestion pathway.

CONTENTS:

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RADIOLOGICAL ACCIDENT AT NUCLEAR REACTOR SITE	APPENDIX A
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INGESTION PATHWAY DOSE PROJECTIONS

SECTION 1 -- BACKGROUND

In the event of an unplanned release of radioactive material from a nuclear power plant, (or other types of accidents where a significant radiation dose could be received by ingestion) the consequences to individuals in critical populations of the general public from ingesting radioisotopes must be determined.

This procedure determines the dose commitment from ingestion of milk, food, and water contaminated with radioisotopes. Based on the dose commitment calculations, decisions on continued consumption of milk, food, and water can be made.

The Protection Action Guides (PAGs) for Ingestion are:

Milk and Food

0.5 rem (5 mSv) committed effective dose equivalent (CEDE),

or

5.0 rem (50 mSv) committed dose equivalent (CDE) to an individual tissue or organ, whichever is most limiting.

These PAGs are based on the 1998 FDA, Accidental Radioactive Contamination of Human Foods and Animal Feeds: Recommendations for State and Local Agencies

By measuring the radioisotope concentration in milk and food an estimate of the dose commitment can be made. This estimate is made using Derived Intervention Levels (DIL's), which are concentrations of radioisotopes in milk and food, which will give a dose commitment at the Protection Action Guide (PAG) if the milk or food is consumed at the assumed rate for the exposed individual. By design, the computed dose commitments describe the maximum dose commitment expected to be seen in an exposed individual.

Drinking Water

0.5 rem whole body, bone marrow or other organs

or

1.5 rem thyroid

These PAGs are based on FEMA REP-13, 1990, Guidance on Offsite Emergency Radiation Measurement Systems, PHASE 3- Water and Non-Dairy Food Pathway (Note: FDA 1998 guidance is currently not applied to drinking water, pending EPA review.)

By measuring the radioisotope concentration in water, and estimating the quantity of the contaminated item consumed, an estimate of the dose commitment can be made. This estimate is made using Derived Preventive Response Levels (DRL's), which are concentrations of radioisotopes in water, which will give a dose commitment at the Preventive Protection Action Guide (PAG) if the water is consumed at the assumed maximum rate for the maximum exposed individual. By design, the computed dose commitments describe the maximum dose commitment expected to be seen in an exposed individual.

SECTION 2 -- REFERENCES

References: See these documents for a full discussion of ingestion pathway dose commitments --

- a. "Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 Water and Non-Dairy Food Pathways", FEMA REP - 13, May 1990.
- b. "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", EPA 400-R-92-001, EPA, October 1991.
- c. "Accidental Radioactive Contamination of Human Food and Animal Feeds; Recommendations for State and Local Agencies", U.S. Food and Drug Administration, August 13, 1998

SECTION 3 -- GENERAL PROCEDURE

A. For the nature of the radiological accident and the ingestion pathway of concern, select the appropriate Appendix of this procedure.

The Appendixes are:

Appendix A -- RADIOLOGICAL ACCIDENT AT NUCLEAR REACTOR SITE - Estimates the dose commitment to a member of the population from I-131, the Cesium and Ruthenium Groups and additional radioisotopes. The estimates for milk and other foods are calculated using the section A-1. The estimates for water are calculated using section A-2. (Accidents involving spent nuclear fuel stored at a nuclear reactor site are addressed in Appendix B)

Appendix A-1 -- MILK and FOOD: Estimates the fraction of the Derived Intervention Levels (DILs) from the consumption of fluid milk and foods based on the measured radioisotope concentration (in pCi/liter) of fluid milk and (pCi/kg) of food.

Appendix A2 -- DRINKING WATER: Estimates the fraction of the Derived Preventive Response Level (DRL) received by a member of the critical population (infant -- child less than one year old) from consuming contaminated water. The calculation is based on the measured radioisotope concentration (in uCi/liter) of water consumed, and an assumed consumption rate.

Appendix B-- OTHER LARGE SCALE RADIOLOGICAL ACCIDENTS - Estimates the dose commitment to a member of the population from specific long lived radioisotopes expected from these types of accidents. These include accidents at or involving nuclear fuel reprocessing plants, nuclear waste storage facilities, nuclear weapons, radioisotope thermoelectric generators or radioisotope heater units. The isotopes of concern are Sr-90, Cs-137, Am-241, Pu-238 and Pu-239.

B. Follow the procedure outlined in the Appendix to compute the Dose Commitment, Fraction of the Derived Intervention Level (DIL) or Derived Response Level (DRL) received from consuming the contaminated milk, food, or water.

C. Notify the Pennsylvania Department of Agriculture of the results of the calculation for milk and foodstuffs. Notify the DEP Emergency Response Coordinator of the results of the calculation for drinking water.

APPENDIX A -- RADIOLOGICAL ACCIDENT AT NUCLEAR REACTOR SITE

MILK AND FOOD

The PAGs used for MILK and FOOD were developed by HHS/FDA, and are listed in the Reference (c). These values are intended to include both the milk and food components of the diet, and represent the dose commitment from ingestion over the entire episode.

A Protective Action Guide is the committed effective dose equivalent (CEDE) or committed dose equivalent (CDE) to an individual tissue or organ that warrants protective action following a release of radioisotopes.

The Ingestion Pathway PAGs for milk and food are:

0.5 rem (5 mSv) committed effective dose equivalent (CEDE),

-or-

5.0 rem (50 mSv) committed dose equivalent (CDE) to an individual tissue or organ,

whichever is most limiting.

A Derived Intervention Level (DIL) corresponds to the radioisotope concentration in food present throughout the relevant period of time that, in the absence of any intervention, could lead to an individual receiving a radiation dose equal to the most limiting PAG.

DILs for specific radioisotopes have been calculated by FDA taking into account the assumed annual dietary intake by critical segments of the population, the fraction of the food intake assumed to be contaminated, and related factors.

For a particular food, the individual radioisotope DILs are to be applied independently. DIL fraction contributions for individual radioisotope groups in a food are not added together. DILs for individual radioisotope groups are based on different critical organs, different critical age groups, and different ingestion characteristics (e.g., length of exposure, fraction of intake assumed contaminated).

DRINKING WATER

NOTE: Use this procedure for fallout, rainout, or atmospheric deposition. For a liquid release of radioisotopes from a fixed nuclear power plant into the adjacent river, use BRP-ER-6.06, "Estimation of Liquid Release Consequences to Downstream Water Users".

For drinking water, Preventive Protection Action Guides (PAG's) and corresponding Early Emergency Phase and Long-Term Derived Preventive Response Levels (DRL's) for drinking water are published in FEMA REP-13, Reference (a).

For airborne releases which result in direct deposition and runoff from contaminated land, the Derived Preventive Response Levels for drinking water in FEMA REP-13, Chapter 2 are used, and are applied to finished drinking water. For an initial evaluation of drinking water, BRP will use the Long-Term Derived Preventative Response Levels. (If only raw water samples are available, the DRLs may be applied to the raw water in order to evaluate the degree of contamination and the suitability of the water for treatment and consumption.)

For water the radioisotope DRLs are summed for a total DRL, to project the dose commitment due to contaminated drinking water. A Sum Total DRL of > 1.0 will deliver a committed dose above the Preventive Protection Action Guide (PAG).

APPENDIX A-1 -- THE MILK AND FOOD PATHWAY

Protective Action Guides (PAGs) and corresponding Derived Intervention Levels (DIL's) are based on U.S. FDA guidance published in Reference (c). This information is used to estimate the dose commitment to an individual that consumes the milk or food.

NOTE : An individual Attachment A-1 "RADIOLOGICAL ACCIDENT AT NUCLEAR REACTOR SITE FOOD/MILK DIL FRACTION CALCULATION" , must be prepared and maintained for each sample. Special care must be taken to complete the header for each location.

1. Complete header information.

PRINCIPAL RADIOISOTOPES

The recommended DILs may be applied immediately following an accident. Early identification of radioisotopes other than the principal radioisotopes that may be present in food is not required. However, the recommended DILs for the principal radioisotopes should be evaluated as soon as possible after an accident to ensure that they are appropriate for the situation.

2. Obtain radioisotope results from the BRP Laboratory Liaison, or other analytical laboratory. Record results for I-131, Cs-134, Cs-137, Ru-103, Ru-106 in Column 2. Results are to be entered in pCi/kg. (1 Bq = 27 pCi)
(NOTE : For milk, assume 1 liter = 1 kilogram.)
3. Using the formula in Column 3, calculate the DIL Fraction for each Radioisotope group and record in Column 4.

For a particular food, the individual radioisotope DILs are to be applied independently. DIL fraction contributions for individual radioisotope groups in a food are not added together. DILs for individual radioisotope groups are based on different critical organs, different critical age groups, and different ingestion characteristics (e.g., length of exposure, fraction of intake assumed contaminated).

**PROTECTIVE ACTION TO BE INITIATED WHEN ANY RADIOISOTOPE DIL FRACTION ≥ 1
IF ANY DIL FRACTION IS ≥ 1 NOTIFY THE PA DEPARTMENT OF AGRICULTURE
IMMEDIATELY, RECOMMENDING THE ITEM NOT BE CONSUMED**

ADDITIONAL RADIOISOTOPES

4. Laboratory sample results for radioisotopes other than the principal radioisotopes may also be available. If laboratory results for additional radioisotopes are available, they may be entered and evaluated on page 3 of Appendix A-1, when time permits.

APPENDIX A-2 -- THE DRINKING WATER PATHWAY

NOTE: Use this procedure for fallout, rainout, or atmospheric deposition. For a liquid release of radioisotopes from a fixed nuclear power plant into the adjacent river, use DEP/BRP/IP-209, "Estimation of Liquid Release Consequences to Downstream Water Users".

This procedure utilizes Long-Term Derived Preventive Response Levels (DRL's) for Drinking Water (One Year Ingestion Period) based on Preventive Protective Action Guides (PAG's) to assess the consequences of a radiological event which contaminates drinking water. The infant (child less than one year old) is taken to be the critical exposed population for all isotopes. The Derived Preventive Response Levels (DRL's) for Drinking Water (One Year Ingestion Period) are found in Table A2-2, which is taken from Reference (a). The Long-Term levels assume a contaminated water ingestion period equivalent to the shorter time interval of the radioisotope mean lifetime or one year.

NOTE: FEMA REP-13, Reference (b), also provides Early Emergency Phase Derived Preventive Response Levels for Drinking Water (Five Day Ingestion Period). These Early Emergency Phase levels assume a contaminated water ingestion period equivalent to the shorter time interval of the radioisotope mean lifetime or 5 days. The Early Emergency Phase Derived Preventive Response Levels for Drinking Water (Five Day Ingestion Period) are presented for information in Table A2-1, which is taken from Reference (a). These Early Emergency Phase levels may be used in place of the Long-Term levels in this procedure, if desired, to determine the short-term suitability of water for consumption.

It is also noted that the EPA has published the National Interim Primary Drinking Water Regulations, EPA 570/9-76-003. This document also addresses the issue of radioisotope concentrations in drinking water.

The Preventive Protection Action Guides (PAG's) give a dose commitment of 1.5 Rem thyroid or 0.5 Rem whole body, bone marrow or other organs. This procedure calculates the Sum Total of the Fractional DRL's for an exposure to contaminated drinking water. A Sum Total DRL of > 1.0 will deliver a committed dose above the Preventive Protection Action Guide (PAG).

NOTE: An individual Attachment A-2 to DEP/BRP/IP-211, "Drinking Water Activity and Total DRL Fraction" must be prepared and maintained for each sample location. Special care must be taken to complete the header for each location.

1. Complete header information
2. Obtain the radioisotope sample results from the BRP Laboratory Liaison, or other analytical laboratory. Enter the Isotope in Column 1, and the Sample Concentration (in $\mu\text{Ci/liter}$) in Column 2.
3. Obtain the Long-Term Derived Response Levels for Drinking Water for each isotope from Table A2-2. Use the "INFANT" column of Table A2-2. Enter the value in Column 3.
4. Compute the Fractional DRL for each isotope by dividing the value in Column 2 by the value in Column 3. Enter this value in Column 4.
5. Sum the Total DRL values in Column 4.

NOTE: IF THE SUM TOTAL OF THE DRL VALUES IN COLUMN 5 IS > 1.0 , NOTIFY THE DEP EMERGENCY RESPONSE COORDINATOR IMMEDIATELY, RECOMMENDING THAT THE CONTAMINATED WATER NOT BE CONSUMED. NOTIFICATION OF THE PUBLIC WILL BE COORDINATED BY THE DEP BUREAU OF WATER SUPPLY AND COMMUNITY HEALTH.

TABLE A2-1

**Early Emergency Phase
Derived Preventive Response Levels for Drinking Water
(Five Day Ingestion Period)^a**

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci}/\text{liter}$)	Teenager ^d ($\mu\text{Ci}/\text{liter}$)	Child ^d ($\mu\text{Ci}/\text{liter}$)	Infant ^d ($\mu\text{Ci}/\text{liter}$)
I-131	Th	1.2E-1 ^e	1.1E-1	4.5E-2	2.5E-2
I-132	Th	1.2E+1	1.4E+1	4.9E+0	3.5E-1
I-133	Th	2.4E+0	2.6E+0	9.1E-1	5.8E-1
Rb-86	Lv	2.6E+0	5.6E+0	1.9E+0	7.1E-1
Cs-134	Lv	7.4E-1	3.6E-1	1.9E-1	9.4E-1
Cs-136	Lv	2.2E+0	2.4E+0	1.3E+0	9.3E-1
Cs-137	Lv	8.2E-1	4.8E-1	2.2E-1	1.6E+0
Te-127m	Kd	1.8E+0	1.9E+0	8.8E-1	7.8E-1
Te-131m	GI	2.4E+0	3.1E+0	2.9E+0	4.4E+0
Te-132	GI	1.0E+0	1.6E+0	2.5E+0	2.7E+0
Sb-127 ^f	GI	1.1E+0	1.7E+0	2.6E+0	4.8E+0
Sr-89	Bo	4.3E+0	1.7E-1	5.6E-2	5.9E-1
Sr-90	Bo	7.1E-2	8.6E-3	4.2E-3	4.5E-2
Ba-140	GI	1.4E+0	1.9E+0	9.8E-1	7.4E-1
Mo-99	Kd	9.1E+0	9.4E+0	4.6E+0	5.9E+0
Ru-103	GI	2.4E+0	3.5E+0	3.9E+0	6.4E+0
Ru-106	GI	2.8E-1	3.8E-1	3.9E-1	6.1E-1
Rh-105 ^f	GI	1.2E+1	1.8E+1	2.9E+1	5.4E+1
Co-58	GI	3.4E+0	5.5E+0	7.0E+0	1.3E+1
Co-60	GI	1.2E+0	2.0E+0	2.4E+0	4.3E+0
Y-90	GI	4.9E-1	6.3E-1	6.1E-1	9.3E-1
Y-91	GI	6.6E-1	8.9E-1	9.2E-1	1.4E+0
Zr-95	GI	1.7E+0	2.4E+0	2.8+0	4.6E+0
Zr-97	GI	3.4E+0	4.0E+0	3.3E+0	4.9E+0
Nb-95	GI	2.5E+0	3.8E+0	4.6E+0	8.0E+0
La-140	GI	6.1E-1	8.3E-1	8.2E-1	1.3E+0
Ce-141	GI	2.2E+0	3.0E+0	3.0E+0	4.7E+0
Ce-143	GI	4.0E+0	5.1E+0	4.7E+0	7.1E+0
Ce-144	GI	3.0E-1	4.1E-1	4.2E-1	6.5E-1
Pr-143	GI	1.4E+0	1.9E+0	1.9E+0	2.9E+0
Nd-147	GI	1.7E+0	2.2E+0	2.3E+0	3.6E+0
Np-239	GI	4.5E+0	5.8E+0	5.5E+0	8.4E+0
Pu-238 ^f	Bo	7.5E-3	9.9E-3	4.8E-3	6.9E-3
Pu-239 ^f	Bo	6.4E-3	8.4E-3	3.4E-3	5.8E-3
Pu-240 ^f	Bo	6.4E-3	8.4E-3	3.4E-3	5.8E-3
Pu-241 ^f	Bo	3.1E-1	4.0E-1	2.0E-1	2.8E-1
Am-241 ^f	Bo	1.2E-3	2.0E-2	7.8E-4	1.1E-3
Cm-242 ^f	Bo	5.9E-2	7.8E-2	3.8E-2	5.3E-2
Cm-244 ^f	Bo	2.5E-3	3.2E-3	1.6E-3	2.3E-3

TABLE A2-1 (Continued)

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)

a Assumes a contaminated water ingestion period equivalent to the shorter time interval of the radionuclide mean lifetime or 5 days (see Appendix A). Water is ingested at the rates given in Reference 9 for the maximum exposed individual.

b The derived response level for each radionuclide is capable of producing the preventive PAG dose. Therefore, if more than one radionuclide is present in the sample, the sum of ratios technique must be used to estimate the individual radionuclide concentrations that are permissible, e.g.

$$\frac{\text{Conc A}}{\text{Response Level A}} + \dots + \frac{\text{Conc X}}{\text{Response Level X}} = \leq 1.$$

c Th=thyroid, Lv=liver, Kd=kidney, Bo=bone, Wb=whole body, GI=gastro-intestinal tract. These are the critical organs for the corresponding radionuclides.

d Calculated concentrations may vary if calculation assumptions concerning ingestion rates and dose conversion factors are different from those presented in Reference 9.

e $1.2\text{E-1} = 1.2 \times 10^{-1} = 0.12.$

f Adult dose conversion factors (DCF's) were obtained from ICRP-30; 10, 11, 12 dose conversion factors for other age groups were estimated by multiplying these adult DCF's by DCF ratios ($\frac{\text{other age group}}{\text{adult}}$) presented in Reference 9 for other nuclides having similar critical organs and retention times.

TABLE A2-2

Long-Term Derived Preventive Response Levels for Drinking Water^a
(One Year Ingestion Period)

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)
I-131	Th	6.3E-2 ^e	5.7E-2	2.4E-2	1.3E-2
I-132	Th	1.2E+1	1.4E+1	4.9E+0	3.5E-1
I-133	Th	2.4E+0	2.6E+0	9.1E-1	5.8E-1
Rb-86	Lv	6.4E-1	1.4E+0	4.7E-1	1.8E-1
Cs-134	Lv	1.2E-2	5.8E-3	3.0E-3	1.5E-2
Cs-136	Lv	7.6E-1	8.2E-1	4.3E-1	3.2E-1
Cs-137	Lv	1.1E-2	6.6E-3	3.0E-3	2.2E-2
Te-127m	Kd	8.5E-2	8.5E-2	4.0E-2	3.6E-2
Te-129	Kd	4.0E+4	3.1E+4	9.1E+2	5.2E+2
Te-131m	GI	2.4E+0	3.1E+0	2.9E+0	4.4E+0
Te-132	GI	1.0E+0	1.6E+0	2.5E+0	2.7E+0
Sb-127 ^f	GI	9.8E-1	1.5E+0	2.4E+0	4.4E+0
Sr-89	Bo	4.1E-1	1.6E-2	5.3E-3	5.6E-2
Sr-90	Bo	9.9E-4	1.2E-4	5.8E-5	6.2E-4
Ba-140	GI	4.7E-1	6.5E-1	3.4E-1	2.6E-1
Mo-99	Kd	9.1E+0	9.4E+0	4.6E+0	5.9E+0
Ru-103	GI	3.0E-1	4.3E-1	4.9E-1	7.9E-1
Ru-106	GI	5.1E-3	6.9E-3	7.2E-3	1.1E-2
Rh-105 ^f	GI	1.2E+1	1.8E+1	2.9E+1	5.4E+1
Co-58	GI	2.4E-1	3.8E-1	4.9E-1	8.8E-1
Co-60	GI	1.8E-2	2.8E-2	3.6E-2	6.3E-2
Y-90	GI	6.8E-3	8.8E-3	8.5E-3	1.3E-2
Y-91	GI	5.5E-2	7.5E-2	7.7E-2	1.2E-1
Zr-95	GI	1.3E-1	1.9E-1	2.1E-1	3.5E-1
Zr-97	GI	3.4E+0	4.0E+0	3.3E+0	4.9E+0
La-140	GI	2.1E-1	2.9E-1	2.9E-1	4.5E-1
Ce-141	GI	3.2E-1	4.4E-1	4.5E-1	7.0E-1
Ce-143	GI	4.0E+0	5.1E+0	4.7E+0	7.1E+0
Ce-144	GI	5.9E-3	7.9E-3	8.2E-3	1.3E-2
Pr-143	GI	4.6E-1	6.1E-1	6.2E-1	9.6E-1
Nd-147	GI	6.5E-1	8.9E-1	9.1E-1	1.4E+0
Np-239	GI	4.5E+0	5.8E+0	5.5E+0	8.4E+0
Pu-238 ^f	Bo	1.0E-4	1.4E-4	6.5E-5	9.6E-5
Pu-239 ^f	Bo	8.8E-5	1.2E-4	5.4E-5	8.0E-5
Pu-240 ^f	Bo	8.8E-5	1.2E-4	5.4E-5	8.0E-5
Pu-241 ^f	Bo	4.4E-3	5.6E-3	2.8E-3	4.0E-3
Am-241 ^f	Bo	1.7E-5	2.2E-5	1.1E-5	1.5E-5
Cm-242 ^f	Bo	2.1E-3	2.7E-3	1.3E-3	1.8E-3
Cm-244 ^f	Bo	3.5E-5	4.5E-5	2.2E-5	3.2E-5

TABLE A2-2 (Continued)

Nuclide	Organ ^c	Initial Water Concentration Equivalent to the Preventive PAG Ingestion Dose Commitment ^b			
		Adult ^d ($\mu\text{Ci/liter}$)	Teenager ^d ($\mu\text{Ci/liter}$)	Child ^d ($\mu\text{Ci/liter}$)	Infant ^d ($\mu\text{Ci/liter}$)

a Assumes a contaminated water ingestion period equivalent to the shorter time interval of the radionuclide mean lifetime or 365 days (see Appendix A). Water is ingested at the rates given in Reference 9 for the maximum exposed individual.

b The derived response level for each radionuclide is capable of producing the preventive PAG dose. Therefore, if more than one radionuclide is present in the sample, the sum of ratios technique must be used to estimate the individual radionuclide concentrations that are permissible, e.g.

$$\frac{\text{Conc A}}{\text{Response Level A}} + \dots + \frac{\text{Conc X}}{\text{Response Level X}} = \leq 1.$$

c Th=thyroid, Lv=liver, Kd=kidney, Bo=bone, Wb=whole body, GI=gastro-intestinal tract. These are the critical organs for the corresponding radionuclides.

d Calculated concentrations may vary if calculation assumptions concerning ingestion rates and dose conversion factors are different from those presented in Reference 9.

e $6.3\text{E-}2 = 6.3 \times 10^{-2} = 0.063.$

f Adult dose conversion factors (DCF's) were obtained from ICRP-30; 10, 11, 12 dose conversion factors for other age groups were estimated by multiplying these adult DCF's by DCF ratios ($\frac{\text{other age group}}{\text{adult}}$) presented in Reference 9 for other nuclides having similar critical organs and retention times.

APPENDIX B - OTHER LARGE SCALE RADIOLOGICAL ACCIDENTS

1. FOOD/MILK DIL FRACTION CALCULATION

The following lists several types of large scale radiological accidents and associated principal radioisotopes :

<u>Location/Type of Accident</u>	<u>Principal Isotopes</u>
Nuclear Fuel Reprocessing Plant	Sr-90, Cs-137, Pu-239, Am-241
Nuclear Waste Storage Facilities (includes spent nuclear fuel)	Sr-90, Cs-137, Pu-239, Am-241
Nuclear Weapons (dispersal of nuclear material w/o detonation)	Pu-239
Radioisotope Thermoelectric Generators or Radioisotope Heater Units (used in space vehicles)	Pu-238

The radioisotopes listed are expected to be the predominant contributors to radiation dose through ingestion. Several radioisotopes could be released by an accident at a nuclear fuel reprocessing plant or nuclear waste storage facility, while only the specific radioisotope used in a nuclear weapon or space vehicle would be released in that type of accident. When more than one radioisotope is released, the relative contribution that a radioisotope makes to radiation dose from ingestion of subsequently contaminated food depends on the specifics of the accident and the mode of release.

In unique circumstances, such as transportation accidents, other radioisotopes may contribute radiation doses through the food ingestion pathway. These situations are not specifically treated in this procedure. An evaluation of the radiation dose from ingestion of these other radioisotopes should be performed, however, to determine if the PAGs would be exceeded.

Sample Activity to Isotope Group DIL Fraction Formula

$$\begin{array}{l}
 \text{Sr-90} \quad \text{Sr90(pCi/kg)} \div 4300 \\
 \text{Cs-137} \quad \text{Cs-137(pCi/kg)} \div 32000 \\
 \\
 \text{Pu-238} \\
 \text{Pu-239} \\
 \text{Am-241}
 \end{array}
 = \frac{\text{Pu238(pCi/kg)} + \text{Pu-239(pCi/kg)} + \text{Am-241(pCi/kg)}}{54}$$

Protective Action Guides (PAGs) and corresponding Derived Intervention Levels (DIL's) are based on U.S. FDA guidance published in Reference (c). This information is used to estimate the dose commitment to an individual that consumes the milk or food.

NOTE : An individual Attachment B, page 3 OF 3, "OTHER LARGE SCALE RADIOLOGICAL ACCIDENT FOOD/MILK DIL RATIO CALCULATION" , must be prepared and maintained for each sample. Special care must be taken to complete the header for each location.

1. Complete header information.
2. Obtain radioisotope results from the BRP Laboratory Liaison, or other analytical laboratory. Record results for Principal radioisotopes listed above in Column 1 and Column 2.
3. Record the appropriate formula listed above in Column 3, calculate the DIL Fraction for each Radioisotope group and record in Column 4.

**PROTECTIVE ACTION TO BE INITIATED WHEN ANY RADIOISOTOPE DIL FRACTION ≥ 1
IF ANY DIL FRACTION IS ≥ 1 NOTIFY THE PA DEPARTMENT OF AGRICULTURE IMMEDIATELY,
RECOMMENDING THE ITEM NOT BE CONSUMED**

2. DRINKING WATER DRL FRACTION CALCULATION

The dose commitment due to contaminated drinking water due to other large scale radiological accidents is calculated using the same method identified in Appendix A-2.

**ATTACHMENT B -- OTHER LARGE SCALE RADIOLOGICAL ACCIDENT
 FOOD/MILK DIL FRACTION CALCULATION**

Site of Accident _____ Type of Accident _____

County/Township _____

Address: _____

Sample Location information _____

Type of Sample: _____

Collection Date/Time _____

Calculation performed by _____ Date/Time _____ / _____

1	2	3	4
Isotope	Sample Concentration (pCi/kg)	Sample Activity to Isotope Group DIL Fraction Formula (pCi/kg)	Sample Isotope DIL Fraction

Column 1 -- Defined by Accident - Table B-1
 Column 2 -- As Reported by Lab
 Column 3 -- As Given - Table B-1
 Column 4 -- As Calculated

PROTECTIVE ACTION TO BE INITIATED WHEN ANY ISOTOPE DIL FRACTION ≥ 1

ENVIRONMENTAL SAMPLING PROCEDURE

PURPOSE:

The purpose of this procedure is to provide detailed sampling procedures for Commonwealth Field Teams that include BRP staff performing or assisting in environmental sampling. Sampling locations may include the portions of the Ingestion Pathway EPZ that are identified as Restricted Zones, and those portions of the Ingestion Pathway EPZ outside of Restricted Zones where deposition of radioactive material by the plume occurred. Sampling is performed to determine the extent of agricultural product, water and soil contamination by radionuclides from a fixed nuclear facility or other large-scale radiological event. The determination of Restricted Zones and of areas outside Restricted Zones where deposition by the radioactive plume have occurred will be made by BRP staff at the State EOC, or by the FRMAC (when established). This procedure is intended for use during the Intermediate and Recovery (i.e. Post-Emergency) phases of an event.

This procedure covers sampling procedures for: milk, stored food crops, stored animal feed, forage, unharvested crops, vegetation, soil, snow, other food items and water.

CONTENTS:

FIELD TEAM EQUIPMENT CHECKLIST	SECTION 1
BACKGROUND	SECTION 2
REFERENCES	SECTION 3
FIELD TEAM COMPOSITION AND ACTIVATION	SECTION 4
SAMPLING PROCEDURE	SECTION 5

SECTION 1: FIELD TEAM EQUIPMENT CHECKLIST

A. Equipment From BRP Plume Phase Emergency Kits:

- 1. Canberra ADM-300 (or equivalent).
- 2. KI Tablets and instructions.
- 3. Maps.
- 4. Calculator.
- 5. Spare batteries

B. Additional Equipment:

- 1. Electronic Dosimeters or dosimeter charger and 0-500 (if available), 0-20 R direct-reading dosimeters.
- 2. Ludlum Model 19 Micro-R-Meter (or equivalent low dose rate capable instrument).
- 3. Ludlum 2221 or equivalent contamination monitoring instrument.
- 4. GPS Unit (if available).

C. Environmental Sample Kits

- 1. Environmental Sampling Kit – Toolbox
- 2. Environmental Sampling Kit – Cooler
- 3. Environmental Sampling Kit - Bucket

See attachment 4 – Environmental Sampling Kit Inventory

SECTION 2 -- BACKGROUND

The Ingestion Pathway EPZ encompasses the area within a 50-mile radius of a nuclear power plant. Agricultural product sampling will be focused on this area, though the area of sampling may be extended beyond 50 miles if it is believed that radionuclide contamination may have spread beyond the 50-mile boundary.

Sampling and analysis of the environmental products is necessary to evaluate the effectiveness of protective actions, to evaluate the Ingestion Pathway dose commitment, and to verify that areas producing contaminated agricultural products or water have been identified. This sampling and analysis of the environment and agricultural products will occur during the Intermediate and Recovery (i.e. Post-Emergency) phases of an event.

BRP is responsible for developing a sampling plan, in consultation with the PA Department of Agriculture and the Department of Environmental Protection.

Sampling of agricultural products is tasked to the PA Department of Agriculture.

Sampling of public water supplies is tasked to the DEP Regional Water Supply Management Staff.

Sampling of surface water supplies and ground water supplies is tasked to the DEP Regional Water Quality Protection Staff.

The Environmental Sampling kit contains all necessary equipment (excluding instrumentation) necessary to perform agricultural, water and soil sampling.

Agricultural product sampling, water and soil sampling in areas of the Ingestion Pathway EPZ where no significant deposition of radioactive material by the plume occurred will be conducted by PA Department of Agriculture personnel or DEP Water staff, with supplementary field sampling teams provided by USDA, if necessary. Since these areas will not have received significant deposition, the radiological control precautions outlined in this procedure (such as wearing of protective anti-contamination clothing, using self-reading dosimeters, and having KI) will not be required by these sampling teams. Agricultural sampling teams operating in areas of the Ingestion Pathway EPZ where no significant deposition of radioactive material by the plume occurred will conduct sampling in accordance with PDA Annex E, "PDA Plan for Nuclear Power Generating Station Incidents". DEP water sampling teams operating in areas of the Ingestion Pathway EPZ where no significant deposition of radioactive material by the plume occurred will conduct sampling in accordance with the DEP Emergency Operations Plan, Annex E, Nuclear Power Plant Incidents, and water program standard sampling procedures. BRP will provide health physics support for these sampling teams, as required, until establishment of the FRMAC, when the FRMAC will take over that responsibility.

Agricultural product sampling, water or soil sampling in areas of the Ingestion Pathway EPZ where significant deposition of radioactive material by the plume occurred (including Restricted Zones) will be conducted with assistance by health physicists from BRP or the FRMAC (when established) using this procedure. These sampling teams may be accompanied by DEP, PA Department of Agriculture and/or USDA staff, who have received a radiological briefing, dosimetry, and appropriate anti-contamination clothing, to obtain the required samples in a timely manner, if necessary.

SECTION 3 -- REFERENCES

- a. Guidance on Offsite Emergency Radiation Measurement Systems, Phase 3 -- Water and Non-Dairy Food Pathway, FEMA REP-13, May 1990.
- b. Guidance on Offsite Emergency Radiation Measurement Systems, Phase 2 -- The Milk Pathway, FEMA REP-12, September 1987.
- c. PA Department of Agriculture Annex E, "PDA Plan for Nuclear Power Generating Station Incidents", PDA, March 1994.
- d. Commonwealth of Pennsylvania Department of Environmental Protection Emergency Operations Plan, Annex E, Nuclear Power Plant Incidents, March 2002.
- e. Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA 400-R-92-001, EPA, October 1991.
- f. Accidental Radioactive Contamination of Human Food and Animal Feeds; Recommendations for State and Local Agencies, U.S. Food and Drug Administration, August 13, 1998

SECTION 4 -- SAMPLE TEAM COMPOSITION AND ACTIVATION

A. Field Team Composition:

1. PDA Teams: When sampling in areas where there is no Significant deposition from the radioactive plume, PA Department of Agriculture personnel will perform the sampling, Supplemented by field sampling teams provided by USDA, if requested. BRP will provide health physics support for these Field Teams, as required, until the FRMAC is established and assumes that responsibility.
2. DEP Teams: When sampling in areas where there is no significant deposition from the radioactive plume, DEP personnel listed in Section 2 above will perform the sampling, supplemented by field sampling teams provided by EPA, if requested. BRP will provide health physics support for these Field Teams, as required, until the FRMAC is established and assumes that responsibility.
3. BRP Teams: When sampling in areas where there is significant deposition from the radioactive plume (and in Restricted Zones), the sampling will be performed with assistance by health physicists from BRP or the FRMAC (when established). BRP Teams may be accompanied by PA Department of Agriculture, USDA or DEP Water staff who have received a radiological briefing, dosimetry, and appropriate anti-contamination clothing, to obtain the required samples in a timely manner, if necessary. BRP teams will be composed of two (or more) individuals, one of which must be a Radiation Health Physicist.

B. Field Team Activation:

1. PDA Teams: BRP will notify the PA Department of Agriculture when conditions warrant the dispatch of PDA Agricultural Product Field Teams. Notification will be by commercial telephone or face-to-face communication with the PA Department of Agriculture Representative at the State EOC.

2. DEP Teams: BRP will notify the DEP Emergency Response Program Director (ERPD) when conditions warrant the dispatch of Water Sampling Field Teams. Notification will be by commercial telephone or face-to-face communication with the DEP ERPD at the State EOC.

3. BRP Teams: BRP at the State EOC will notify BRP Regional Program Managers when conditions warrant the dispatch of BRP Environmental Sampling Teams. Notification will be by commercial telephone or other means. BRP Field Teams involved in sampling should report first to their Regional Office to obtain equipment, a briefing, and assignment. They should then report to the assigned location (typically a County EOC in an affected county [before Full Federal Activation] or FRMAC [after Full Federal Activation]) for dispatch to specific sampling locations, and to pick-up additional staff, if necessary.

This BRP notification and assignment scheme may be modified during an incident, as conditions warrant, to provide for the orderly deployment of BRP Field Teams tasked to perform Environmental Sampling.

SECTION 5 – BRP SAMPLING TEAM PROCEDURES

1. BRP staff should report to the BRP Regional Office or designated location to pick-up equipment.
2. Before leaving the BRP Regional Office or designated location:
 - a. If during sampling, entry into the restricted zone is necessary, obtain the equipment in Section 1, parts A, B and C. In addition, all sampling team staff that will enter the restricted zone must have a Personnel Record Dosimeter (PRD or TLD).
 - b. If during sampling, entry into the restricted zone is not necessary obtain the equipment in Section 1, parts B and C.
 - c. Verify the seal number listed on the Environmental Sampling Kit is intact. If the seal is not intact or does not match number listed, perform full inventory of Environmental Sample Kit.
 - d. Install batteries in instruments. Conduct battery checks on instruments.
 - e. Check instruments to insure calibration is current.
 - f. Check proper operational response of instruments, including response of survey instruments for those instruments with check sources, and response of low range survey instruments to background radiation. Document checks completion on Attachment 1.
 - g. Seal the instrument probes as necessary in plastic probe covers.
 - h. If direct-reading dosimeters are used, rezero.
 - i. Obtain DEP vehicle with DEP radio and/or other communications, if available. (If no DEP vehicle is available, any suitable vehicle is acceptable.)
 - j. Conduct a communications check with the Field Team Coordinator (BRP before Full Federal Activation; FRMAC after Full Federal Activation).
 - k. Load equipment listed in Section 1, "Field Team Equipment Checklist", into vehicle.
 - l. Receive assignment from the BRP Regional Program Manager (or his/her designee) on where to proceed (typically a County EOC in an affected County, or the FRMAC, when established.)
 - m. Begin an "Attachment 1: Environmental Sampling Team Message/Event Log", using Attachment 1(or other suitable general log form).

3. Proceed to the assigned rendezvous location (typically a County EOC in an affected County, or FRMAC, when established).

4. Upon arrival at the assigned location (typically a County EOC in an affected County or FRMAC, when established):

- a. Report to Radiological Officer and/or Agricultural liaison.
- b. Receive briefing on local conditions, weather conditions, access control points, radiological conditions, decontamination centers, and sample drop off locations.
- c. Obtain sampling location assignments, and samples required.
- d. If required, pick-up PDA, USDA or DEP staff to assist in sampling. Ensure these individuals have received a radiological briefing, dosimetry, and appropriate anti-contamination clothing.
- e. Fill out applicable sections of "Intermediate and Recovery (Post-Emergency) Phase Personnel Monitoring" form [Attachment 3 of this procedure] (or equivalent form from County EOC or FRMAC). Each team member should have an Electronic dosimeter or one self-reading dosimeter (if available).
- f. Don necessary anti-contamination clothing.

5. Proceed to sampling locations. If entering a Restricted Zone, proceed to the controlled entry point to the Restricted Zone, and register at that point.

- a. Proceed to the first assigned sample location.
- b. While enroute to the sample locations, monitor ambient gamma exposure rate reading .
- c. Record dosimeter exposure readings every hour (every half-hour when in a Restricted Zone) on Attachment 1.

NOTE: If your mission cumulative self reading dosimeter reading reaches 500 mR or more, go to the Restricted Zone controlled entry point, establish communication with your Field Team Coordinator, and receive instructions.

6. Upon arrival at the sampling location:

- a. At place where sample is to be taken, take an ambient gamma exposure rate reading at waist height (1 meter off the ground) with the Micro-R-Meter.

NOTE: To avoid sending highly contaminated samples to the laboratory, samples should not be collected from areas where the ambient gamma exposure rate from deposited materials is greater than 1000 uR/hr (1.0 mR/hr) at waist level. DO NOT sample. Notify your Field Team Coordinator at the first opportunity. Proceed to next sample location.

- b. Obtain the required sample. Below are general sample procedures, followed by specific procedures for some commonly sampled items.

7. General Sampling Procedures:

- a. Use appropriate radiological contamination precautions, such as wearing gloves and changing gloves frequently.
- b. Prepare container to receive the sample.
- c. If the sample is taken in the open field (such as forage, unharvested crops, snow and vegetation), measure an area of 1 meter x 1 meter on which to collect sample.
- d. Obtain sample. (See below for quantities to be collected.)
- d. Place sample in the container. Seal container securely.
- e. Change gloves frequently
- f. Complete appropriate sections of Attachment 2: ENVIRONMENTAL SAMPLING TEAM DATA LOG
- g. Initiate the BRP-ER-8.05, "Sample Control and Chain of Custody" procedure, Chain of Custody form.

8. Specific Agricultural Product Sampling Notes:

- a. Milk -- Obtain 4 liter/1gallon sample in 4 liter/1 gallon cubitainer. Milk should be agitated in a bulk tank at least five minutes before sampling. If the sample cannot be taken at the valve, it will be necessary to sample through the opening at the top of the tank. If the sample is taken in this way, the equipment must be sanitized prior to use. Milk sampling required adherence to bio-security procedures. Milk sampling may only be done by qualified individuals ad specified by the PDA. Place milk in a cooler for shipment to the laboratory. (The samples may be iced if ice is available. However, it is not required to keep milk iced for radiological analysis, but it makes analysis more convenient by retarding bacteria growth and spoilage.)
- b. Stored Animal Feed and Stored Food Crops -- Obtain a 1 kilogram sample (about 2.2 pounds).
- c. Forage, Unharvested Crops, Vegetation -- Obtain a 1 kilogram sample (about 2.2 pounds). The vegetation sample should be collected from a ground surface area of 1m x 1m. [If more than 1 kilogram is available in the 1m x 1m area, take a representative sample. If 1 kilogram can not be obtained in the 1m x 1m area, a larger sample area may be used, and the size of the larger sample area should be noted on the log sheet.] Surface grown leafy vegetables should be cut at 1 to 2 cm (about 1/2 to 1 inch) above ground level and care should be taken to avoid contamination of the vegetation by the soil.

- d. Soil –Using the soil sampler top – push/hammer soil sampler top into soil, to a depth, which comes in contact with horizontal stops on sampler top. Using soil sampler scoop, push/hammer scoop under soil sampler until flush with sampler top. Remove both sampler and scoop together and deposit soil into plastic bag.
- e. Snow -- Obtain a 4 kilogram sample (about 8.8 pounds). This will yield about 4 liters/1gallon when melted. Scrape the snow from a surface area of 1m x 1m.
- f. Other Food Items, such as fruit, berries, honey, etc. -- Obtain a 1 kilogram sample (about 2.2 pounds) in an appropriate container.
- g. When finished at the sample location, proceed to next sample location.

9. Water Sampling Procedures:

- a. Use appropriate radiological contamination precautions, such as waterproof gloves, to prevent contact with the water.
- b. Prepare 4 liter/1 gallon cubitainer to receive the sample. (Note: a minimum of 3.5 liters are needed for analysis at lab.
- c. Collect Water Sample:
- d. Public Water Supply Samples:
 - 1. Sample finished drinking water from the facility. Sample raw water from the facility if instructions to do so have been given at the briefing. See sampling techniques below.
 - 2. Raw Surface or Groundwater Samples:
 - a. Obtain a representative sample of water. See sampling techniques below.
 - b. Sampling Techniques:
 - Collecting Water Sample From a Tap or Faucet:
 - 1. Run water for 5 minutes before collecting sample, to ensure the line is flushed, and a representative sample is obtained.

Collecting Surface Water Samples:

1. Submerge the mouth of the sampling container under the water (to about half the total depth of the water, if possible) and move the container upstream away from the hand. Keep hands away from the mouth of sampling container to prevent contamination of the sample. Avoid obtaining sludge or sediment samples

Stream samples can be collected from bridges with the use of a bucket. The bucket should be rinsed twice with sample water prior to collecting the sample, to prevent contamination from the previous sample.

- e. Be sure container is filled as completely as possible. Seal container securely.

10.. Sample Processing

- a. Using permanent marker, write 'Collector ID/Seq. No.' (Sample ID Number) on sample container in accordance with BRP-ER-8.05, "Sample Control and Chain of Custody" procedure..
- b. Take a gamma exposure rate reading on the collected sample with the Micro-R-Meter (or ADM-300, closed window, if Micro-R-Meter is not available or is off scale high) by measuring about 1 inch from the side of the container. **If the background radiation level in the area of sample collection is greater than normal background (about 6-12 uR/hr), wait until you are in a low background area to make this gamma exposure rate measurement on the sample.**
- c. Place the sample container inside a clear plastic bag to avoid cross contamination. Seal securely.
- d. Affix (with tape) the "DEP Laboratory Sample Submission Sheet" to the outer plastic bag.
- e. Record sample information on Attachment 2, "Environmental Sampling Team Data Log".
- f. Wipe off sampling instruments/equipment with a moist wipe to remove any contamination. Place used cloth/wipes in a waste bag.
- g. Using moist wipes provided in kit, wipe outer bags/containers, place used wipes in waste bag.

11. When sampling run has been completed:

if sampling in a Restricted Zone, proceed to the Restricted Zone access control point and perform these steps.

if sampling outside a Restricted Zone, return to the location directed or FRMAC and perform these steps:

- a. Monitor persons and equipment for contamination by using the available contamination monitoring instruments (for example, E-120 with HP-210 probe or Ludlum 2221 setup in contamination monitoring mode). If contamination is found, (reading more than twice background), attempt decontamination by washing with decon solution or wiping with towelettes provided in kit. If the contamination cannot be removed from equipment, place the equipment in a plastic bag, label it, and return it to the FRMAC for decontamination. If contamination cannot be removed from a person, go to the nearest decontamination station for personnel decontamination.
- b. Read self reading dosimeter and record total dose on Attachment 4, if it is the last mission for the day.
- c. If you did not make a gamma exposure rate reading on the collected samples at the sample collection point due to high background radiation levels, make a gamma exposure rate reading on the collected sample now and record the reading on Attachment 2.
- d. Drop off samples at location directed. Perform Chain of Custody duties as required in BRP-ER-8.05, "Sample Control and Chain of Custody" procedure. Samples > 5 mR/hr shall not be brought to the DEP laboratory. Contact dispatching agency for resolution to samples > 5 mR/hr.
- e. Inform the organization that sent you on sampling mission of completion of sampling mission. Inform your Field Team Coordinator if available for other duties.

ATTACHMENT 2: ENVIRONMENTAL SAMPLING TEAM DATA LOG

Reactor Site: _____ Date: _____ Team: _____

Micro-R-Meter Ser. #: _____ ADM-300 Ser. #: _____ Other Instrument type: _____ Ser # _____

1	2	3	4	5	6	7
Date/Time Collected	Location	Collector ID /Sequence #	Sample Type	Survey Inst.	Ambient Reading (1 meter, Closed Window) (SPECIFY UNITS: uR/hr or mR/hr)	Sample Reading (1" away, Closed Window) (SPECIFY UNITS: uR/hr or mR/hr)

NOTE: DO NOT sample if ambient gamma exposure rate reading at sampling location is \geq 1000 uR/hr (1.0 mR/hr).

ATTACHMENT 3: INTERMEDIATE AND RECOVERY PHASE PERSONNEL MONITORING

DATE : _____

NAME: _____

SSN: _____

HOME ADDRESS : _____

PRD #: _____
 (if assigned)

PHONE NUMBER: _____

AGENCY: _____

	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Date/ Time Out					
Date/Time In					
DRD range					
DRD serial #					
DRD reading out					
DRD reading in					
DRD TOTAL					
Electronic dosimeter serial #					
Electronic dosimeter out					
Electronic dosimeter in					
Electronic dosimeter total					
Total for day					
TOTAL EXPOSURE (ADD DAYS TOGETHER)					

For DAILY TOTAL USE DOSIMETER WITH HIGHEST READING.

PRD Reading (if assigned)

Reviewed by _____ Area HP or RPM _____ Date: _____

ENVIRONMENTAL SAMPLE KIT INVENTORY

TOOL BOX				
Qty.	Unit		Description	Sat / Unsat
1	Each		Clip board	
1	Roll		Duct tape	
1	Each		Duffle bag	
1	Each		Flashlight	
2	Each		Flashlight batteries (Spares)	
1	Each		Folding shovel	
1	Each		Garden trowel	
1	Each		Grass clippers	
1	Each		Hammer	
1	Each		Lined tablet	
6	Each		Metal stakes (12" X 1/4")	
1	Each		Nylon rope	
1	Each		Nylon string	
1	Roll		Paper towels	
1	Each		Portfolio bag	
1	Pair		Scissors (<i>inside portfolio bag</i>)	
3	Each		Sharpie markers (<i>inside portfolio bag</i>)	
1	Pair		Tweezers (<i>inside portfolio bag</i>)	
3	Each		Ball point pens (<i>inside portfolio bag</i>)	
3	Each		Plastic bags (38" X 65")	
2	Packages		Pre moistened towelettes	
1	Roll		Radioactive material tape	
2	Pair		Slip on rubber boots (non skid)	
1	Each		Soil sample cutter (with scoop)	
1	Each		Spoon	
1	Box		Surgeons gloves	
1	Each		Tape measure	
1	Each		Tool kit (computer type)	
1	Package		Ty wraps	
2	Each		Tyvek suits	
2	Pair		Work gloves	
1	Each		Zip lock bag (with smears)	
COOLER				
Qty.	Unit		Description	Sat / Unsat
2	Each		One pint poly bottles	
4	Each		One gallon cubitainers	
1	Each		Funnel	
10	Each		Plastic bags (4" X 4")	
10	Each		Plastic bags (6" X 6")	
10	Each		Plastic bags (8" X 8")	
10	Each		Plastic bags (14" X 18")	
1	Each		BRP-ER-8.02 Environmental Sampling Procedure	
1	Each		BRP-ER-8.05 Chain of Custody Procedure	
20	Each		BRP-ER-8.05 Chain of Custody Forms	
20	Each		BRP-ER-8.02 Attachments	
20	Each		BRP-ER-8.05 Environmental Sample Labels	
MISCELLANEOUS				
			2 Gallon Sampling bucket (1 each)	

Kit # _____ Inventory Date _____ Inventoried By _____ Seal # _____

REENTRY, RETURN, RELOCATION AND RECOVERY PROCEDURES

PURPOSE:

This procedure provides implementing procedures which are to be followed after a fixed nuclear facility accident or incident has de-escalated from General Emergency to a lower emergency classification, uncontrolled radioactive releases have terminated, and the facility has been placed in a cold shutdown mode.

The basic guidance on Bureau of Radiation Protection (BRP) actions with regard to Reentry, Return, Relocation, and Recovery are contained in the "Bureau of Radiation Protection Nuclear Power Station Emergency Plan".

This implementing procedure addresses issues of:

- Bureau/Federal Interface
- Description of Position Functions
- Dose Projection

during Reentry into the 10 mile plume EPZ and other areas affected directly or indirectly as a consequence of the incident; Return or Relocation of the population; and Recovery operations.

This implementing procedure assumes that Emergency Phase PARs have been implemented by the Commonwealth; the Bureau is mobilized for emergency operations; and Federal technical assistance has been requested and has responded.

CONTENTS OF PROCEDURE

DEFINITIONS	SECTION 1
BUREAU/FEDERAL INTERFACE	SECTION 2
DESCRIPTION OF POSITION FUNCTIONS	SECTION 3
DOSE PROJECTION	SECTION 4
GROUND SHINE PROJECTED DOSE	ATTACHMENT 1
INHALATION OF RESUSPENDED NUCLIDES PROJECTED DOSE	ATTACHMENT 2

REENTRY, RETURN, RELOCATION, AND RECOVERY PROCEDURES

SECTION 1 – DEFINITIONS

Advisory Team for Environment, Food and Health (Advisory Team) – Develops coordinated advice and recommendations concerning environmental, food health and animal health matters. Contains representatives from DHS, EPA, USDA, and FDA. Operates from FRMAC.

Aerial Measurement System (AMS) -- Determination of plume and ground deposition locations by aircraft. It is accessible through DOE.

Consequence Management Response Team (CMRT)-- A DOE team that rapidly responds to the scene of a serious radiological incident. Provides expertise in radiation monitoring, sampling, analysis, assessment, health and safety, and logistics and support. Prepares for arrival of FRMAC.

Federal Radiological Monitoring and Assessment Center (FRMAC) -- Established and managed by the Department of Energy (DOE) to provide extended technical support on radiation monitoring and assessment in support of the state. The timeframe for establishment and full operation for the FRMAC in Pennsylvania is normally 24-48 hours from the time of a request.

Interagency Modeling and Atmospheric Assessment Center (IMAAC) – A Federal interagency group responsible for production, coordination, and dissemination of consequence predictions for an airborne hazardous materials release. The IMAAC generates the single Federal prediction of atmospheric dispersions and their consequences utilizing the best available resources from the Federal Government.

Joint Field Office (JFO) – A temporary Federal facility established locally to provide a central point for Federal, State, local, and tribal executives with responsibility, for incident oversight, direction, and/or assistance to effectively coordinate protection, prevention, preparedness, response and recovery actions.

National Atmospheric Release Advisory Capability (NARAC) -- A sophisticated computer system used for estimating meteorological factors, plume travel, population doses, and other parameters. It is accessible through the FRMAC.

National Response Plan (NRP) -- The Federal plan which defines the federal response to major disasters and other emergencies, including emergencies at nuclear power plants, and major radiological incidents.

Recovery -- The efforts to reduce offsite contamination to acceptable levels for unrestricted use. The major considerations in recovery are the operation of a long-term surveillance program to verify and control exposure to the general population, and systematic decontamination of affected areas. Recovery also includes the restoration of vital services and infrastructure.

Reentry -- (also called "Controlled Entry") -- The temporary return of emergency workers and others authorized by the Governor for a prescribed period into restricted zones for the purposes of protection of valuable property, and functions including law enforcement, firefighting, securing property, removing property, tending livestock, control of industrial processes, and public utilities.

Relocation -- Relocation is a protective action focusing on moving populations still residing in restricted zones out of the restricted zones.

Relocation Protective Action Guide (PAG) -- The projected TEDE (whole body) dose above which relocation of the population is necessary. EPA-400 proposes the use of a projected dose of 2 Rem over the first year as the Protective PAG. It further indicates that the projected dose during pregnancy should be limited to 0.5 Rem, with the fetus as the critical population. This plan uses a projected dose of 0.5 Rem TEDE over the first year as the relocation PAG. EPA-400 also proposes relocation PAGs for the second year, and for the entire period from 0-50 years. As recommended by EPA-400, the second year relocation PAG is 0.5 Rem TEDE, and the 50 year relocation PAG is 5 Rem TEDE.

Restricted Zone -- Restricted Zones are those areas where whole body dose (TEDE) to the general public from ground deposition and inhalation of resuspended material is expected to exceed relocation PAGs. It may also include a buffer zone to prevent radionuclides from being deposited in unrestricted zones.

Return -- (also called "Controlled Return") -- The return of evacuees to unrestricted zones, following verification of the boundaries of the restricted zones. Since unrestricted zones may include contaminated areas, ingestion pathway controls may be in operation in these unrestricted zones.

Unrestricted Zone -- Unrestricted Zones are those areas outside restricted zones. Since unrestricted zones may include contaminated areas, ingestion pathway controls can be in operation in these zones. Unrestricted Zones are divided into two tiers, based on radiation levels, and other factors as described in Section 7.4.3.2 of the BRP "Emergency Plan. The radiation levels that describe the tiers are:

First Tier -- Areas where the radiation levels are less than 0.025 mR/hr.

Second Tier -- Areas where the radiation levels are greater than or equal to 0.025 mR/hr, up to the edge of the restricted zone.

SECTION 2 -- BUREAU/FEDERAL INTERFACE

FIGURE 2.1

**BRP EMERGENCY ORGANIZATION
(Full Federal Activation)**

JFO - Joint Field Office

EOF - Licensee's Emergency Operations Facility

TSC - Licensee's Technical Support Center

RML - DEP Radiation Measurements Laboratory, Harrisburg

FRMAC - Federal Radiological Monitoring and Assessment
Center

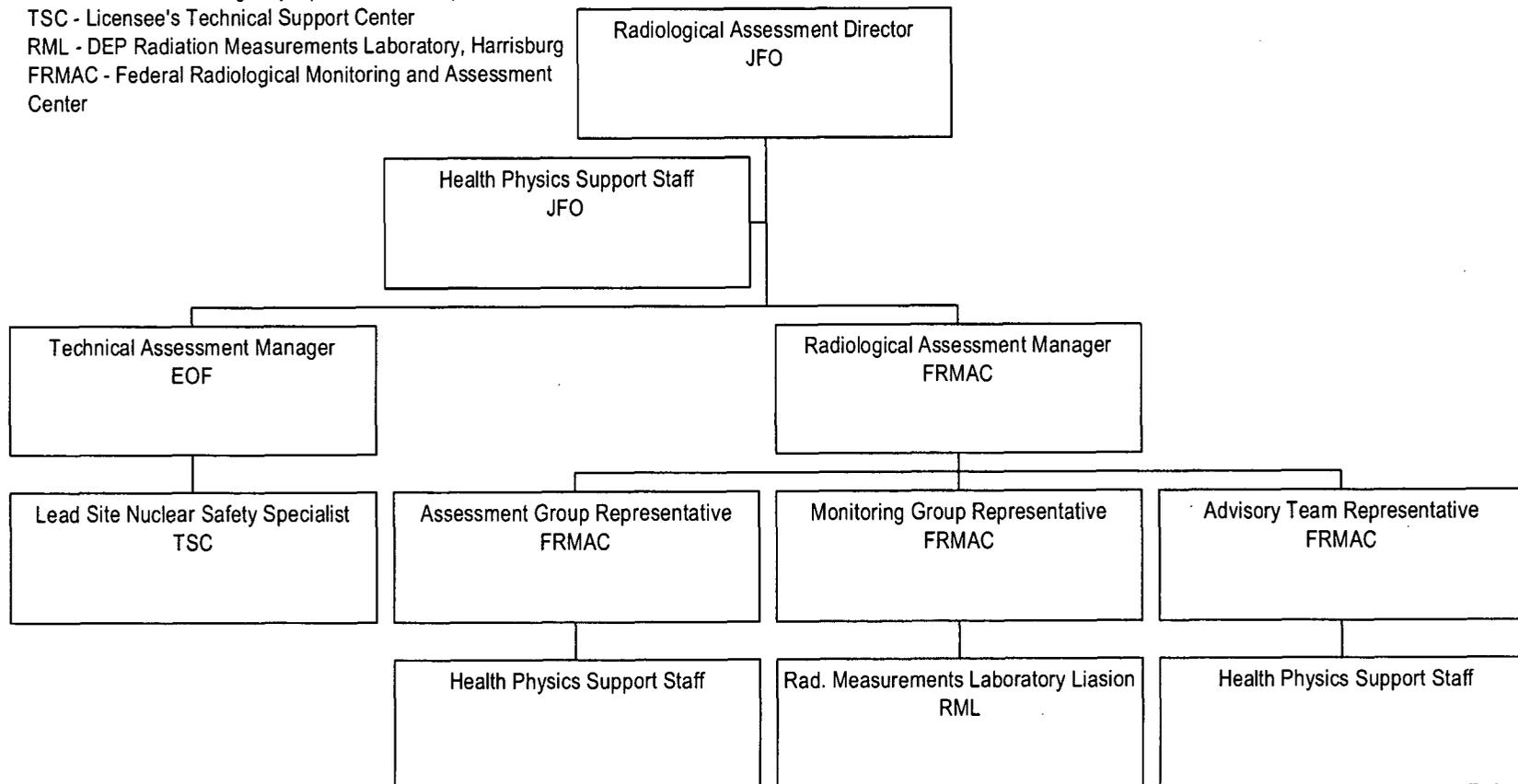


FIGURE 2.2

Primary Personnel Assignments for Full Federal Activation

Radiological Assessment Director -----	Bureau Director
Technical Assessment Manager -----	Chief, Nuclear Safety Division
Radiological Assessment Manager-----	BRP-CO RPPS or RPPM
Lead Site Nuclear Safety Specialist -----	Assigned Nuclear Safety Specialist
Advisory Team Representative -----	Chief, Emergency Response Section
Monitoring Group Representative -----	Regional Health Physicist
Assessment Group Representative -----	Regional or BRP-CO Health Physicist (EOF Radiological Support)
Radiation Measurements Laboratory ----- Liaison	Health Physicist, Environmental Surveillance Section

All other support positions will be filled from remaining BRP technical staff.

If BRP cannot fill all of the emergency positions, they will be filled in order of priority listed in Figure 2.1. Also, some individuals may fill combined positions if the situation demands. If required, administrative and technical assistance to supplement BRP staff will be secured through DEP management.

SECTION 3 -- DESCRIPTION OF POSITION FUNCTIONS

At full Federal activation, BRP staff will interface with Federal and State agencies to coordinate the Commonwealth's response. Specific responsibilities for each position described in Section 2 of this procedure above are outlined in this section.

A. Radiological Assessment Director -- Works from the JFO.

General:

1. Provides overall direction for all BRP response activities.
 2. Consults with Nuclear Safety Manager and Radiological Assessment Manager on appropriate PARs.
 3. Consolidates technical input into state protective action decisions.
 4. Provides interface between State decision-makers and NRC Director of Site Operations.
 5. Participates as required on State Recovery Task Force.
 6. Acts as primary spokesperson for BRP response activities.
 7. Forms working groups from Bureau staff and appoints supervisors as needed.
- Consideration to the following areas should be given:
- a. Emergency Worker Dosimetry
 - b. Restricted Zone Control
 - c. Long-Term Environmental Monitoring
 - d. Agriculture
 - e. Remediation
 - f. Population Dose Assessment
 - g. Decontamination

B. Technical Assessment Manager -- Works from EOF.

General:

1. Directs all BRP staff at EOF activities.
2. Provides assessment of plant status.
3. Consults with Radiological Assessment Director and Radiological Assessment Manager on appropriate PARs.
4. Acts as BRP liaison with NRC and licensee representatives at EOF.
5. Directs BRP nuclear engineering staff at TSC.

C. Lead Site Nuclear Safety Specialist -- Works from TSC.

General:

1. Maintains detailed familiarity with technical information for assigned plant.
2. Assists the Technical Assessment Manager with technical assessment and liaison responsibilities.

D. Radiological Assessment Manager -- Works from FRMAC.

General:

1. Acts as lead State representative at the FRMAC.
2. Establishes State radiological monitoring and assessment needs and priorities for the FRMAC.
3. Interfaces with FRMAC Director and NRC Protective Measures Coordinator.
4. Evaluates all radiological data and assessments.
5. Advises Incident Manager on appropriate PARs and status of FRMAC activities.
6. Directs BRP staff at the FRMAC.

Environmental Monitoring:

1. Obtains information from the Federal Coordinator on previous plume locations and known deposition areas.
2. Requests AMS flyovers from Federal Coordinator.
3. Directs Monitoring Group Representative to release personnel from Bureau field monitoring teams to Federal Coordinator when appropriate.
4. Determines needs for milk, food, and feed sampling with PA Department of Agriculture; water sampling with DEP Emergency Response Coordinator.
5. Establishes analytical priorities for samples with DEP Bureau of Laboratories.
6. Direct Monitoring Group Representative to provide inventory of available field survey instruments and laboratory equipment.
7. Requests assistance from FRMAC to fill unmet needs of personnel and equipment.
8. Directs Assessment Group Representative to develop dose projections based on environmental monitoring data, and establish restricted zone boundaries.
9. Works with Federal Coordinator to implement environmental monitoring program and work out common sampling nomenclature and location descriptions.
10. Develops long term environmental monitoring program with Federal Coordinator and DEP Bureau of Laboratories.

Relocation:

1. Once restricted zone boundaries have been established, advises Radiological Assessment Director and issues a PAR to PEMA that any evacuees with residences in restricted zones should be converted to relocated status.
2. Advises PEMA that residents who did not evacuate restricted zones should be relocated out of these zones as soon as possible.

Reentry:

1. Advises PEMA on radiological situation and advisability of reentry.
2. Requests AMS flyovers to locate hotspots and establish isodose contours.
3. Obtains isotopic deposition data from Federal Coordinator.
4. Requests dispatch of ground monitoring teams to verify aerial survey data.
5. Works with Federal Coordinator and PEMA to verify restricted zone and unrestricted zone boundaries.

Return:

1. Develops Bureau environmental monitoring plan for unrestricted zones in coordination with the Federal Coordinator and the DEP Bureau of Laboratories.
2. Advises PEMA of the tier classifications and locations of unrestricted zones, where return of the general public may commence.
3. Works with Federal Coordinator and State agencies to develop decontamination strategies for contaminated areas.

E. Advisory Team Representative -- Works with Advisory Team at FRMAC.

General:

1. Assists Radiological Assessment Manager with assessment and liaison responsibilities.
2. Interfaces with Advisory Team on Environment, Food and Health in developing protective action positions.
3. Relays FRMAC recommendations requiring policy decisions (such as implementation or relaxation of PARs and radiological controls) to the Radiological Assessment Manager.
4. Performs duties as assigned by the Radiological Assessment Manager.

Relocation:

1. Once restricted zone boundaries have been established, works with Radiological Assessment Manager to issue a PAR to PEMA that any evacuees with residences in restricted zones should be converted to relocated status.

E. Monitoring Group Representative -- Works at FRMAC.

General:

1. Acts as BRP representative in the FRMAC Monitoring Group.
2. Responsible for integrating all State field sampling and analysis activities into FRMAC operations.
3. Receives BRP environmental sample and TLD results from BRP Radiation Measurements Laboratory Liaison for input into FRMAC database.
4. Coordinates with FRMAC Monitoring Group Manager and Assessment Group Manager on development of both near-term and long-term environmental monitoring plans, as directed by the Radiological Assessment Manager.
5. Work with Radiological Assessment Manager and Federal Coordinator to implement and environmental monitoring program and work out common sampling nomenclature and location designations.

6. Performs duties as assigned by the Radiological Assessment Manager.

Environmental Monitoring:

1. Releases personnel from Bureau field monitoring teams to Federal Coordinator when directed by the Radiological Assessment Manager.
2. Inventories available field survey instruments and laboratory equipment as directed by the Radiological Assessment Manager.
3. Gathers, collates, and transmits laboratory and field data from the FRMAC to Bureau headquarters.
4. Receives BRP environmental sample and TLD results from Radiation Measurements Laboratory Liaison for input into the FRMAC database.
5. Assists in development of Bureau's short-range and long-range environmental monitoring plan.

Relocation:

1. Provides data to Radiological Assessment Manager on isodose curves and hot spots detected by aerial monitoring and ground monitoring.
2. Assists in developing restricted zone boundaries from field monitoring data.

Reentry:

1. Obtain and collate deposition data from FRMAC and forward to Radiological Assessment Manager.
2. Implement environmental monitoring program in coordination with FRMAC.

Return:

1. Obtain and collate deposition data from FRMAC and forward to Radiological Assessment Manager.
2. Implement long-term environmental monitoring program in coordination with FRMAC.

G. Assessment Group Representative -- Works from FRMAC.

General:

1. Acts as BRP representative in the FRMAC Assessment Group.
2. Responsible for review of FRMAC Assessment work products, including environmental data reports, dose assessment reports, mapping of deposition patterns, etc.
3. Provides State generated data and dose projections for input into FRMAC database.
4. Coordinates data formatting and summary reports as needed by State decision makers.
5. Work with Radiological Assessment Manager and Federal Coordinator to implement environmental monitoring program and work out common sample nomenclature and location descriptions.

6. Performs duties as assigned by the Radiological Assessment Manager.

Environmental Monitoring:

1. Develops dose projections based on environmental monitoring data.
2. Provides State generated dose projections to FRMAC.

Relocation:

1. Works to establish isodose curves based on field monitoring data.
2. Assists in establishing restricted zone boundaries based on field monitoring data.

Reentry:

1. Uses field team monitoring data to verify the restricted zone boundaries.
2. Informs FRMAC of the location and classification of radiological zones.

Return:

1. Identifies hot spots in need of decontamination from aerial survey information and field survey data.

H. Radiation Measurements Laboratory Liaison -- Works as DEP Radiation Measurements Laboratory.

General:

1. Receives data from all environmental samples analyzed by the DEP Radiation Measurements Laboratory and TLDs analyzed by the BRP Environmental Surveillance Section.
2. Reports data to the BRP Monitoring Group Representative at the FRMAC.
3. Advises Radiation Measurements Laboratory on contamination control procedures.
4. Performs duties as assigned by the BRP Monitoring Group Representative.

SECTION 4 -- DOSE PROJECTIONS

The Relocation Protective Action Guide (PAG) used by the Commonwealth is 0.5 Rem TEDE (Whole Body) in the first year of exposure. The second year Relocation PAG is 0.5 Rem TEDE in the second year of exposure. The 50 year Relocation PAG is 5 Rem TEDE in the entire period 0-50 years.

Two pathways must be considered in computing dose projections:

- Ground Shine
- Inhalation of Resuspended Nuclides.

Ground shine will be the major dose contribution.

Attachment 1 provides for the computation of projected dose by Ground Shine from gamma emitters deposited on the ground.

Attachment 2 provides for the computation of projected dose by Inhalation of Resuspended Nuclides.

Discussion and tables of Dose Conversion Factors are found in, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", EPA 400-R-92-001, EPA, May 1992.

A. Ground Shine Projected Dose -- Attachment 1

The following steps are used to calculate:

- a. First year, second year, and fifty year TEDE doses, based on individual nuclide contributions.
- b. Dose Conversion Factors which convert gamma exposure rate measurements taken at waist level directly into dose that an individual would receive during the first year of exposure, the second year of exposure, and 50 years of exposure.
- c. The exposure rate which corresponds to the Relocation PAG, for the first year of exposure. This value is the dose rate that would define the boundary of the Restricted Zone.

This calculation does not take credit for weathering.

1. Obtain gamma spectral analysis of deposited radionuclides and determine the relative abundance of the principal gamma emitting radionuclides. Analysis of samples from several locations may be necessary to determine whether the relative concentrations of radionuclides are constant. The results should be expressed in pCi/sample. Enter in Column 2 of Attachment 1.
2. Multiply the concentrations in Column 2 by the corresponding values in Column 3 to determine the relative contribution to the gamma exposure rate (mR/hr) at 1 meter and enter the result in Column 7.

3. Multiply the concentrations in Column 2 by the corresponding value in Column 4. Enter the results in Column 8. This gives the first year integrated dose contribution of each radionuclide.
4. Multiply the concentrations in Column 2 by the corresponding value in Column 5. Enter the result in Column 9. This gives second year integrated dose contribution of each radionuclide.
5. Multiply the concentrations in Column 2 by the corresponding value in Column 6. Enter the result in Column 10. This gives the fifty year integrated dose contribution of each radionuclide.
6. Sum the results in Column 7 to determine a total exposure rate (mR/hr) at one meter for the sample being considered. Enter the total value at the bottom of Column 7.
7. Sum the results in Column 8 to determine a total first year integrated dose (mRem). Enter the total value at the bottom of Column 8.
8. Sum the results in Column 9 to determine a total second year integrated dose (mRem). Enter the total value at the bottom of Column 9.
9. Sum the results in Column 10 to determine a total fifty year integrated dose (mRem). Enter the total value at the bottom of Column 10.
10. Calculate the Dose Conversion Factors for the first year, second year, and fifty years, by dividing the Columns 8, 9, and 10 totals (mRem) by the Column 7 total (mR/hr). Enter in the appropriate space for Dose Conversion Factors.
11. Calculate the Exposure Rate (mR/hr) at one meter at the Restricted Area Boundary corresponding to the Relocaton PAG for the first year of exposure by:
$$\frac{\text{Restricted Area Boundary Exposure Rate at 1 meter (mR/hr)}}{\text{Year 1 DCF (mRem/mR/hr)}} = \frac{500 \text{ mRem (Relocation PAG)}}{\text{Year 1 DCF (mRem/mR/hr)}}$$
12. Provide the results of the calculation to the Radiological Assessment Manager.

B. Inhalation Projected Dose -- Attachment 2

The dose from inhalation should be relatively small when compared to the dose from ground shine from gamma emitters. The following procedure may be used to project the first year and second year inhalation dose.

This procedure does not account for weathering.

1. Obtain results of gamma isotopic and Sr-90/Y-90 analysis of air samples from laboratory.
2. Convert if necessary to pCi/m^3 , and enter in Column 2 of Attachment 2.
3. Multiply the entry in Column 2 by the DCF in Column 3 to obtain the first year dose commitment in mRem for each respective radionuclide, and enter the result in Column 5.
4. Sum the results in Column 5 to obtain the total first year dose commitment, and enter the result at the bottom of Column 5.
5. Multiply the entry in Column 2 by the DCF in Column 4 to obtain the second year dose commitment in mRem for each respective radionuclide, and enter the result in Column 6.
6. Sum the results in Column 6 to obtain the total second year dose commitment, and enter the result at the bottom of Column 6.
7. Report the results to the Radiological Assessment Manager.

ATTACHMENT 1 -- GROUND SHINE PROJECTED DOSE

Location: _____ Date: _____

NOTE: NO CREDIT TAKEN FOR WEATHERING.

1	2	3	4	5	6	7	8	9	10
NUCLIDE	SAMPLE CONC (pCi/samp.)	mR/hr pCi/sq. m @ 1 m (a)	Year 1 mRem pCi/sq.m	Year 2 mRem pCi/sq.m	0-50 Years mRem pCi/sq. m	Calculated (mR/hr)	Dose Year 1 (mRem)	at 1 Year 2 (mRem)	meter 0-50 Years (mRem)
Zr-95		1.2E-8	3.8E-5	8.0E-7	3.9E-5				
Nb-95		1.3E-8	(b)	(b)	(b)				
Ru-103		8.2E-9	7.8E-6	0	7.8E-6				
Ru-106		3.4E-9	1.5E-5	7.6E-6	3.0E-5				
Te-132		4.0E-9	3.3E-6	0	3.3E-6				
I-131		6.6E-9	1.3E-6	0	1.3E-6				
I-132		3.7E-8	(b)	(b)	(b)				
I-133		1.0E-8	2.1E-7	0	2.1E-7				
I-135		2.4E-8	1.6E-7	0	1.6E-7				
Cs-134		2.6E-8	1.3E-4	9.6E-5	4.7E-4				
Cs-137		1.0E-8	6.0E-5	5.9E-5	1.8E-3				
Ba-140		3.2E-9	1.2E-5	0	1.2E-5				
La-140		3.5E-8	(b)	(b)	(b)				
					TOTALS:				

(a.) Estimated exposure rate at 1 meter above the contaminated ground.

(b.) Radionuclides that have short-lived daughters (Zr/Nb-95, Ru/Rh-106, Te/I-132, Cs-137/Ba-137m, Ba/La-140) are assumed to quickly reach equilibrium. The integrated dose factors listed are the effective gamma dose due to the parent and daughter.

Reference: EPA 400-R-92-001, May 1992.

Dose Conversion Factors:

$$\text{Year 1 DCF} = \frac{\text{Total of Column 8 (mRem)}}{\text{Total of Column 7 (mR/hr)}} = \frac{\text{mRem}}{\text{mR/hr}}$$

$$= \frac{\text{mRem}}{\text{mR/hr}}$$

ATTACHMENT 1 -- GROUND SHINE PROJECTED DOSE (Continued)

$$\begin{aligned} \text{Year 2 DCF} &= \frac{\text{Total of Column 9 (mRem)}}{\text{Total of Column 7 (mR/hr)}} = \frac{\text{mRem}}{\text{mR/hr}} \\ &= \frac{\text{mRem}}{\text{mR/hr}} \end{aligned}$$

$$\begin{aligned} \text{0-50 Year DCF} &= \frac{\text{Total of Column 10 (mRem)}}{\text{Total of Column 7 (mR/hr)}} = \frac{\text{mRem}}{\text{mR/hr}} \\ &= \frac{\text{mRem}}{\text{mR/hr}} \end{aligned}$$

Exposure Rate at Restricted Area Boundary:

$$\begin{aligned} \text{Exposure Rate (mR/hr) at Restricted Area Boundary} &= \frac{500 \text{ mRem (Relocation PAG -- Year 1)}}{\text{Year 1 DCF (mRem/mR/hr)}} \\ &= \frac{500 \text{ mRem}}{\text{mRem/mR/hr}} \\ &= \text{mR/hr} \end{aligned}$$

ATTACHMENT 2 -- INHALATION OF RESUSPENDED MATERIALS PROJECTED DOSE

Location: _____ Date: _____

NOTE: NO CREDIT TAKEN FOR WEATHERING.

1	2	3	4	5	6
Radionuclide	Concentration (pCi/ cu.m)	mRem/pCi/cu.m Year 1	mRem/pCi/cu.m Year 2	Inhalation Dose (mRem) Year 1	Inhalation Dose (mRem) Year 2
Sr-90/Y-90		1.4E+1	1.3E+1		
Zr-95/Nb-95		7.9E-2	-----		
Ru-103		1.5E-2	-----		
Ru-106/Rh-106		3.7E+0	1.9E+0		
Te-132/I-132		1.3E-3	-----		
I-131		1.1E-2	-----		
Cs-134		4.1E-1	3.0E-1		
Cs-137/Ba-137m		3.3E-1	3.2E-1		
Ba-140/La-140		4.7E-3	-----		
Ce-144/Pr-144		2.7E+0	9.8E-1		
			TOTALS:		

NOTE: Short lived daughters are not listed separately because the entries include the dose from both the daughter and the parent. These factors are based on the concentration of the parent only, at the beginning of the exposure period.

Reference: EPA 400-R-92-001, May 1992.

SAMPLE CONTROL AND CHAIN OF CUSTODY

PURPOSE:

The purpose of this procedure is to provide instructions for uniquely identifying samples, completing RML required documentation and for insuring a chain of custody is maintained while transferring each sample from location to location.

This procedure should be used whenever any samples are to be sent to a laboratory for analysis.

CONTENTS:

SAMPLE CONTROL	SECTION 1
DEP LABORATORY SAMPLE SUBMISSION SHEET	SECTION 2
CHAIN OF CUSTODY	SECTION 3

SECTION 1 SAMPLE CONTROL

1. Sample control is a means of uniquely identifying each sample taken regardless of type of sample. The Sample Control number will be a combination of the Sequence number and the date..
2. Sequence number is developed as follows:

The first digit is derived by using the Field team identifier and modifying it to a numerical value.

TEAM A = 1
TEAM B = 2
TEAM C = 3
TEAM D = 4
TEAM E = 5
TEAM F = 6
TEAM G = 7
TEAM H = 8
TEAM I = 9

The next two digits are simply the order in which the samples are taken for the day:

The first sample is 01, second is 02, etc. Each team is to maintain a log of the numbers assigned to each samples using Attachment 1.

3. Examples:

Team B's second sample of the day would =

2 (Team B) 02 (second sample) , Sequence number = 202

The date is 01/01/03, therefore the Sample Control number (which is a combination of the sequence number and the date) would be:

202010103.

4. Record this value on the "DEP Laboratory Sample Submission Sheet" in the Sequence number and date fields.

SECTION 2 DEP LABORATORY SAMPLE SUBMISSION SHEET

1. Fill out the applicable sections of the "DEP Laboratory Sample Submission Sheet." Attachment 2. Be sure that all of the information is included:
 - a. Collector ID = **5999**
 - b. Sequence # - as described in Section 1: Sample Control
 - c. Date (if not already completed from Section 1) and time collected
 - d. SAC or Suite code as follows:

Air Sample Filter	- 99
Air Sample charcoal	- 60
Both	- 98
Water Sample, snow	- 96
Soil Sample	- 95
Milk Sample	- 94
Vegetation Sample	- 05
 - e. Reason code as follows:

Drill	- 88
Emergency	- 99
 - f. Cost Center - 029
 - g. Program - 0014 (normal code for Radiation Protection)
 - h. Matrix code as follows:

Water	- 001
Stored Animal Feeds	- 015
Stored food crops	- 015
Forage, unharvested crops	- 015
Vegetation	- 015
Other food items	- 015
Soil	- 009
Milk	- 018
Fauna	- 014
 - i. Collector name and phone number
 - j. Sample Location (use GPS latitude and longitude if available)
 - k. Size of area sampled (if applicable)
 - l. Radiation dose rate reading at the sampling location (waist height)
 - m. Radiation dose rate reading at 1" from sample
 - n. For milk samples only: provide date of last pick-up from bulk tank, and number of milkings since last bulk pick-up
 - o. If sample is being delivered to RML, RML Liaison will review Sample Submission sheet prior to submittal for analysis.

SECTION 3 CHAIN OF CUSTODY

1. Chain of custody is a means of ensuring that the sample taken and the documentation completed remains accurate from "birth to death" of the sample.
2. The Field Teams taking the original sample(s) that must be transported to a laboratory for analysis will initiate chain of custody by starting Attachment 1, "Chain of Custody Record."
3. Samples taken that are being transported to the same location may be listed on the same "Chain of Custody Record."
4. Complete :

- a. Project name
- b. Sampler(s) signature

For each sample being transferred to same location complete:

- a. Location sampled
 - b. # of containers within each sample
 - c. Sample Description
 - d. Sample Control Number
 - e. Date and Time
5. Upon arrival at a sample transfer location, the teams delivering the sample(s) will complete the "Relinquished by" portion of the "Chain of Custody Record".
 6. The individual taking possession of the sample(s) shall complete the "Received by" portion of the "Chain of Custody Record".
 7. If the location taking possession of the sample is the laboratory that will perform the analysis, the individual accepting the sample should complete the "Received by lab" portion of the "Chain of Custody Record".

Fixed: _____
HNO₃: _____
HCHO: _____

DEP Laboratory
Sample Submission Sheet

Lab Use Only
Lab Number: _____
Date Received: _____

Sequence
***Collector ID *Number:**

5 9 9 9

*** Date Collected (MMDDYY)* Time Collected:**

SAC/Suite Code (see below)

RAD

***Reason:**

***Cost Center:**

***Program**

Legal Seal Number:

_____ Yes No
_____ Yes No
_____ Yes No

88-Drill
99-Emergency

029 - Nuclear Power Plant
031 - Radiation Protection

0014 - Radiation Protection

***Matrix Code**
(see below)

***Collector Name:** _____

***Collector Phone Number:** _____

How Shipped:	Date:	How Shipped:	Date:	How Shipped:	Date:
Received by:	Date:	Received by:	Date:	Received by:	Date:

Location Collected: _____ **Lat./Long.:** _____ / _____

Facility/Incident: _____ **Waist level Meter Open/Closed:** _____

Air Sample **Filter:** Matrix - 016 **Charcoal:** Matrix - 017 **Both:** Matrix - 019
SAC - RAD 99 SAC - RAD 60 SAC - RAD 98

Volume Sampled: _____ **Weather Conditions:** _____

Meter Closed@1" from Sample: _____ **Comments:** _____

Water Sample - Matrix - 001 **Ground Water:** **Surface Water:** **Private Well:** **Snow:**
SAC - RAD - 96

Volume Sampled: _____ **Weather Conditions:** _____

Meter Closed@1" from Sample: _____ **Comments:** _____

Soil Sample - Matrix - 009
SAC - RAD 95

Volume Sampled: _____ **Weather Conditions:** _____

Meter Closed@1" from Sample: _____ **Comments:** _____

Milk Sample - Matrix - 018
SAC - RAD 94

Volume Sampled: _____ **Weather Conditions:** _____

Meter Closed@1" from Sample: _____ **Comments:** _____

Vegetation Sample - Matrix - 015 **Variety:** _____
SAC - RAD 05

Volume Sampled: _____ **Weather Conditions:** _____

Meter Closed@1" from Sample: _____ **Comments:** _____

BRP EMERGENCY PLAN

SECTION 9.0

SITE SPECIFIC DESCRIPTIONS

BRP-ER-9A	Beaver Valley Power Station (BVPS)
BRP-ER-9B	Limerick Generating Station (LGS)
BRP-ER-9C	Peach Bottom Atomic Power Station (PBAPS)
BRP-ER-9D	Susquehanna Steam Electric Station (SSES)
BRP-ER-9E	Three Mile Island (TMI)

APPENDIX 9A

BEAVER VALLEY SITE-SPECIFIC DESCRIPTION

Site Description

Beaver Valley Power Station (BVPS) Units 1 and 2 are pressurized water reactors, each rated at approximately 850 Mw(e). The facility is operated by First Energy Nuclear Operating Company.

The exclusion zone radius is 2,000 feet or about 0.4 miles.

A diagram of the site is shown on Attachment 1.

Location and Physical Description

BVPS is located on a 500 acre site on the south bank of the Ohio River in Shippingport Borough, Beaver County, Pennsylvania.

The 10-mile EPZ contains portions of Beaver County, Pennsylvania; Columbiana County, Ohio; and Hancock County, West Virginia. No community within the 10-mile EPZ has a population in excess of 15,000.

The Ohio River in the vicinity of the site is about 1 mile wide and the plant is situated in the south bank flood plain. The normal water elevation is about 664 feet mean sea level (MSL). The minimum plant grade is 730 feet MSL. The probable maximum flood is estimated to produce a water elevation of 730 feet MSL. The plant is protected from floods of that magnitude by technical specifications and by safety features added to the intake structure (the only safety-related structure that would be affected).

The major topographical features are the Ohio River and Beaver River, and the mountainous character of the area with numerous steep ridges and small valleys. The tops of nearby ridges reach an elevation of 400-500 feet above the river valley floor. Critical site meteorology is governed by these local topographic features. Although the synoptic pattern follows the prevailing westerly and northwesterly wind pattern, the steep-sided river valley tends to produce a channel effect. This channeling effect produces predominant wind directions along the axis of the valley. Another important terrain effect is the relatively high frequency of night-time inversion conditions and fog formation.

The closest major airport is Pittsburgh International Airport, approximately 15 miles southeast of the site.

Emergency Operations Facility (EOF)

The BVPS EOF is collocated with the Technical Support Center in the Emergency Response Facility (ERF), approximately 1200 feet from the site. The location of the ERF is shown in page Attachment 2. The layout of the ERF is shown in on Attachment 3.

In the event that the primary EOF is uninhabitable, the EOF will be relocated to the Alternate EOF at the Airport Industrial Park on Spring Run Road near the Pittsburgh International Airport. The location of the Alternate EOF is shown on Attachment 4.

Neighboring States

Neighboring states within the 10-mile and 50-mile EPZs are as follows:

10-mile EPZ

Ohio
West Virginia

50-mile EPZ

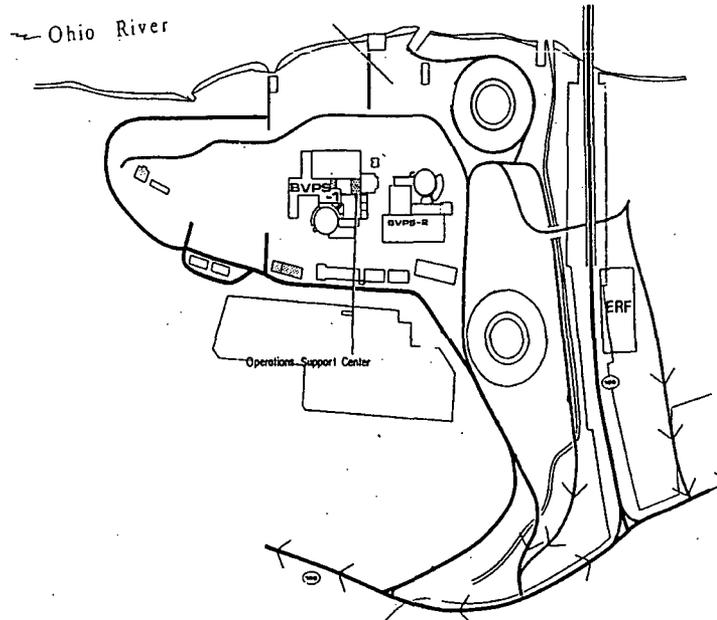
Ohio
West Virginia

A map of the 10-mile EPZ is shown on Attachment 5. A map of the 50 mile EPZ is shown on Attachment 8.

Letters of Agreement with Ohio are on Attachment 6 and West Virginia are on Attachment 7.

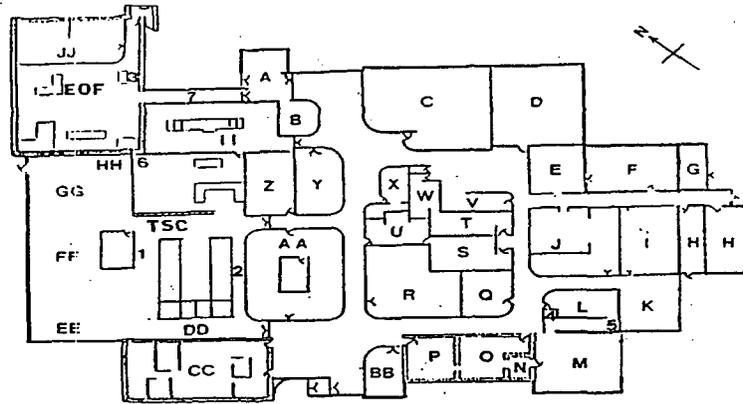
ATTACHMENT 2

LOCATION OF BVPS EMERGENCY RESPONSE FACILITY (ERF)



ATTACHMENT 3

LAYOUT OF BVPS EMERGENCY RESPONSE FACILITY (ERF)



AREA DESIGNATIONS

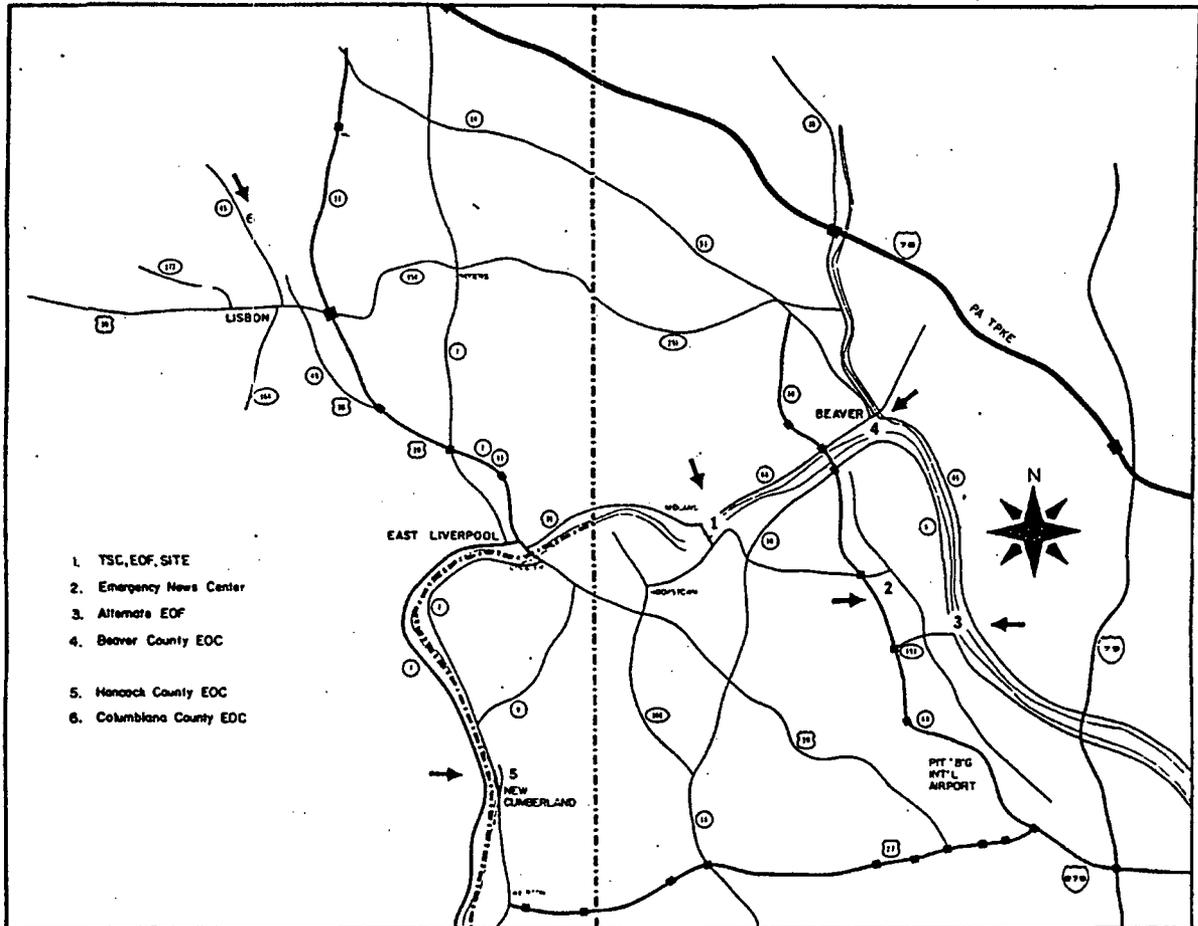
- | | |
|---------------------------------|--|
| A. Non-Emergency Entrance | S. Men's Sleeping Area |
| B. Computer Group Office | T. Women's Sleeping Area |
| C. Engineering | U. Men's Restroom |
| D. Office/Conference Room | V. Kitchen and Lunch Room |
| E. Electrical Distribution Room | W. Women's Restroom |
| F. Equipment Court | X. Medical Room |
| G. Water Treatment Room | Y. Communications Equipment Room |
| H. Electrical Control Room | Z. Engineering Manager's Office |
| I. Switchgear Room | AA. Engineering Management Services/NRC Area |
| J. UPS Battery Room | BB. Radcon Files |
| K. Mechanical Equipment Room | CC. Dosimetry Area |
| L. Service Dock | DD. Communications Area |
| M. Decon Room/Shower | EE. Environmental Station/LLEA |
| N. Garage/Emergency Entrance | FF. Rad Health Services/LLEA |
| O. Irradiation Facility | GG. Radiological Engineering |
| P. Chemistry Sample Prep Room | HH. Helon Storage/LLEA |
| Q. Chemistry Counting Room | II. Comp. Maint./Conf. Room |
| R. X-ray Room | JJ. Computer Room |
| S. Records Room | |

EPP CABINETS

1. TSC Cabinets 1,2,3
2. TSC Cabinets 4-10
3. EGF Cabinets 1,2,3
4. Access Area/Ran Van Supplies
5. Personnel Decon Cabinet & Decon Kit #2
6. Break Glass Box
7. EGF Air Sample Equip. Cart

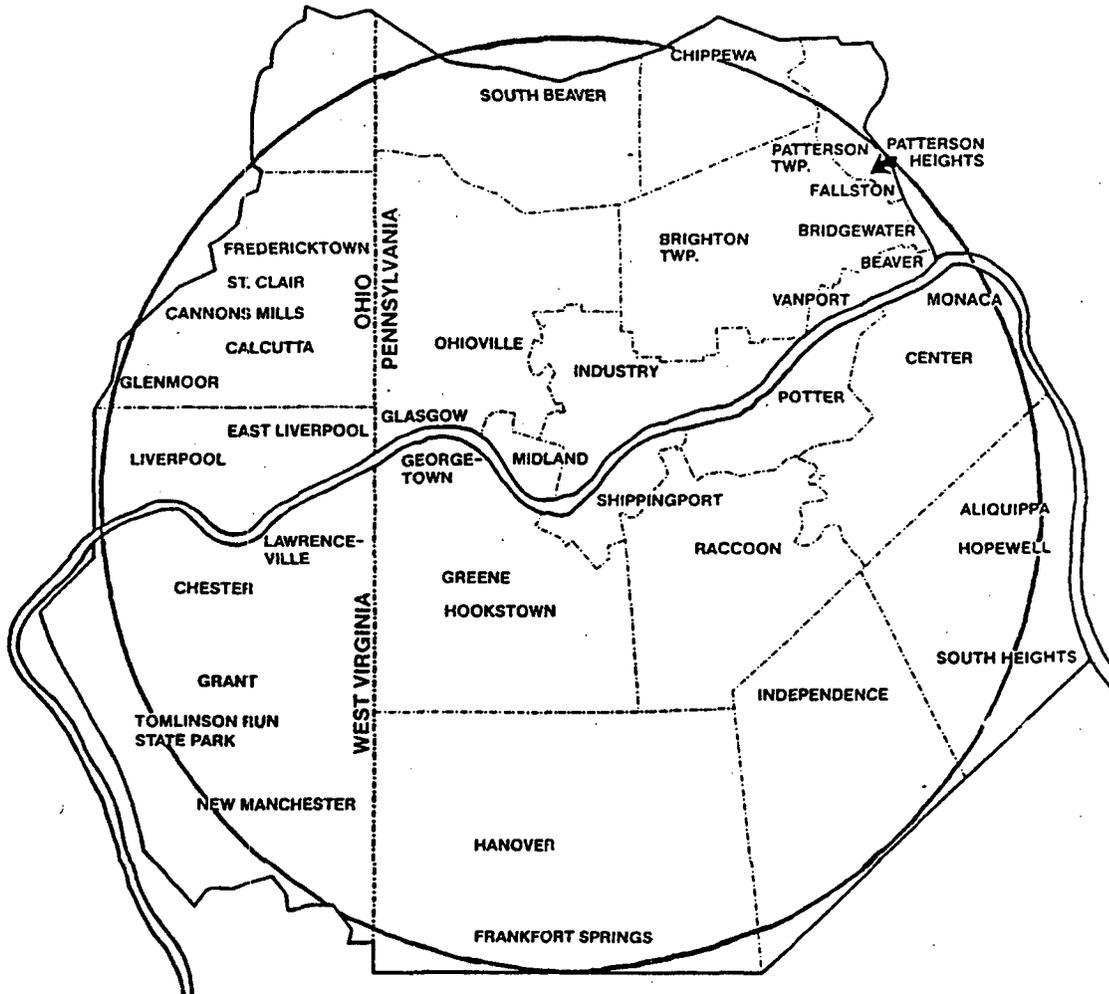
ATTACHMENT 4

LOCATION OF BVPS ALTERNATE EMERGENCY OPERATIONS FACILITY (EOF)



ATTACHMENT 5

BVPS 10-MILE EMERGENCY PLANNING ZONE (EPZ)



ATTACHMENT 6

PENNSYLVANIA-OHIO RADIATION PROTECTION MEMORANDUM OF UNDERSTANDING

I. Purpose

This memorandum of understanding between the Pennsylvania Department of Environmental Resources Bureau of Radiation Protection (hereafter PA BRP) and the Ohio Department of Health Radiological Health Program (hereafter ORHP) expresses the desire of both parties to cooperate in the exchange of information and in the development of protective action recommendations, in response to accidents at The Beaver Valley Power Station in Pennsylvania and Perry Nuclear Power Plant in Ohio.

This memorandum of understanding supplements the memorandum of understanding between the Pennsylvania Emergency Management Agency (PEMA) and the Ohio Disaster Services Agency (OSDA) of June 19, 1987.

The geographic areas of interest include the 10 mile Plume Emergency Planning Zone and the 50 mile Ingestion Emergency Planning Zone surrounding Beaver Valley Power Station, portions of which are located in Ohio. The areas of interest also include the 50 mile Ingestion Emergency Planning Zone surrounding the Perry Nuclear Power Plant, a portion of which is located in Pennsylvania.

II. Agreement

A. Notification

1. PABRP will make confirmatory notification to ORHP upon occurrence of an Unusual Event, Alert, Site Emergency, or General Emergency at Beaver Valley Power Station.
2. ORHP will make a confirmatory notification to PABRP upon occurrence of an Alert, Site Emergency, or General Emergency at Perry Nuclear Power Plant.
3. For accidents at Beaver Valley Power Station with a classification of Site Emergency or higher, PABRP assessment staff will collocate with PEMA at the State EOC. A partial collocation may occur at Alert. (Telephone and Telefax numbers are provided on the attachment.)
4. For accidents at Beaver Valley Power Station or Perry Nuclear Power Plant with a classification of Site Emergency or higher, ORHP assessment staff will collocate with OSDA at the State EOC. A partial collocation may occur at Alert. (Telephone and Telefax numbers are provided on the attachment.)
5. The 24-hour emergency notification numbers are: PEMA 717-651-2001; and OSDA 614-889-7150.

ATTACHMENT 7

Pennsylvania - West Virginia Radiation Protection Agreement

I. Purpose

The purpose of this agreement is to establish the parameters upon which the Pennsylvania Bureau of Radiation Protection (PABRP) will exchange information and make protective action decisions with the West Virginia Department of Health/Industrial Hygiene Division (WVDOH/IHD).

This agreement supplements the Memorandum of Understanding between the Pennsylvania Emergency Management Agency (PEMA) and the West Virginia Office of Emergency Services (WVOES).

II. Agreement

The following items are agreed to by the WVDOH/IHD and PABRP:

- A. All major protective action recommendations will be discussed together before any final decisions are made to implement them. The possibility that the States may take unilateral action on such recommendations is recognized.
- B. The WVDOH/IHD will accept PABRP's assessment during the duration of the incident. This will not preclude the WVDOH/IHD from making an independent assessment.
- C. Monitoring team leaders from Pennsylvania and West Virginia will be located together in the Emergency Operations Facility (EOF).
- D. The WVDOH/IHD may send a liaison to the PABRP Assessment Center.
- E. PABRP will establish telephone contact with the WVDOH/IHD.
- F. PABRP will give the following information to the WVDOH/IHD: weather data; status of reactor safety system; and/or water contamination; source term; dose estimate; 50 mile EPZ significance; reactor prognosis; and recommendations.
- G. The WVDOH/IHD will supply the PABRP with its team monitoring and food contamination data. This will normally be accomplished via the EOF dedicated phone to the PABRP Assessment Center. PABRP will reciprocate.
- H. The results of all accident related measurements generated by PABRP and/or WVDOH/IHD shall be reconciled within 30 days of the closeout of an accident involving measurements by either party.

APPENDIX 9B

LIMERICK SITE-SPECIFIC DESCRIPTION

Site Description

The Limerick Generating Station (LGS) Units 1 and 2 are boiling water reactors, each rated at 1050 Mw(e). The facility is operated by Exelon.

The exclusion zone radius is 2500 feet, or about 0.5 miles.

A diagram of the site is shown in Attachment 1.

Location and Physical Description

LGS is located on the east bank of the Schuylkill River in Montgomery County, Pennsylvania.

The 10-mile EPZ contains portions of Montgomery, Chester, and Berks Counties. The closest population center is the Borough of Pottstown, located 1.7 miles northwest of the site, with a population of approximately 22,000.

Elevations in the site area range from 110 feet mean sea level (MSL) at the river to 300 feet MSL. The plant is at about 217 feet MSL.

The closest major airport is in Philadelphia, approximately 30 miles southeast of the site. Several smaller airports are located within the 10-mile EPZ which service private aircraft.

Emergency Operations Facility (EOF)

The LGS EOF is located 20 miles southwest of the site near Coatesville, Pennsylvania. The EOF is a common facility for Limerick, Peach Bottom and TMI. The location of the EOF is shown in Attachment 2. The layout of the EOF is shown in Attachment 3.

Neighboring States

Neighboring states within the 10-mile and 50-mile EPZs are as follows:

10-mile EPZ

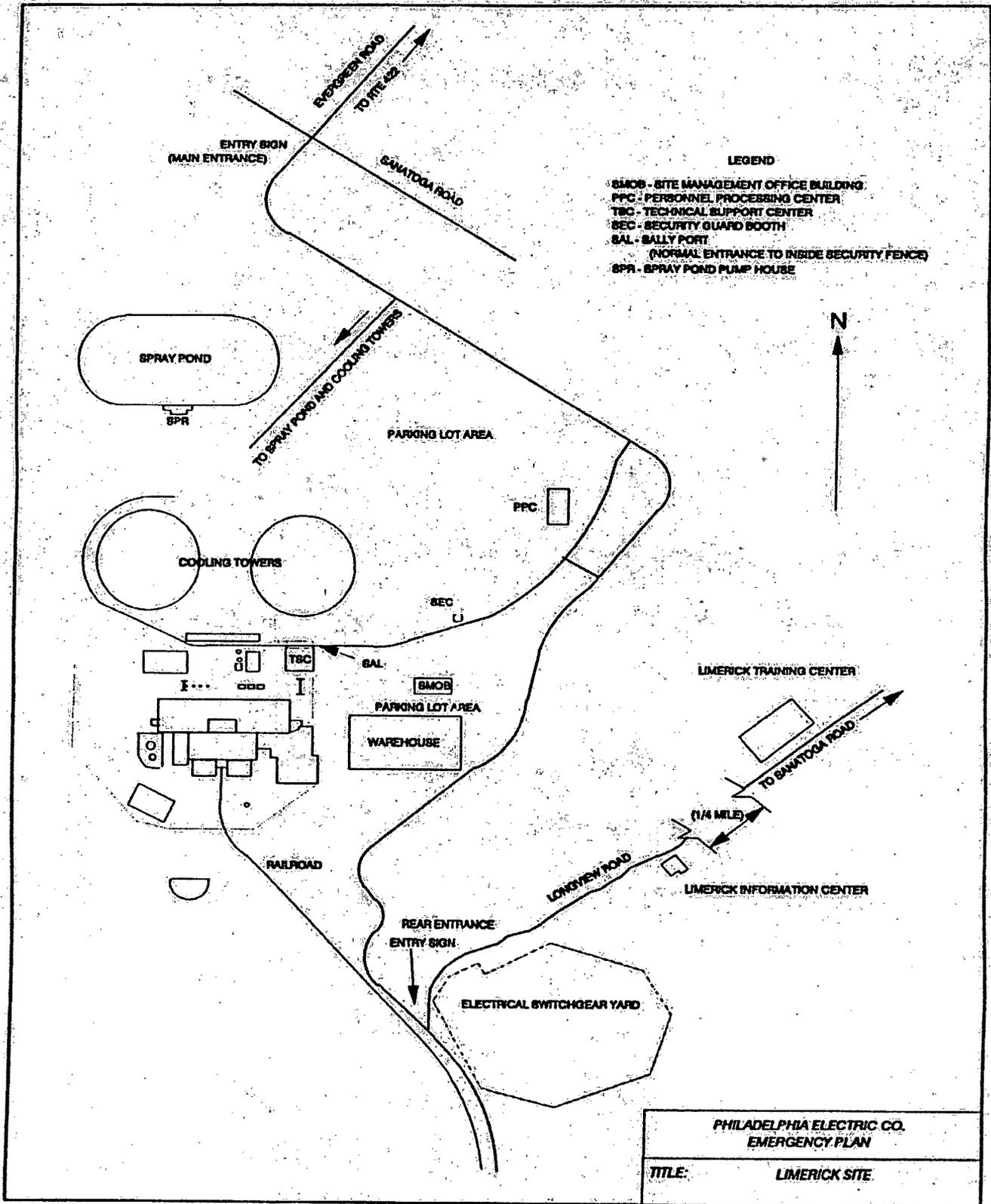
None

50-mile EPZ

Maryland
New Jersey
Delaware

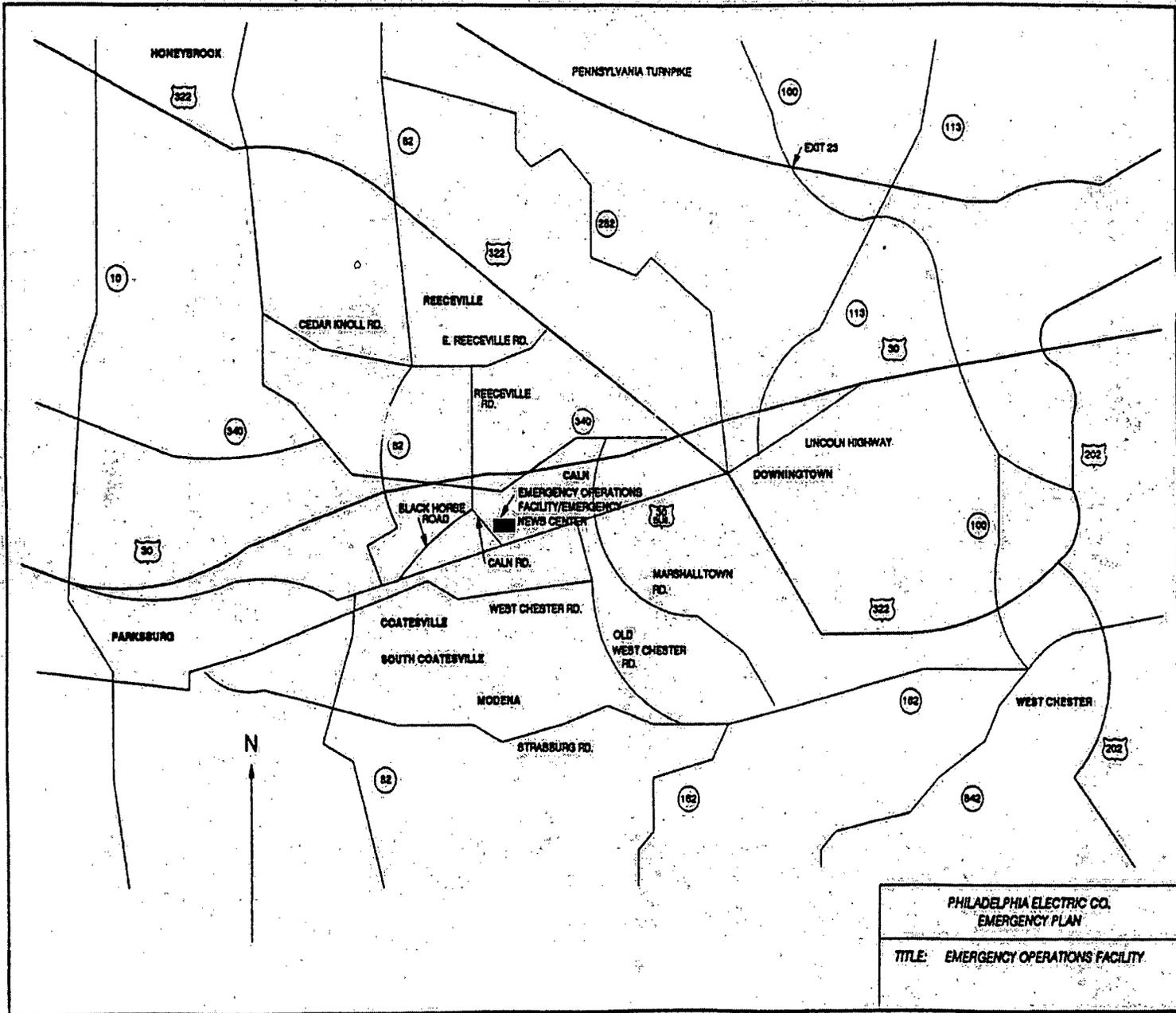
Maps of the 10-mile and 50-mile EPZs are shown in Attachments 4 and 5.

ATTACHMENT 1
 LGS SITE MAP



PHILADELPHIA ELECTRIC CO. EMERGENCY PLAN	
TITLE:	LIMERICK SITE

LOCATION OF LGS EMERGENCY OPERATIONS FACILITY (EOF)

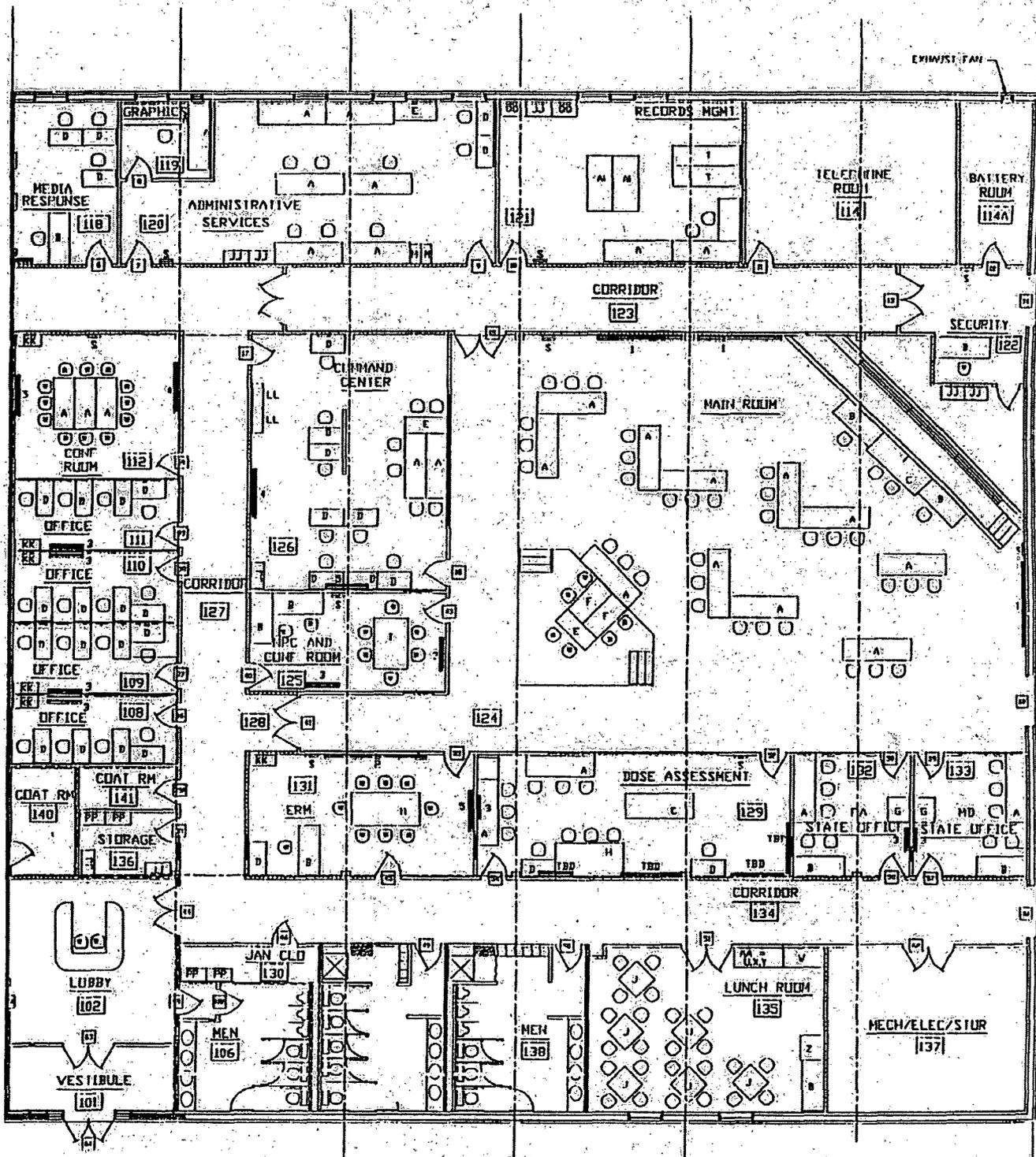


PHILADELPHIA ELECTRIC CO.
EMERGENCY PLAN
TITLE: EMERGENCY OPERATIONS FACILITY

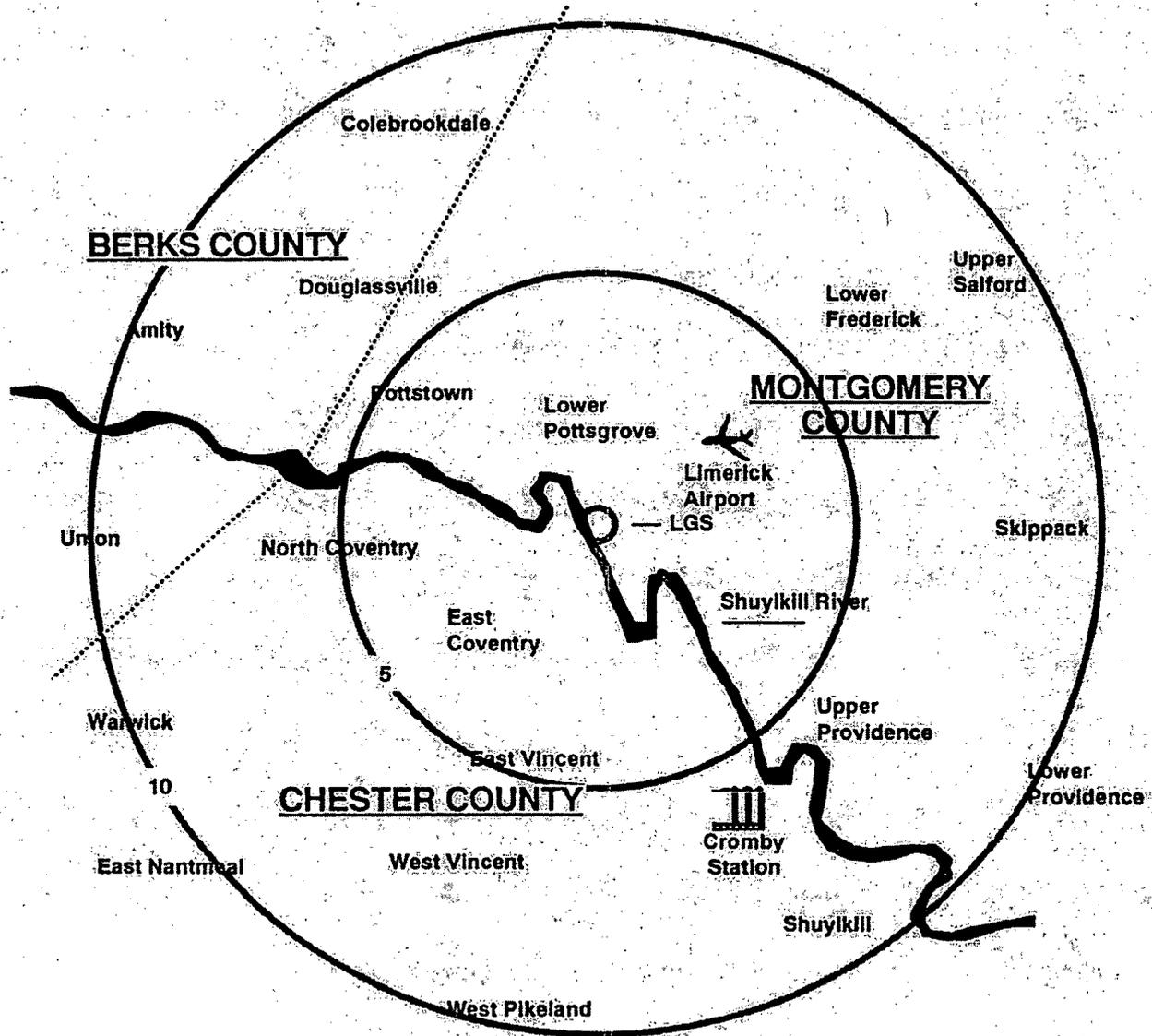
ATTACHMENT 2

ATTACHMENT 3

LAYOUT OF THE LGS EMERGENCY OPERATIONS FACILITY (EOF)

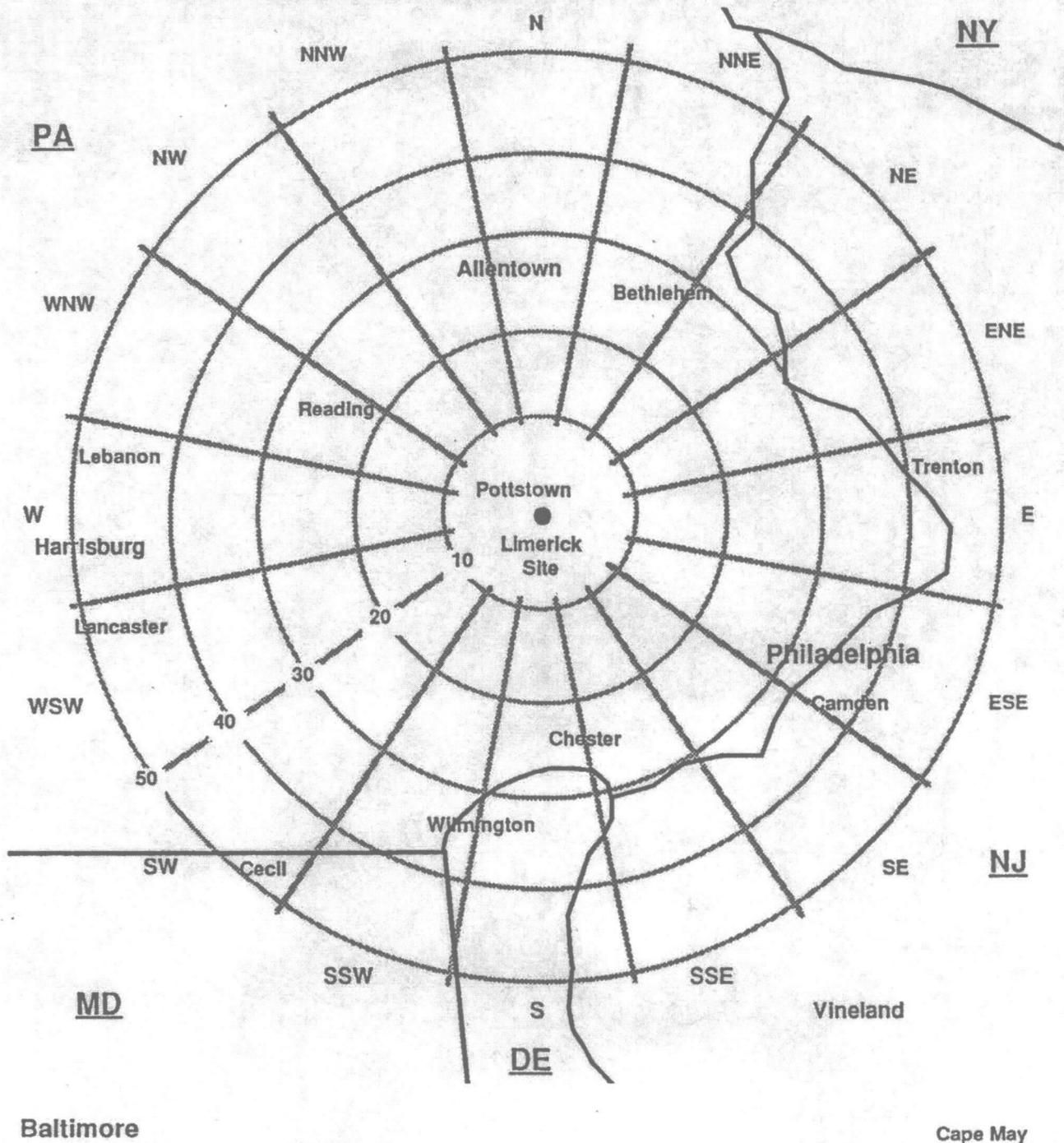


ATTACHMENT 4
LIMERICK
10 MILE PLUME EXPOSURE PATHWAY (EPZ)



ATTACHMENT 5

50 MILE INGESTION EXPOSURE PATHWAY (EPZ)



APPENDIX 9C

PEACH BOTTOM SITE-SPECIFIC DESCRIPTION

Site Description

The Peach Bottom Atomic Power Station (PBAPS) Units 2 and 3 are boiling water reactors, each rated at 1065 Mw(e). Unit 1, a 40 Mw high temperature gas-cooled reactor, has been decommissioned and defueled. The facility is operated by Exelon.

The exclusion zone radius is 2700 feet, or about 0.5 miles.

A diagram of the site is shown in Attachment 1.

Location and Physical Description

PBAPS is located on a 620 acre site on the western shore of Conowingo Pond on the Susquehanna River in southern York County, Pennsylvania.

The 10-mile EPZ contains portions of York and Lancaster Counties in Pennsylvania and Cecil and Harford Counties in Maryland. No community within the 10-mile EPZ has a population in excess of 15,000.

Conowingo Pond, which separates York and Lancaster Counties, is a reservoir formed by the backwater of Conowingo Dam, 9 miles downstream of the site. The normal pool elevation is 109 feet mean sea level (MSL). The maximum flood will produce an estimated pond elevation of 132 feet MSL. Critical safety features are flood protected to 135 feet MSL. Technical specifications require initiation of safe shutdown procedures when the water level at Conowingo Dam reaches 114 feet MSL.

The closest major airport is Harrisburg International Airport, approximately 50 miles northwest of the site. A smaller airport servicing commuter and private aircraft is located in Lancaster, approximately 25 miles north of the site.

Emergency Operations Facility (EOF)

The PBAPS EOF is located 31 miles northeast of the site near Coatesville, Pennsylvania. The EOF is a common facility for Peach Bottom, Limerick and TMI. The location of the EOF is shown in Attachment 2. The layout of the EOF is shown in Attachment 3.

Neighboring States

Neighboring states within the 10-mile and 50-mile EPZs are as follows:

10-mile EPZ

Maryland

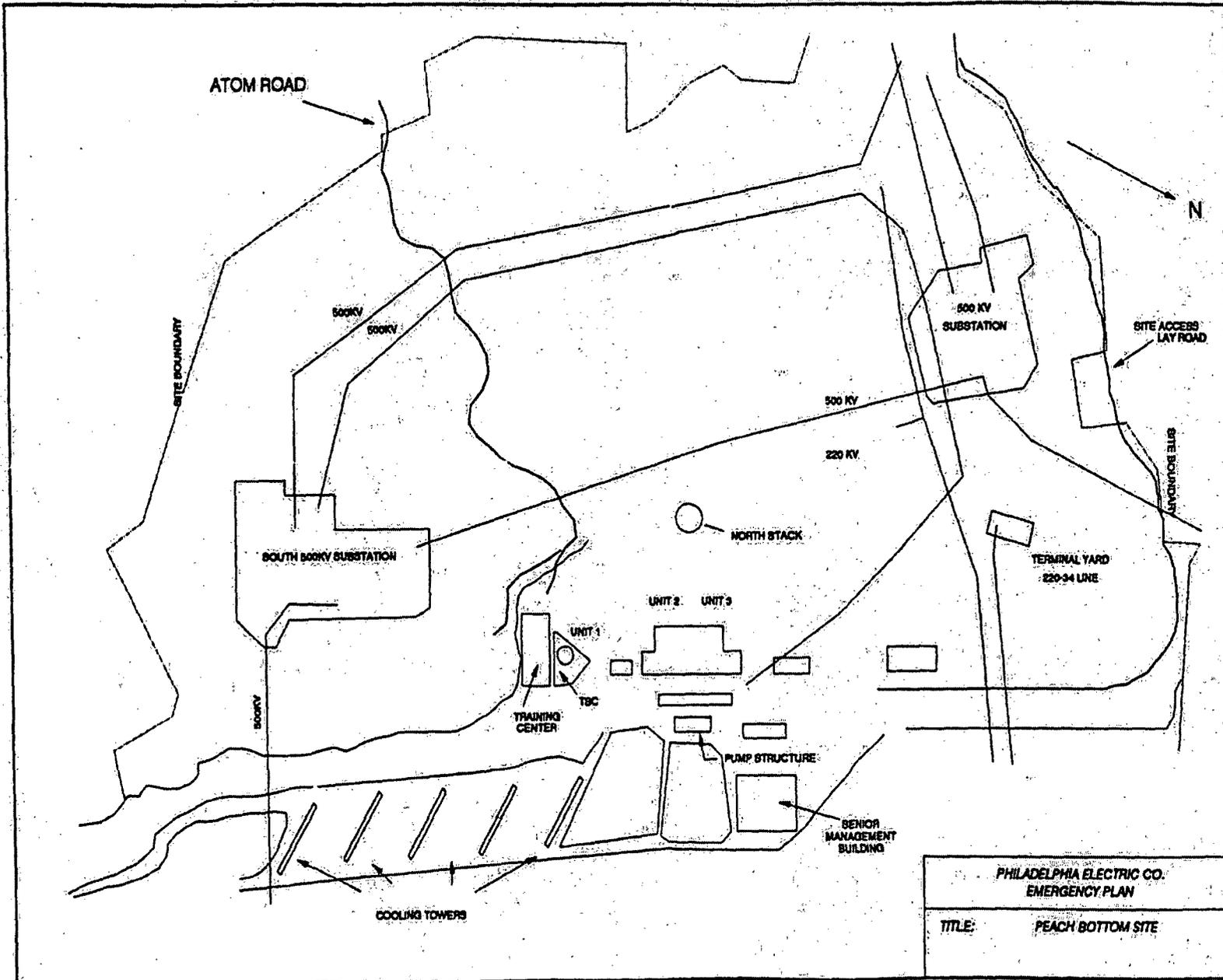
50-mile EPZ

Maryland
New Jersey
Delaware

Maps of the 10-mile and 50-mile EPZs are shown in Attachments 4 and 5.

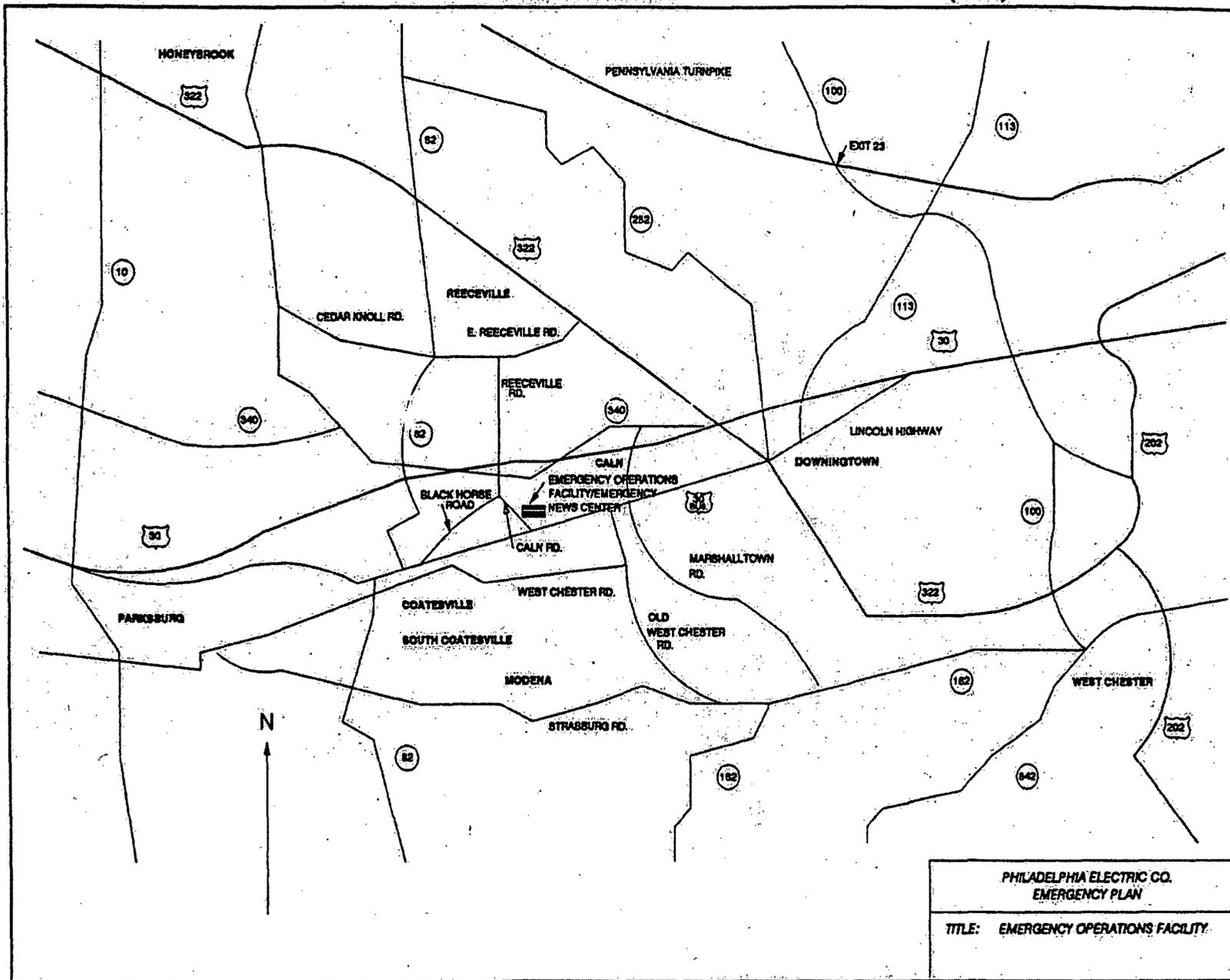
A Letter of Agreement with Maryland is shown in Attachment 6.

PEACH BOTTOM SITE MAP



ATTACHMENT 1

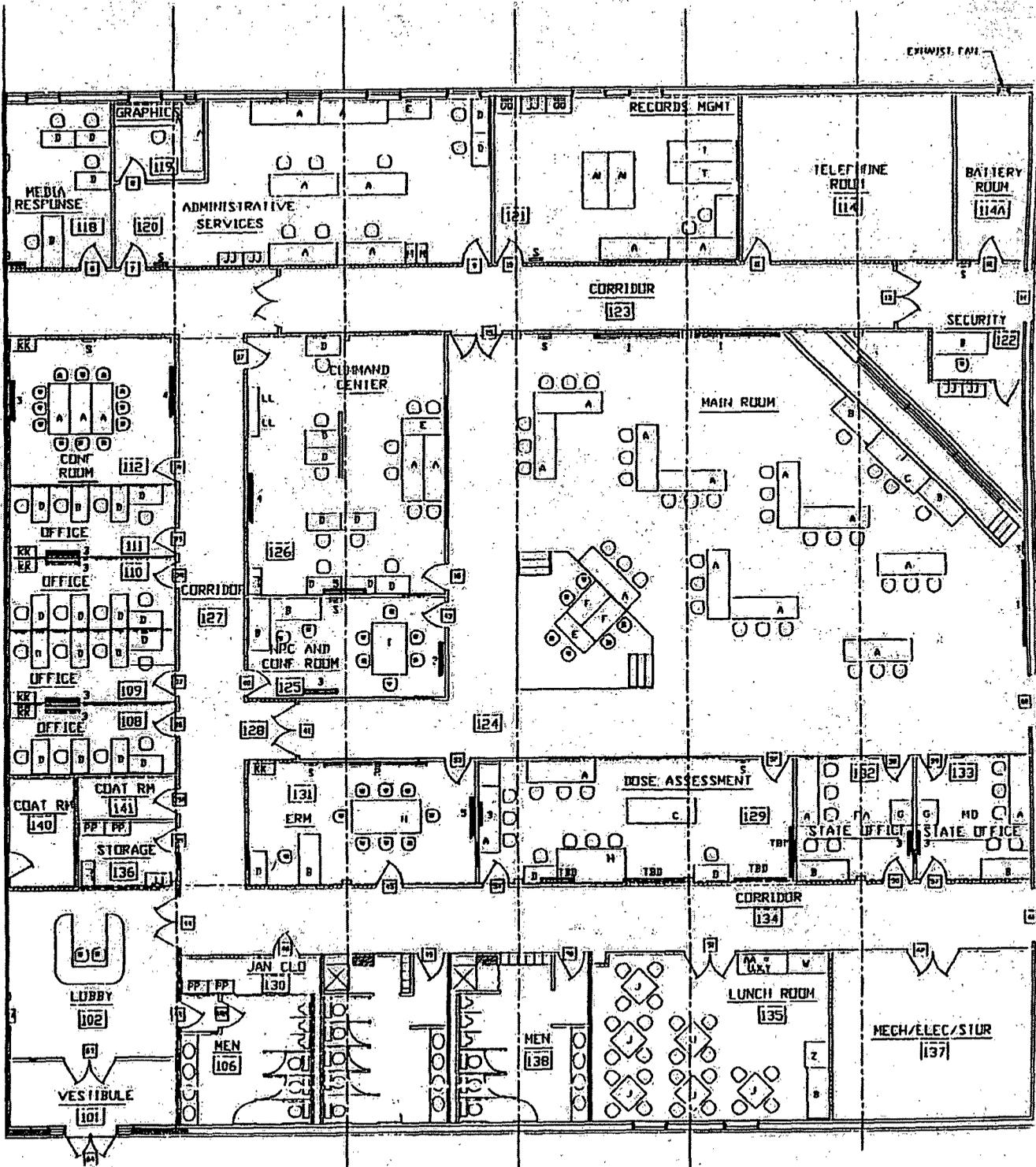
LOCATION OF PBAPS EMERGENCY OPERATIONS FACILITY (EOF)



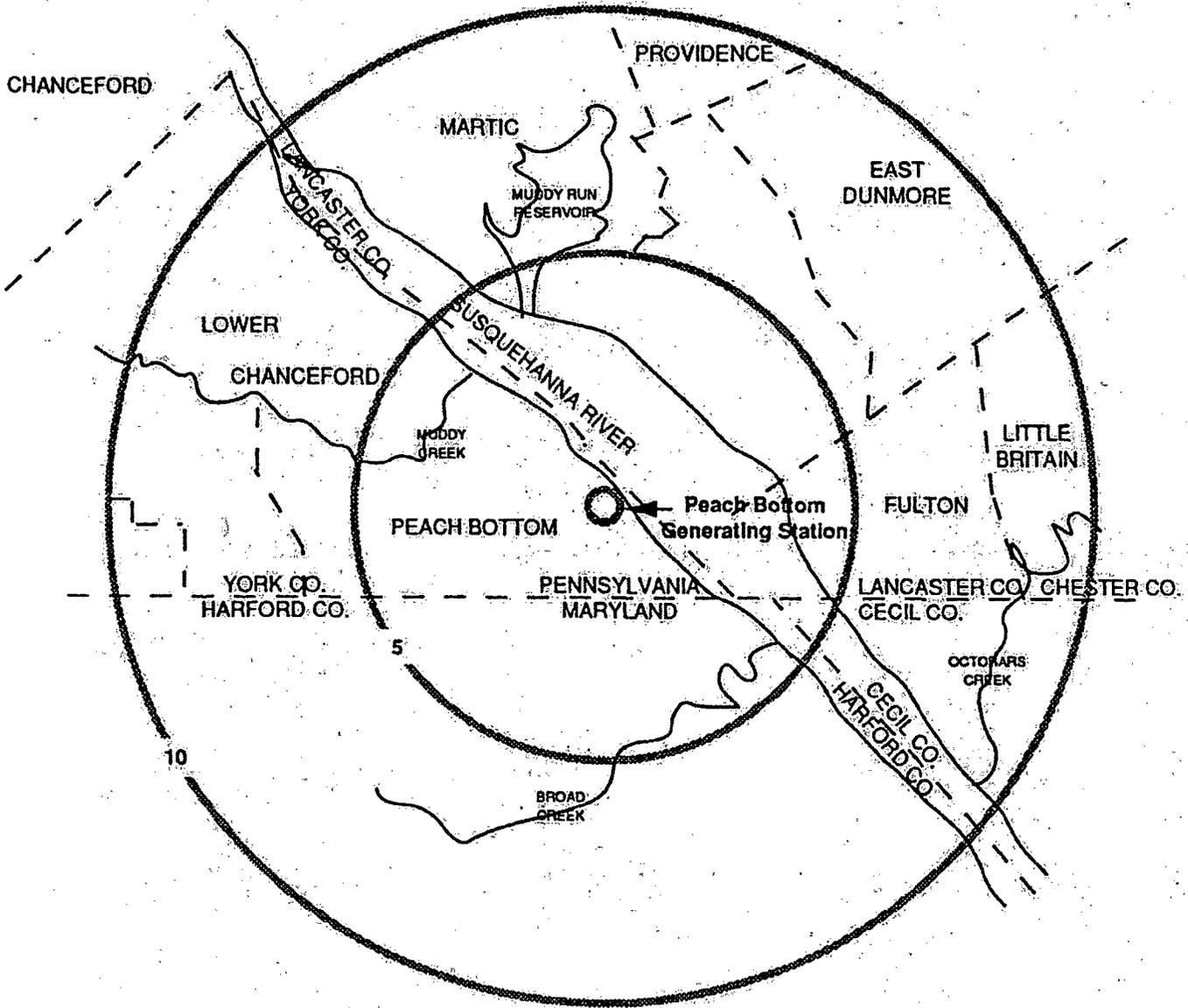
PHILADELPHIA ELECTRIC CO. EMERGENCY PLAN
TITLE: EMERGENCY OPERATIONS FACILITY

ATTACHMENT 2

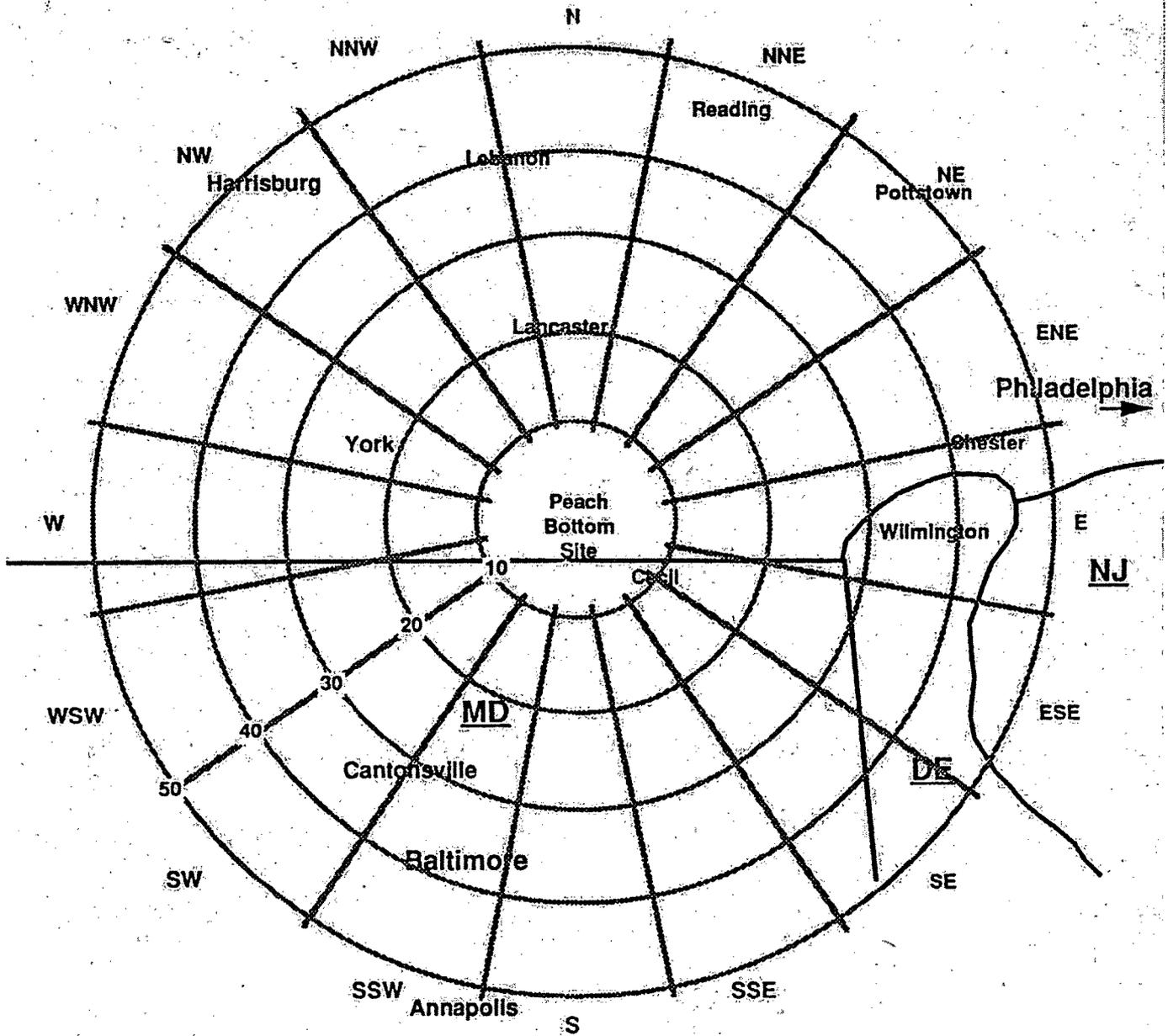
ATTACHMENT 3
LAYOUT OF PEACH BOTTOM EOF



ATTACHMENT 4
PEACH BOTTOM
10 MILE PLUME EXPOSURE PATHWAY (EPZ)



ATTACHMENT 5
50 MILE INGESTION EXPOSURE PATHWAY (EPZ)



ATTACHMENT 6

Pennsylvania-Maryland Radiation Protection Agreement

I. Purpose

This agreement establishes the intentions of the Pennsylvania Bureau of Radiation Protection (PABRP) and the Maryland Center for Radiological Health (MDE-CRH) to exchange information and to notify the other party of recommendations and decisions made during fixed nuclear facility (FNF) incidents to which both agencies are responding.

This agreement supplements the Memorandum of Understanding between the Pennsylvania Emergency Management Agency (PEMA) and the Maryland Emergency Management and Civil Defense Agency (MEM & CDA).

II. Agreement

The following describes the areas of agreement between PABRP and MDE-CRH:

- A. During Alert, Site Area, and General emergencies PABRP will establish contact with MDE-CRH using the most reliable system available (e.g.: dedicated telephone lines; commercial telephone; radio; etc.). This will be the primary means for exchange of information.
- B. The MDE-CRH may send a liaison to the PABRP Assessment Center. The PABRP may send a liaison to the MDE-CRH Accident Assessment Center.
- C. PABRP and MDE-CRH will independently assess the incident when possible. Each will notify the other agency of its assessment results.
- D. Whenever practicable, all major protective action recommendations will be discussed together before final decisions are made to implement them. We recognize the possibility that either State may take unilateral action on a recommendation, or may initiate protective actions without discussions with the other state.
- E. PABRP will give the following information to MDE-CRH: weather data; status of reactor safety systems; and/or water contamination; source terms; dose estimates; 50 mile EPZ significance; reactor prognosis; and recommendations. MDE-CRH will reciprocate to the extent possible when requested by PABRP.

APPENDIX 9D

SUSQUEHANNA STEAM SITE-SPECIFIC DESCRIPTION

Site Description

The Susquehanna Steam Electric Station (SSES) Units 1 and 2 are boiling water reactors, each rated at 1050 Mw(e). The facility is operated by Pennsylvania Power and Light Company.

The exclusion zone radius is 1800 feet, or about 0.3 mile.

A diagram of the site is shown on Attachment 1.

Location and Physical Description

SSES is located on the west bank of the Susquehanna River in Salem Township, Luzerne County, Pennsylvania.

The 10-mile EPZ contains portions of Luzerne County and Columbia County. No community within the 10-mile EPZ has a population in excess of 15,000.

The normal pool elevation of the Susquehanna River in this area is 480 feet mean sea level (MSL). The topography of the plant is hilly with elevations ranging from 500 feet at the Susquehanna River to about 1600 feet MSL at the northern boundary. The station itself is located above the floodplain.

The closest airport is Berwick Airport, southwest of the site, which services private aircraft. The closest major airport is Wilkes-Barre/Scranton Airport, 28 miles northeast of the site.

Emergency Operations Facility (EOF)

The SSES EOF is located about 21 miles northeast of the site. The EOF is located on East Mountain Road in Plains Township, off PA Route 115 (five miles north of exit 36 of the Northeast Extension of the Pennsylvania Turnpike and one mile south of exit 47A of Interstate 81). The location of the EOF is shown on Attachment 2. The layout of the EOF is shown on Attachment 3.

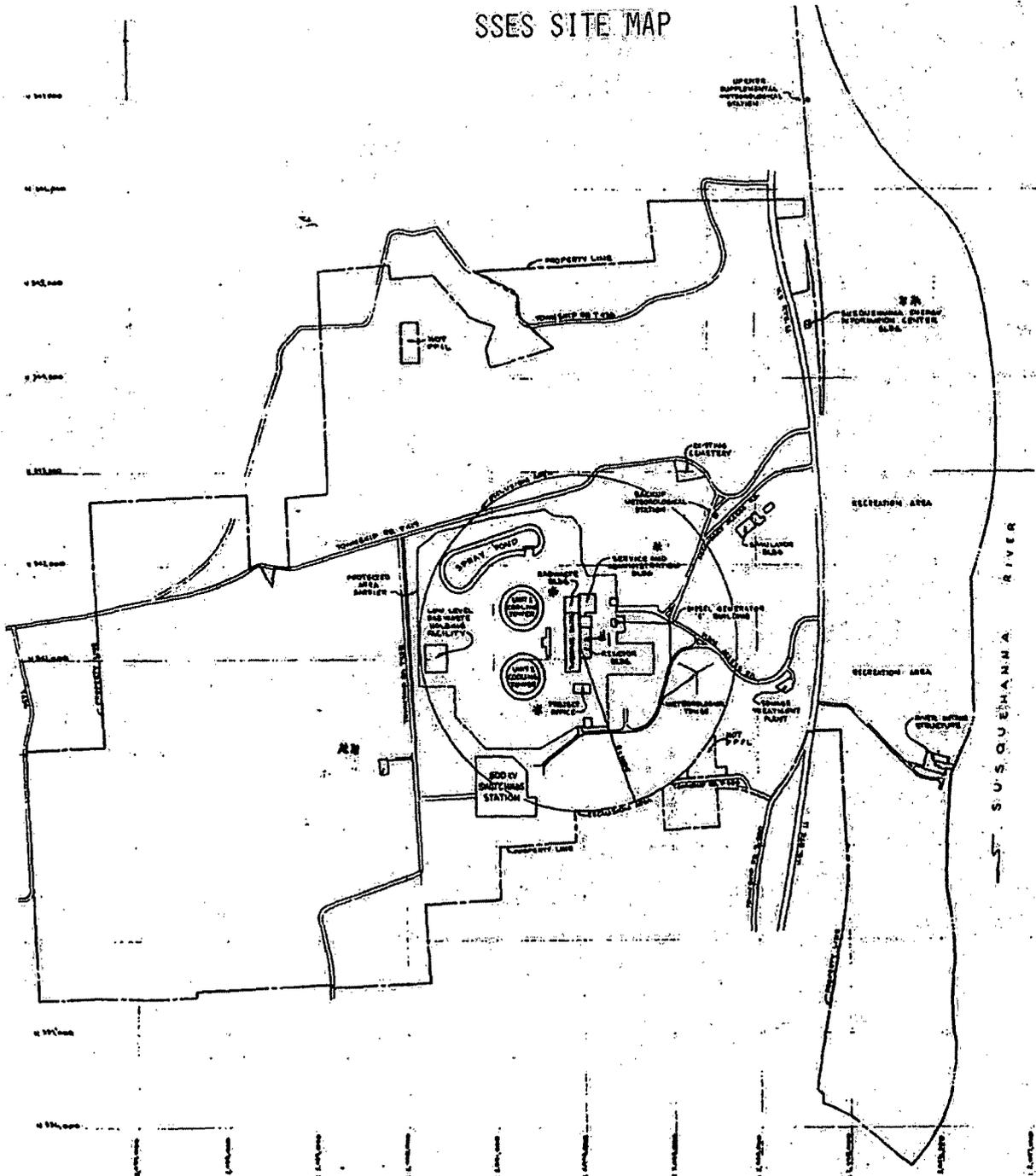
In the event that the primary EOF is uninhabitable, the EOF will be relocated to the Backup EOF at the PP&L Hazleton Service Center on South Poplar Street in Hazleton. The location of the Backup EOF is shown in Attachment 4.

Neighboring States

The 10-mile and 50-mile EPZs for SSES lie entirely within Pennsylvania.

Maps of the 10-mile and 50-mile EPZs are shown in Attachments 5 and 6.

SSES SITE MAP



LEGEND:

- 1. Control Room
- * Assembly Area
- ** Remote Assembly Areas
- Onsite Monitoring Team Boundry

NOTE:

Emergency Operations Facility is located at the East Mountain Business Center, Plains, Penna.

Revision 12, 06/96

SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 AND 2 EMERGENCY PLAN	
MAP OF SUSQUEHANNA SES EMERGENCY FACILITIES	
FIGURE 8.1	

ATTACHMENT 1

**Directions to
East Mountain
Business Center
(Emergency Operations Facility)**
Wilkes-Barre

From the Susquehanna plant/Information Center: Take U.S. Route 11 north to State Route 29. Go south on Route 29 to Interstate 81. Go north on Interstate 81 to Exit 47A. Go south on State Route 115 to East Mountain Blvd. and turn left.

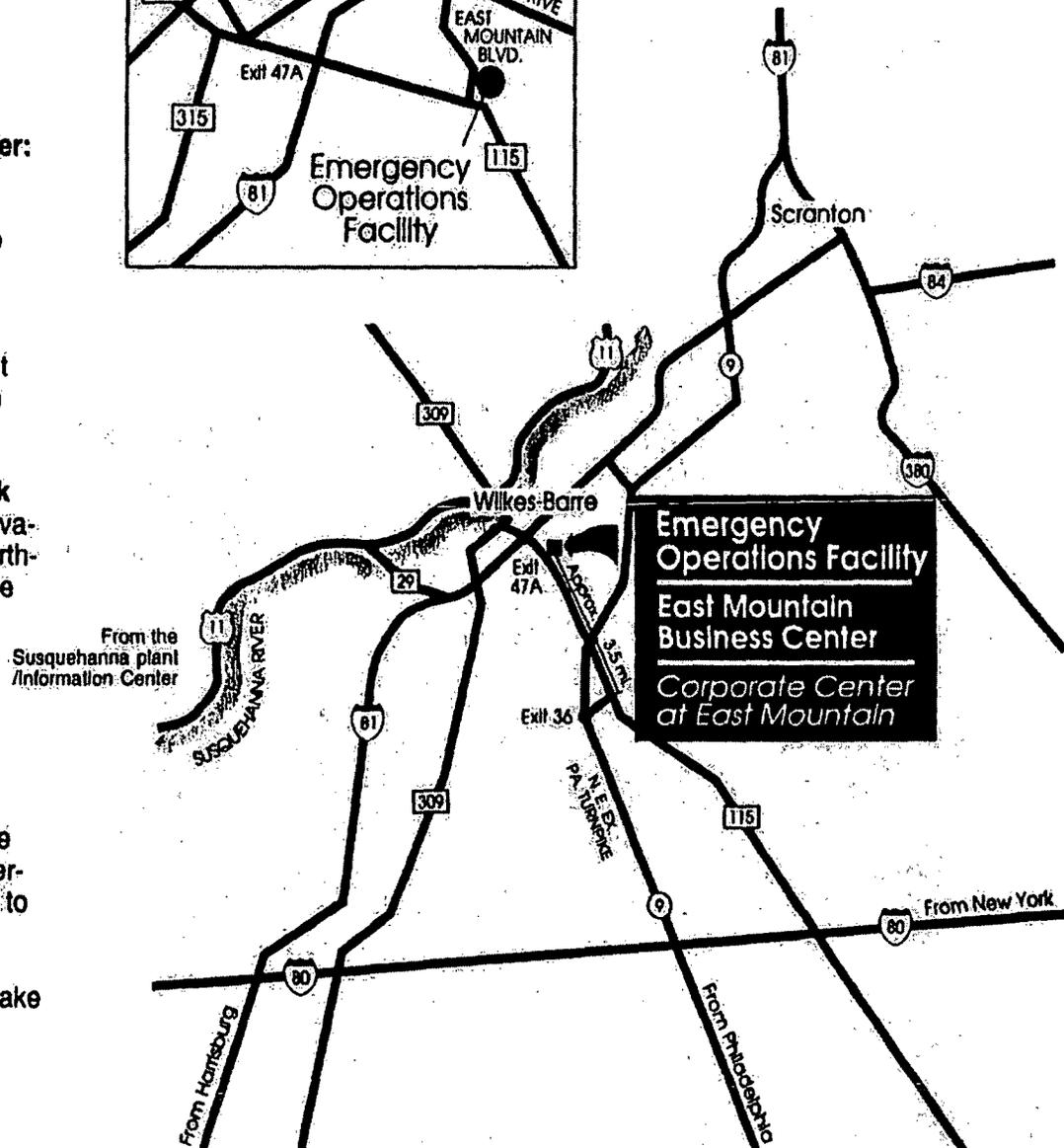
From Allentown, Philadelphia and south: Take Route 9 (Pa. Turnpike Northeast Extension) to Exit 36. Go north on State Route 115 to East Mountain Blvd. and turn right.

From Poconos, northern New Jersey, New York City and east: Take Interstate 80 west to Pennsylvania Exit 42. Go north on Route 9 (Pa. Turnpike Northeast Extension) to Exit 36. Go north on State Route 115 to East Mountain Blvd. and turn right.

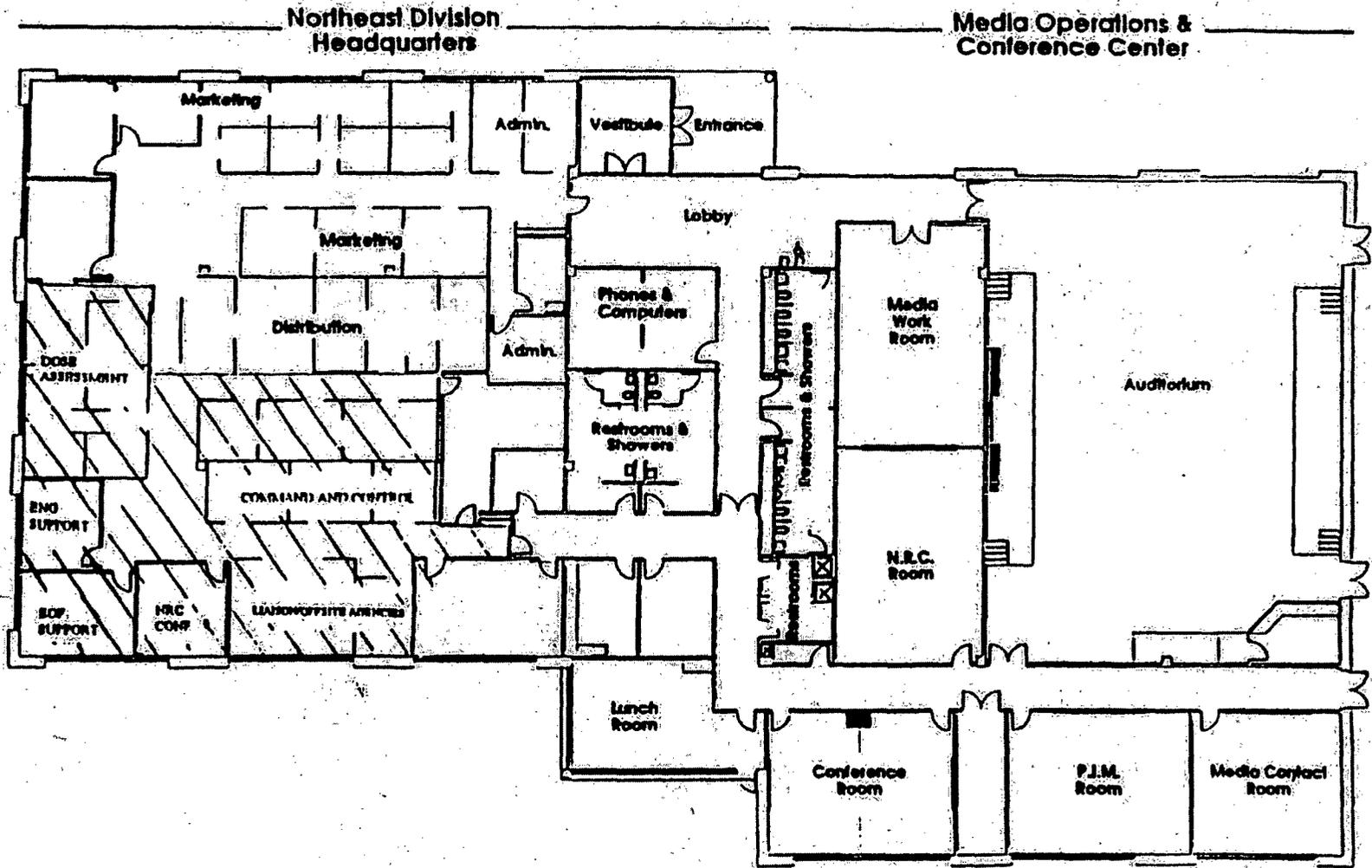
From Hazleton, Harrisburg and southwest: Take Interstate 81 north to Exit 47A. Go south on State Route 115 to East Mountain Blvd. and turn left.

From Bloomsburg, Williamsport and west: Take Interstate 80 east to Interstate 81. Go north on Interstate 81 to Exit 47A. Go south on State Route 115 to East Mountain Blvd. and turn left.

From Scranton, upstate New York and north: Take Interstate 81 south to Exit 47A. Go south on State Route 115 to East Mountain Blvd. and turn left.

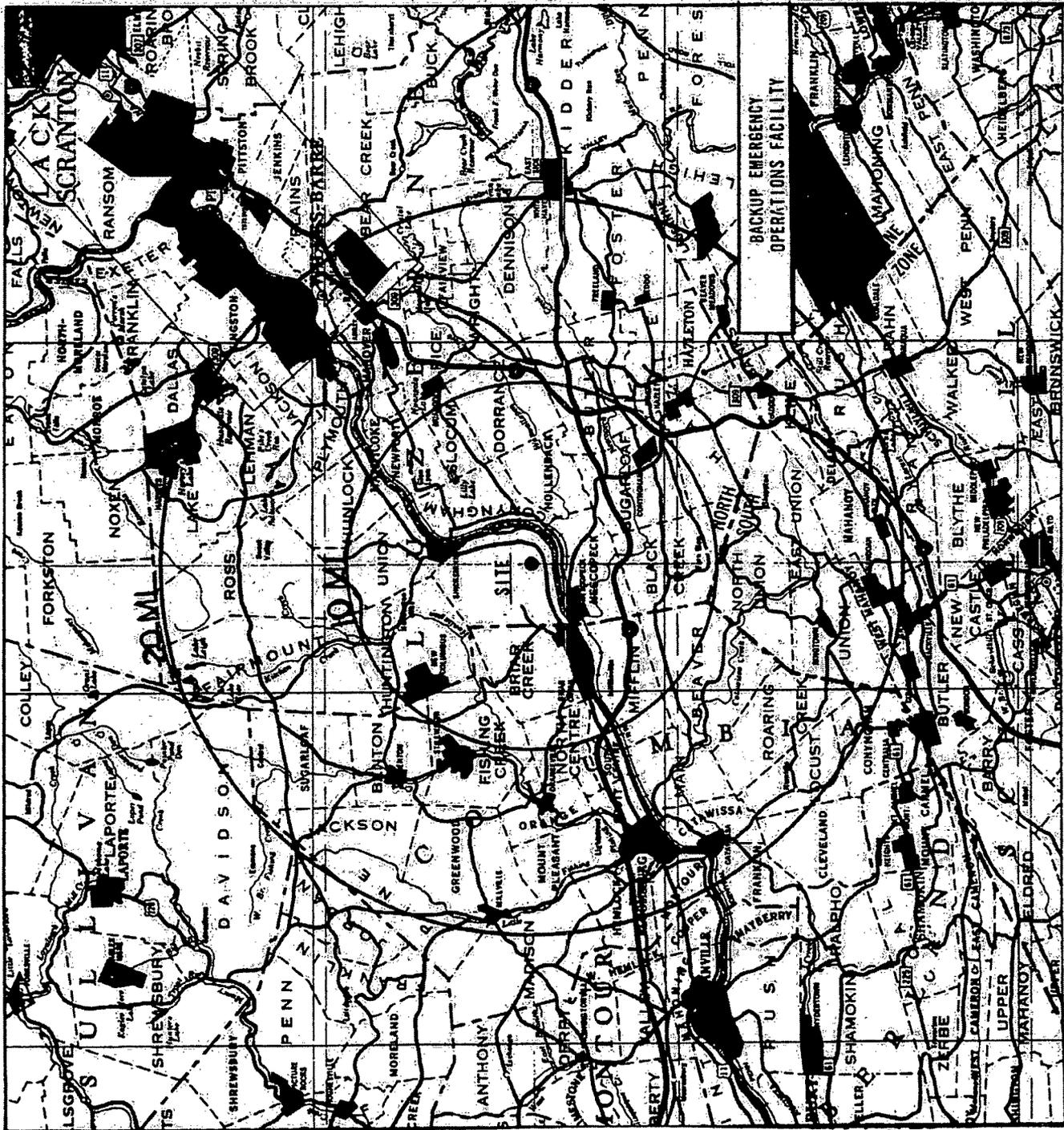


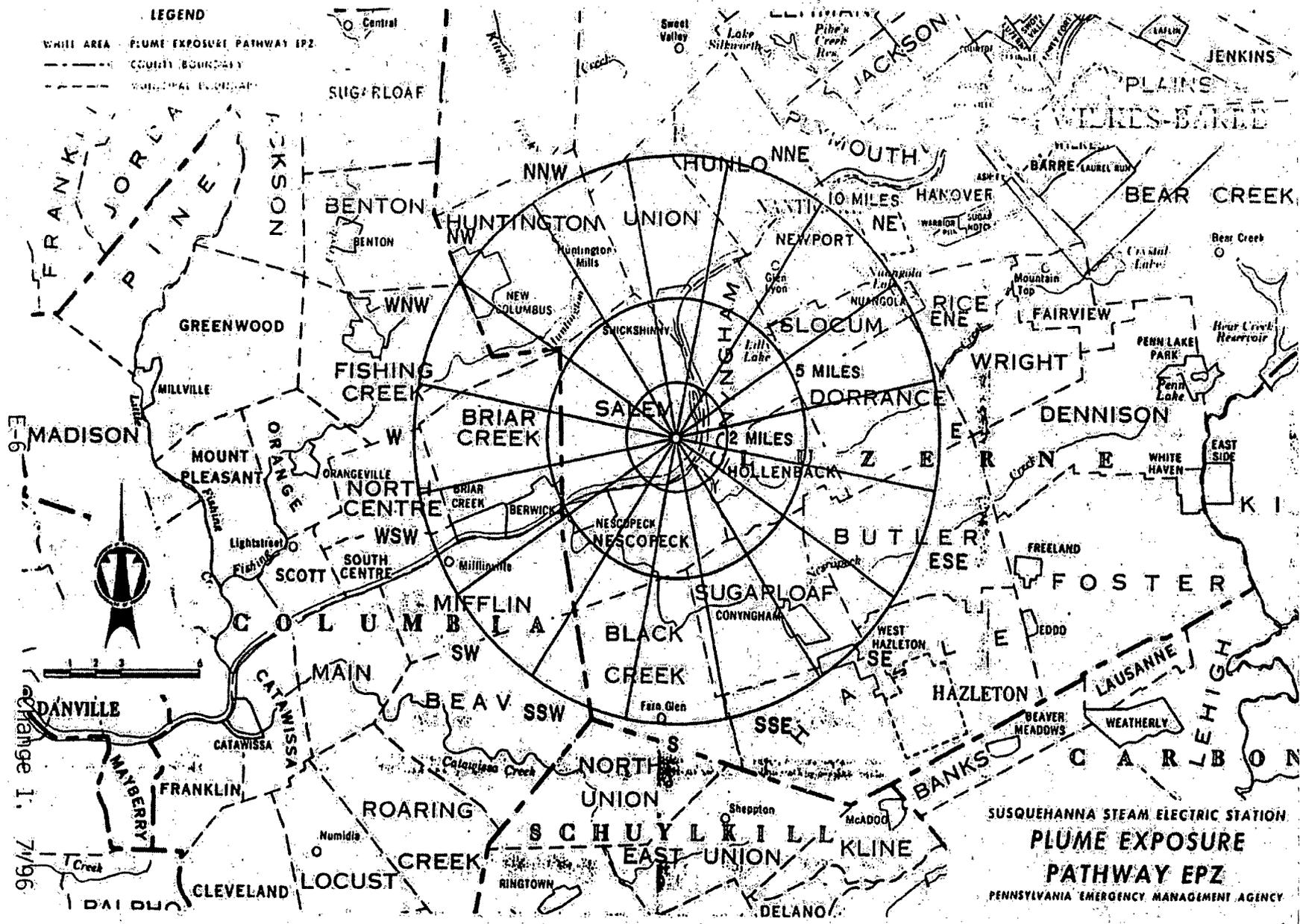
ATTACHMENT 2



ATTACHMENT 3

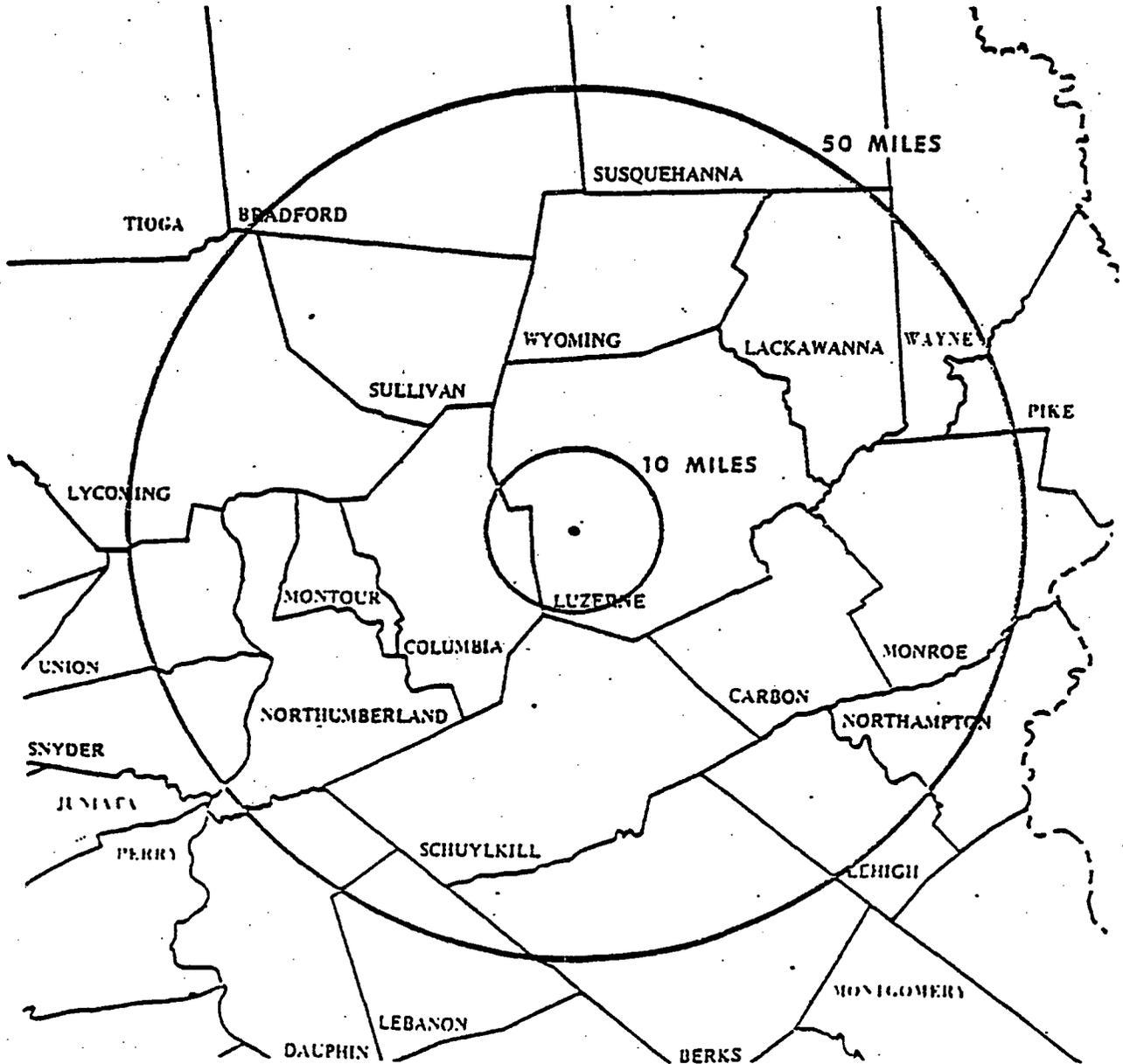
ATTACHMENT 4
LOCATION OF SSES BACKUP EOF





ATTACHMENT 5

ATTACHMENT 6
SSES 50-MILE INGESTION PLANNING ZONE (EPZ)



APPENDIX 9E

THREE MILE ISLAND SITE-SPECIFIC DESCRIPTION

Site Description

Three Mile Island Nuclear Station (TMINS) Unit 1 is a pressurized water reactor rated at 871 Mw(e). Unit 2 has been defueled and placed in long-term monitored storage. The facility is operated by Exelon and owned by AmerGen.

The exclusion zone radius is 2000 feet, or about 0.4 miles.

A diagram of the site is shown in Attachment 1.

Location and Physical Description

TMINS is located on Three Mile Island in the Susquehanna River in Dauphin County, Pennsylvania.

The 10-mile EPZ contains portions of Dauphin, Cumberland, York, Lancaster, and Lebanon Counties. The nearest population center is Harrisburg City, located approximately 10 miles northwest of the site, with a population of 52,000.

The normal pool elevation of the river in the vicinity of TMINS is 278 feet mean sea level (MSL). The probable maximum flood is estimated at 1.1 million cfs. The site is protected from floods of that magnitude by dikes and by safety features added to the intake structure. Component protection to 1.615 million cfs is also provided.

The closest major airport is Harrisburg International Airport, 2.5 miles northwest of the site. Capital City Airport, located 8 miles west-northwest of the site, services commuter and private aircraft.

Emergency Operations Facility (EOF)

The TMI EOF is located approximately 50 miles southeast of the site near Coatesville, Pennsylvania. The EOF is a common facility for Peach Bottom, Limerick and TMI. The location of the EOF is shown in Attachment 2. The layout of the EOF is shown in Attachment 3.

Neighboring States

Neighboring states within the 10-mile and 50-mile EPZs are as follows:

10-mile EPZ

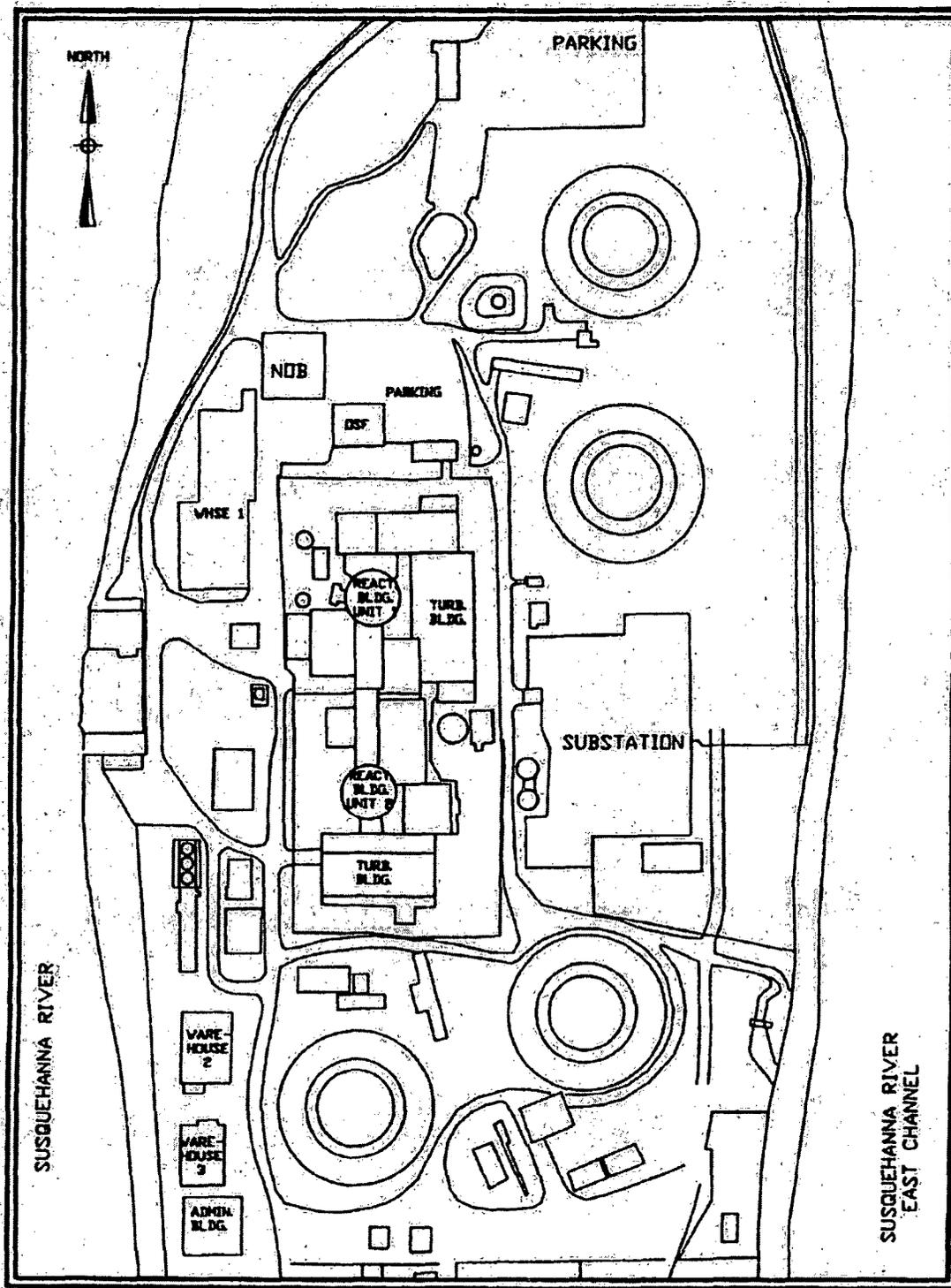
None

50-mile EPZ

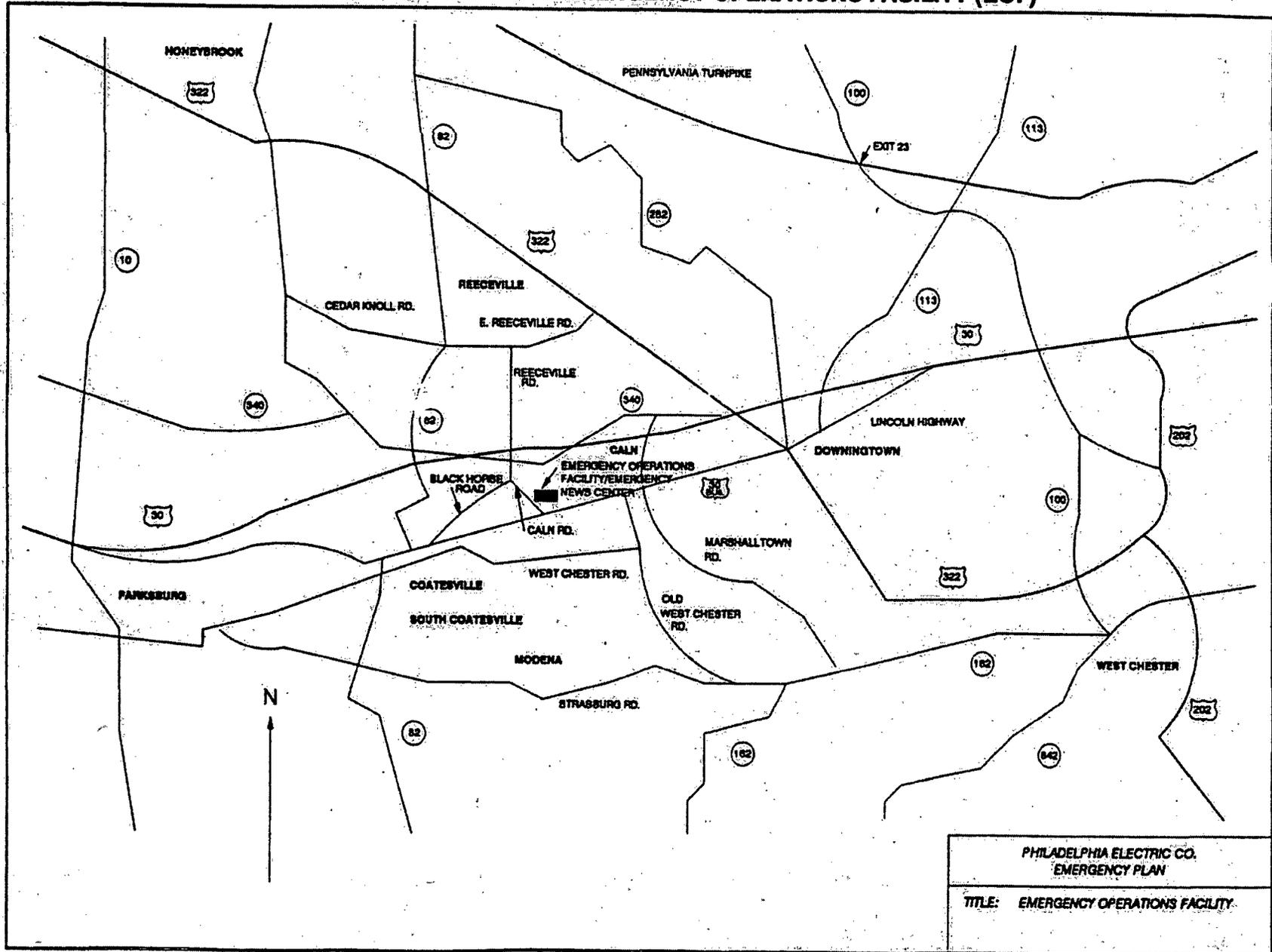
Maryland

Maps of the 10-mile and 50-mile EPZs are shown in Attachments 4 and 5.

ATTACHMENT 1
TMINS SITE MAP

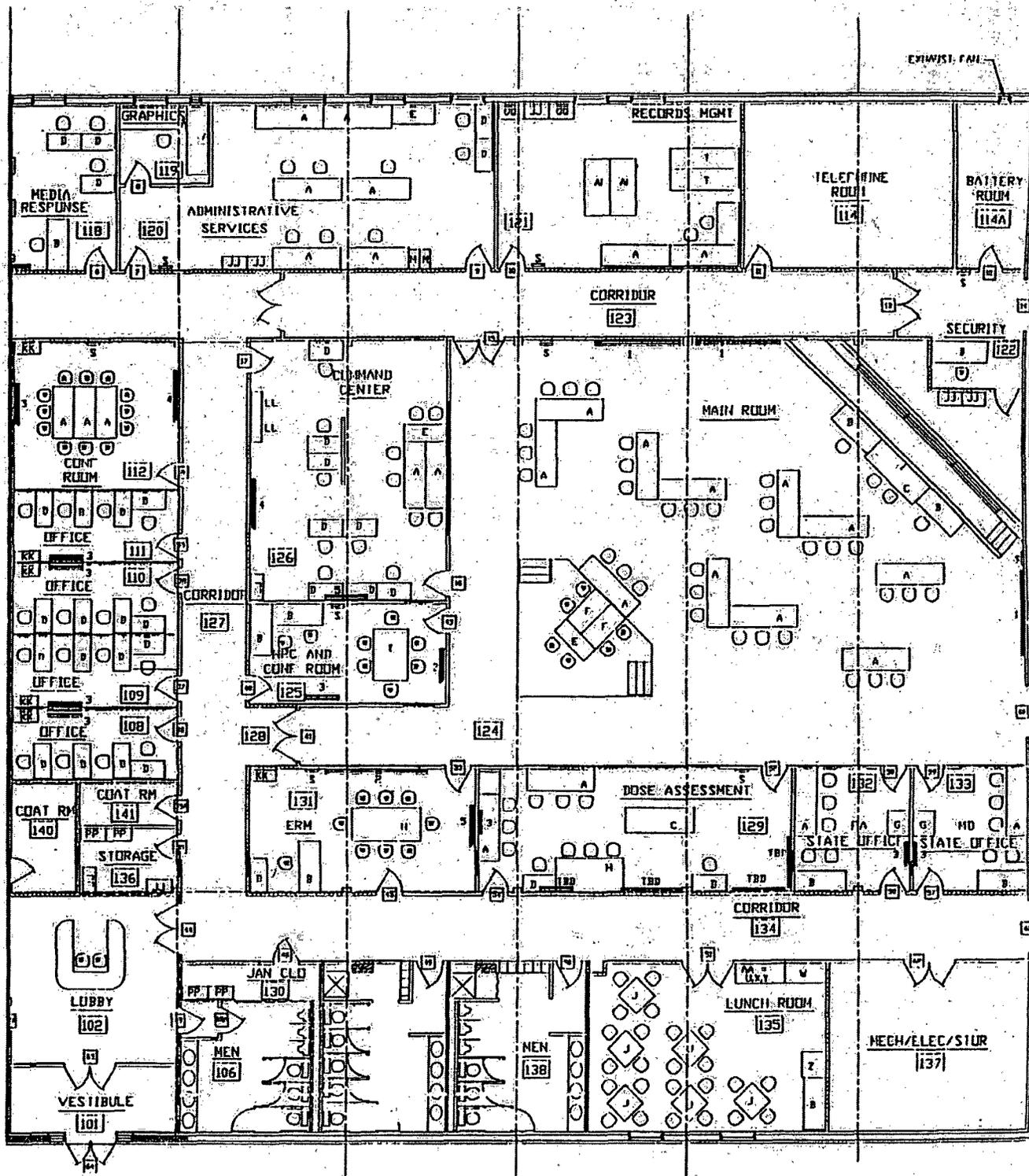


LOCATION OF EMERGENCY OPERATIONS FACILITY (EOF)

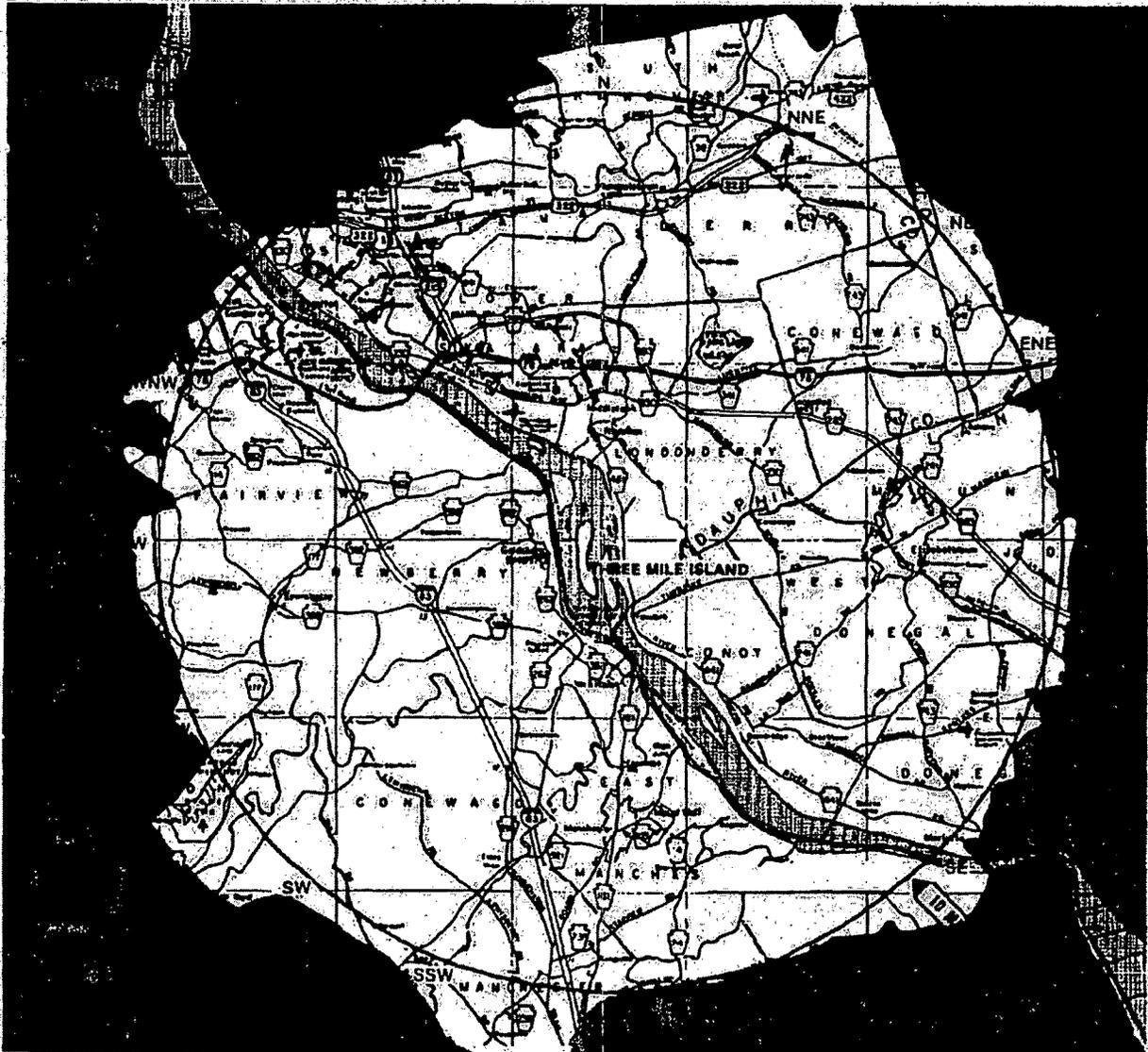


ATTACHMENT 2

ATTACHMENT 3
LAYOUT OF THE TMI EOF



ATTACHMENT 4
TMINS 10-MILE EMERGENCY PLANNING ZONE (EPZ)



Legend:

Interstate Highways	
Toll Roads	
U.S. Highways	
Panna. State Highways	
Twp. & Boro Boundrys	
County Boundrys	



BRP EMERGENCY PLAN

SECTION 10.0

ACRONYMS, DEFINITIONS AND TERMS

BRP-ER-10A
BRP-ER-10B

Acronyms
Definitions and Terms

ACRONYMS & ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
AMS	Aerial Measuring System
BRP	PA Bureau of Radiation Protection
BVPS	Beaver Valley Power Station
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CMRT	Consequence Management Response Team
DCF	Dose Conversion Factor
DEP	PA Department of Environmental Protection
DHS	Department of Homeland Security
DIL	Derived Intervention Level
DOE	US Department of Energy
DOH	PA Department of Health
DRD	Direct Reading Dosimeter
DRL	Derived Response Level
EAL	Emergency Action Level
ED	Electronic Dosimeter
EOC	Emergency Operations Center
EOF	Emergency Operations Facility
EDE	Effective Dose Equivalent
EPA	US Environmental Protection Agency
EPZ	Emergency Planning Zone
ERDS	Emergency Response Data System
ESF	Emergency Support Function
FDA	HHS Food & Drug Administration
FEMA	Federal Emergency Management Agency
FRMAC	Federal Radiological Monitoring & Assessment Center
FSAR	Final Safety Analysis Report
GIS	Geographic Information System
GPS	Global Positioning System
HHS	US Department of Health & Human Services
IMAAAC	Interagency Modeling and Atmospheric Assessment Center
JFO	Joint Field Office
JIC	Joint Information Center
KI	Potassium Iodide
LGS	Limerick Generating Station
LLD	Lower Limit of Detection
MCL	Maximum Contaminant Level
NARAC	National Atmospheric Release Advisory Capability
NIMS	National Incident Management System
NRC	US Nuclear Regulatory Commission
NRP	National Response Plan
PAG	Protective Action Guide
PAR	Protective Action Recommendation
PAST	Protective Action Support Team
PBAPS	Peach Bottom Atomic Power Station
PDA	PA Department of Agriculture

PEMA	Pennsylvania Emergency Management Agency
R3V	Radiological Rapid Response Vehicle
RAC	BRP Radiological Assessment Center
RAP	DOE Radiological Assistance Program
RASCAL	Radiological Assessment System for Consequence Analysis
REAC/TS	Radiation Emergency Assistance Center/Training Site
RML	DEP Radiation Measurements Laboratory
SRTF	State Recovery Task Force
SSES	Susquehanna Steam Electric Station
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
TMINS	Three Mile Island Nuclear Station
USDA	US Department of Agriculture

DEFINITIONS AND TERMS

Advisory Team for Environment, Food and Health: Develops coordinated advice and recommendations concerning environmental, food health and animal health matters. Contains representatives from DHS, EPA, USDA, and FDA. Operates from FRMAC.

Alert: An emergency classification where events are in progress or have occurred which involve an actual or potential substantial degradation of the level of safety of the plant or a security event that involves probable life threatening risk to site personnel or damage to site equipment because of hostile action. Any releases are expected to be limited to small fractions of the EPA Protective Action Guideline exposure levels.

Buffer Zone: An expanded portion of the restricted zone selected for temporary radiation protection controls until the stability of radioactivity levels in the area is confirmed.

Committed Dose: The radiation dose due to radionuclides in the body over a 50-year period following their inhalation or ingestion.

Committed Effective Dose Equivalent: The committed dose equivalent to an internal organ from inhalation, weighted on the basis of relative detriment to the whole body.

Consequence Management Response Team: A DOE team that rapidly responds to the scene of a serious radiological incident. Provides expertise in radiation monitoring, sampling, analysis, assessment, health and safety, and logistics and support. Prepares for arrival of FRMAC.

Derived Intervention Level: A radionuclide concentration in food present throughout the relevant period of time that, in the absence of any intervention, could lead to an individual receiving a radiation dose equal to the most limiting Protective Action Guide.

Derived Response Level: A level of radioactivity in an environmental medium that would be expected to produce a dose equal to its corresponding Protective Action Guide.

Dose Conversion Factor: Any factor that is used to change an environmental measurement to dose in the units of concern.

Dose Equivalent: The product of the adsorbed dose in rads, a quality factor related to the biological effectiveness of the radiation involved, and any other modifying factors.

Effective Dose Equivalent: The sum of the products of the dose equivalent to each organ from external sources and a weighting factor. The weighting factor is the ratio of the risk of mortality from delayed health effects arising from irradiation of a particular organ or tissue to the total risk of mortality from delayed health effects when the whole body is irradiated uniformly to the same dose.

Emergency Action Levels: Predetermined conditions or values which, when reached or exceeded, require implementation of the Emergency Plan. Includes radiation and integrated dose levels, events such as natural disasters or fires, or specific instrument

indications. Used by the licensee to classify the emergency into one of the four emergency classifications.

Emergency Classifications: Grades or classifications of emergencies based on levels of concern for potential hazards to the public. Each emergency classification level has a matching level of response. The four classes of emergencies are Unusual Event, Alert, Site Area Emergency, and General Emergency.

Emergency Operations Facility: The facility for coordinating emergency response activities between on-site and off-site agencies. Activated at Site Area Emergency or higher emergency classification.

Emergency Operations Center: The facility for overall coordination of State response activities and protective action decision-making, prior to establishment of Federal facilities. Activation is at Alert or higher emergency classification.

Emergency Planning Zones: Area for which planning ensures that prompt and effective actions can be taken to protect the public. For the plume exposure pathway, the EPZ is an approximate 10-mile radius from the plant. For the ingestion pathway, the EPZ is an approximate 50-mile radius from the plant.

Evacuation: The urgent removal of people from an area to avoid or reduce high-level, short-term exposure, usually from the plume or from deposited activity. Evacuation can also be a precautionary action taken in response to plant conditions rather than an actual release.

Exclusion Zone: The area surrounding the reactor, in which the licensee has the authority to determine all activities including exclusion or removal of personnel and property from the area.

Federal Radiological Monitoring & Assessment Center: The facility established to provide Federal assistance on radiological monitoring and assessment. Houses the technical resources provided by several different Federal agencies. Initially established and managed by DOE.

General Emergency: Events are in progress or have occurred which involve actual or imminent substantial core degradation or melting with potential for loss of containment integrity or hostile action that results in an actual loss of physical control of the facility. Releases can be reasonably expected to exceed EPA Protective Action Guideline exposure levels off-site for more than the immediate site area.

Geographic Information System: A computer-based mapping and spatial analysis system developed for each commercial nuclear power plant. Contains information on population density, major roads, land use, etc. Used in conjunction with GPS data to integrate field sampling results and produce tailored maps.

Global Positioning System: A highly accurate, satellite-based locating system providing latitude/longitude readings. Used in conjunction with a GIS to plot areas of radiological contamination.

Incident of National Significance: An actual or potential high-impact event that requires a coordinated and effective response by Federal, State, local, tribal, and private-sector entities to save lives and minimize damage, and provide the basis for long-term community recovery and mitigation activities. Declared by the Secretary of Homeland Security.

Interagency Modeling and Atmospheric Assessment Center: A Federal interagency group responsible for production, coordination, and dissemination of consequence predictions for an airborne hazardous materials release. The IMAAC generates the single Federal prediction of atmospheric dispersions and their consequences utilizing the best available resources from the Federal Government.

Joint Field Office: A temporary Federal facility established locally to provide a central point for Federal, State, local, and tribal executives with responsibility, for incident oversight, direction, and/or assistance to effectively coordinate protection, prevention, preparedness, response and recovery actions.

Joint Information Center: The facility near the incident site for coordination of public information. Activated by the licensee at Alert or higher emergency classification.

National Atmospheric Release Advisory Capability: A sophisticated computer system used for estimating meteorological factors, plume travel, population doses, and other parameters. It is accessible through the FRMAC.

National Response Plan: The Federal plan which defines the federal response to major disasters and other emergencies, including emergencies at nuclear power plants, and major radiological incidents.

Off-site: Any area outside the licensee/owner controlled area.

Projected Dose: Future dose calculated for a specified time period, and based on estimated or measured initial concentrations of radionuclides or exposure rates, in the absence of protective actions.

Protective Action: An activity conducted in response to an incident or potential incident to avoid or reduce radiation dose to members of the public.

Protective Action Guide: The projected dose to an individual from an accidental release of radioactive material at which a specific protective action to reduce or avoid that dose is warranted.

Reentry: Temporary entry into a restricted zone under controlled conditions.

Relocation: The removal or continued exclusion of people from contaminated areas to avoid chronic radiation exposure.

Restricted Zone: An area with controlled access from which the population has been relocated.

Return: The reoccupation of areas cleared for unrestricted residence or use.

Sheltering: The use of a structure for radiation protection from an airborne plume and/or deposited radioactive material.

Site Area Emergency: An emergency classification where events are in progress or have occurred which involve actual or likely major failures of plant functions needed for protection of the public or hostile action that results in intentional damage or malicious acts; (1) toward site personnel or equipment that could lead to the likely failure of or; (2) that prevent effective access to equipment needed for the protection of the public. Any releases are not expected to result in exposure levels which exceed EPA Protective Action Guideline exposure levels beyond the site boundary.

Total Effective Dose Equivalent: The sum of the Effective Dose Equivalent resulting from exposure to external sources and the Committed Effective Dose Equivalent incurred from all significant inhalation pathways.

Unusual Event: An emergency classification where events are in progress or have occurred which indicate a potential degradation of the level of safety of the plant or indicate a security threat to facility protection has been initiated. No releases of radioactive material requiring off-site response or monitoring are expected unless further degradation of safety systems occurs.

Whole Body Dose: Dose resulting from uniform exposure of the entire body to either internal or external sources of radiation.

COMMONWEALTH OF PENNSYLVANIA
Department of Environmental Protection
Bureau of Radiation Protection
March 1, 2006

SUBJECT: Forwarding of Change 2 Replacement Pages to the Bureau of Radiation Protection Nuclear Power Station EMERGENCY PLAN, March 2003

TO: Holders of BRP Nuclear Power Station EMERGENCY PLAN

FROM: Martin Vyeniolo
Chief
Emergency Response Section

Attached is Change 2 to the Bureau of Radiation Protection Nuclear Power Station EMERGENCY PLAN, March 2003. This change:

- Makes plan NRP/NIMS compliant.
- Incorporates R3V and Dedicated Field Team Response Vehicles.
- Changes title of BRP Incident Manager to Radiological Assessment Director.
- Reflects change in BRP cell location at the State EOC.
- Corrects miscellaneous typographic errors.

INSTRUCTIONS

Remove

Insert

1. BRP-ER-1.0 all pages, Rev. 0
2. BRP-ER-2.0 all pages, Rev. 1
3. BRP-ER-3.0 all pages, Rev. 1
4. BRP-ER-4.0 all pages, Rev. 0
5. BRP-ER-5.0 all pages, Rev. 0
6. BRP-ER-5.01 all pages, Rev.1
7. BRP-ER-5.02 all pages, Rev.0
8. BRP-ER-5.03 all pages, Rev. 0
9. BRP-ER-6.0 all pages, Rev. 1
10. BRP-ER-6.01 all pages, Rev.1
11. None
12. BRP-ER-6.07 all pages, Rev. 1
13. None
14. None
15. BRP-ER-6B all pages, Rev. 1

- BRP-ER-1.0 all pages, Rev. 1
- BRP-ER-2.0 all pages, Rev. 2
- BRP-ER-3.0 all pages, Rev. 2
- BRP-ER-4.0 all pages, Rev. 1
- BRP-ER-5.0 all pages, Rev. 1
- BRP-ER-5.01 all pages, Rev. 2
- BRP-ER-5.02 all pages, Rev. 1
- BRP-ER-5.03 all pages, Rev. 1
- BRP-ER-6.0 all pages, Rev. 2
- BRP-ER-6.01 all pages, Rev. 2
- BRP-ER-6.04 all pages, Rev. 0
- BRP-ER-6.07 all pages, Rev. 2
- BRP-ER-6.08 all pages, Rev. 0
- BRP-ER-6.09 all pages, Rev. 0
- BRP-ER-6B all pages, Rev. 2

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|-----|--|------------------------------------|
| 16. | BRP-ER-7.0 all pages, Rev. 1 | BRP-ER-7.0 all pages, Rev. 2 |
| 17. | BRP-ER-8.0 all pages, Rev. 0 | BRP-ER-8.0 all pages, Rev. 1 |
| 18. | BRP-ER-8.04 all pages, Rev. 0 | BRP-ER-8.04 all pages, Rev. 1 |
| 19. | BRP-ER-10A all pages, Rev. 0 | BRP-ER-10A all pages, Rev. 1 |
| 20. | BRP-ER-10B all pages, Rev. 0 | BRP-ER-10B all pages, Rev. 1 |
| 21. | BRP-ER- Table of Contents, Rev. 1 | BRP-ER-Table of Contents, Change 2 |
| 22. | BRP Eplan Record of Implementing
Procedures, Rev. 1 | None |
| 23. | Record of Changes, Change 1 | Record of Changes, Change 2 |

On the “Record of Changes” page behind the “Table of Contents” in the front of the BRP EMERGENCY PLAN, enter:

Change Number: 2

Date: 03/06

Entered By: Your Name

Upon of completion of the above listed items, you may file this memo behind the “Record of Changes” page located behind the “Table of Contents” in the front of your BRP EMERGENCY PLAN.

If you have any questions about these changes, please contact me at 717-783-6003.

Thank you.