Standards for Development and Maintenance of an Emergency Preparedness Hazards Assessment [1]

Approved by

President, Westinghouse Savannah River Company

Purpose

This procedure establishes the site requirements and standard methods for the development and maintenance of an Emergency Preparedness Hazards Assessment (EPHA). The performance of the EPHA will provide the technical basis for the facility EP program, facility Emergency Action Levels (EALs), and facility emergency planning zones (EPZs).

Scope

The instructions provided in this procedure include methods and requirements for performing the following activities:

- develop facility description/boundary
- perform hazards identification and screening
- perform hazard characterization
- develop barrier failure events
- estimate potential event consequences
- develop EPZs
- document and approve the EPHA

SRS facilities that contain hazardous materials in quantities that exceed predetermined thresholds will complete the facility EPHA process detailed in this procedure. To provide a graded approach to EPHAs, older facilities that have a limited mission or are scheduled for completion of a compliant 5480.23 SAR may perform an Interim EPHA (IEPHA). Perform IEPHAs as per this procedure. The IEPHA scope is limited to current facility authorization basis and safety basis documentation. Upgrade IEPHAs to reflect new missions or when a compliant 5480.23 SAR is completed.

Terms and Definitions

See also Attachment A, Acronyms.

accident - a deviation from normal operations or activities associated with a hazard that has the potential to result in an emergency.

Alert - an Alert shall be declared when events are predicted, are in progress, or have occurred that result in one or more of the following.

- an actual or potential substantial degradation in the level of control over hazardous materials (radiological and non-radiological) where the radiation dose from any release to the environment of radioactive material or a concentration in air of other hazardous material is expected to exceed the applicable Protective Action Criteria (PAC) at or beyond 30 meters from the point of release. The PAC is not expected to be exceeded at or beyond the facility boundary.
- an actual or potential substantial degradation in the level of safety or security of a nuclear weapon, component, or test device that would not pose an immediate threat to workers or the public
- an actual or potential substantial degradation in the level of safety or security of a facility or process that could, with further degradation, produce a Site Area Emergency or General Emergency

Authorization Basis Documents - Documents dealing with those aspects of the facility design basis and operational requirements relied upon by DOE to authorize operation of Nuclear Facilities. These aspects are considered to be important to the safety of facility operations. The AB is described in documents such as the facility Safety Analysis Report and other safety analyses; hazard classification documents, the Technical Safety Requirements, DOE-issued Safety Evaluation Reports, and facility-specific commitments made to comply with DOE Orders and policies. All AB safety documents are approved by DOE. AB Documents form the technical basis for the EPHA. Reference Procedure Manual 11Q.

committed dose equivalent (CDE) ($H_{T,50}$) - The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake of a radionuclide into the body. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem.

committed effective dose equivalent (CEDE) ($H_{E,50}$) - The sum of the committed dose equivalents to various tissues in the body ($H_{T,50}$), each multiplied by the appropriate weighting factor (w_T) - that is, $H_{E,50} = \Sigma\ w_T\ H_{T,50}$. Committed effective dose equivalent is expressed in units of rem.

consequence - the result or effect (especially projected exposure to radiological or chemical hazards) of a release of hazardous materials to the environment

effective dose equivalent (EDE) (H_E) - the summation of the products of the dose equivalent received by specified tissues of the body (H_T) and the appropriate weighting factor (w_T) - that is, $H_E = \Sigma\ w_T\ H_T$. It includes the dose from radiation sources internal and/or external to the body. The effective dose equivalent is expressed in units of rem.

emergency - an emergency is the most serious event in the Occurrence Reporting system (DOE 232.1A)

emergency action level (EAL) - specific, predetermined, and observable criteria used to detect, recognize, and classify hazardous material emergencies

emergency classification - classifies an Operational Emergency involving a hazardous material release by the degree of severity, depending on the actual or potential consequence of the emergency. The classification levels are Alert, Site Area Emergency (SAE), and General Emergency (GE).

emergency plan - a clear and concise description of the overall emergency organization, designation of responsibilities, and procedures involved in coping with any or all aspects of an operational emergency.

emergency planning zone (EPZ) - an area in which planning is needed to assure that prompt and effective protective actions can be taken to protect onsite personnel, public health and safety, and the environment in a major emergency.

emergency response planning guidelines (ERPGs) - an estimate of the concentration ranges above which one could reasonably anticipate observing adverse effects, as described in the definitions for ERPG-1, ERPG-2, and ERPG-3, as a consequence of exposure to the specific substance. ERPG values are the preferred guidelines when dealing with chemical exposures.

- **ERPG-1** - the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor
- **ERPG-2** - the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action
- **ERPG-3** - the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects

event - any real-time occurrence or significant deviation from planned or expected behavior that could endanger or adversely affect people, property, or the environment

facility boundary - the boundary, determined by this procedure, which represents the receptor location that differentiates between an Alert and Site Area Emergency declaration

General Emergency - a General Emergency shall be declared when events are predicted, in progress, or have occurred that result in one or more of the following situations:

- actual or imminent catastrophic reduction of facility safety or security systems with potential for the release of large quantities of hazardous materials (radiological or non-radiological) to the environment. The radiation dose from any release of radioactive material or a concentration in air from any release of other hazardous material is expected to exceed the applicable Protective Action Guide or Emergency Response Planning Guideline at or beyond the site boundary.

- actual or likely catastrophic failures in safety or security systems threatening the integrity of a nuclear weapon, component, or test device that may adversely impact the health and safety of workers and the public

hazard assessment - identifies hazards significant enough to include in an emergency preparedness program and forms the technical basis for applicable emergency classification procedures

hazardous material - any solid, liquid, or gaseous material that is toxic, flammable, radioactive, corrosive, chemically reactive, or unstable upon prolonged storage, in quantities that could pose a threat to life, property, or the environment

isodose system - a system of classifying operational emergencies where the consequence threshold remains constant and the receptor location changes (30m, facility boundary, site boundary) to determine emergency classification

material-at-risk (MAR) - the amount of hazardous material that is available to be acted on by a given physical stress. Multiply the MAR by the appropriate release fraction to determine the source term.

maximum inventory - for a process; the maximum quantity of a hazardous material that a process produces during the process cycle. For storage tanks the maximum inventory is equivalent to the capacity of the tank.

Operational Emergency (OE) - An event or condition that poses a significant hazard to safety, health, and/or the environment and requires time urgent response from outside the facility. An Operational Emergency involving release of significant quantities of hazardous materials requires further classification as an Alert, Site Area Emergency, or General Emergency. The Emergency Duty Officer (EDO) in the SRS Operations Center is the Site categorization and reporting authority for Operational Emergencies that do not require further classification.

plutonium-238 equivalent (Pu-238$_{eq}$) - an analytic technique of summing the dose potential from all the isotopes of interest in a source term into a single "equivalent" isotope in order to facilitate quick consequence assessment of that source term

protective action - actions taken to avoid or reduce a projected or actual exposure. Protective actions are used to ensure the physical safety of personnel and facilities during radiological or hazardous material incidents. Protective actions are formulated after determining a projected dose. They are only taken when the benefits of the protective action outweigh doing nothing or are sufficient to offset the possible undesirable consequences resulting from not implementing the protective action.

protective action criteria (PAC) - a radiological dose or toxic material concentration level that acts as a trigger, for the receptor point of interest, to declare an operational emergency and initiate the recommendation or issuance of protective actions to protect workers or the general public. The PAC that pertains to SRS onsite and offsite radiological and chemical exposure is as follows:

- for a radiological hazard, 1 rem Total Effective Dose Equivalent (TEDE) or 5 rem Committed Dose Equivalent (CDE) thyroid is used as the trigger for classification of operational emergencies and off-site protective action recommendations. The onsite precautionary protective action criteria uses the limit of 100 mrem TEDE or 500 mrem EDE Thyroid as the initial trigger to clear an area of non-essential workers as a precaution against worsening conditions.
- for a chemical hazard, the limit of ERPG-2 or equivalent value is used as the trigger for classification of operational emergencies and off-site protective action recommendations. The onsite precautionary protective action criterion uses the limit of ERPG-1 as the trigger to clear the area of non-essential workers as a precaution against worsening conditions.

release - an airborne effluent release to the environment as this pathway typically represents the most time-urgent situation. Releases to aquatic and ground pathways in most instances do not have the same time urgency as airborne releases. The hazard assessment considers releases to an aquatic or ground pathway having a time-urgent affect on the workers or the public (e.g., through a community water supply).

release fraction - the coefficient used to estimate the amount of a hazardous material (MAR) suspended in air and made available for airborne transport under a specific set of induced physical stress. The release fraction is a combination of the fraction of the material released (Airborne Release Fraction [ARF]) and the fraction of the material that is respirable (Respirable Fraction [RF]).

safety analysis report (SAR) - a report that documents the adequacy of safety analysis to ensure that a facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. SARs are completed according to Procedure Manual 11Q.

segment - a demarcation used in hazards assessment where the system, section, building, etc., is not affected by the failure of other systems, sections, buildings, etc.

Site Area Emergency (SAE) - a Site Area Emergency shall be declared when events are predicted, in progress, or have occurred that result in one or more of the following situations:

- an actual or potential major failure of functions necessary for the protection of workers or the public. The radiation dose from any release of radioactive material or concentration in air from any release of other hazardous material is expected to exceed the applicable PAC beyond the facility boundary. The PAC is not expected to be exceeded at or beyond the site boundary.
- an actual or potential threat to the integrity of a nuclear weapon, component, or test device that may adversely impact the health and safety of workers in the immediate area, but not the public

- actual or potential major degradation in the level of safety or security of a facility or process that could, with further degradation, produce a General Emergency.

site boundary - in general, the perimeter of the DOE-owned and controlled land at SRS is the site boundary. Areas where the general public has uncontrolled access to areas of SRS are offsite for purposes of emergency classification unless it can be assured (e.g., procedures in place) that those areas can be evacuated and access control established within one hour of event declaration.

source term - the amount of respirable material released to the environment. In an accident analysis, the source term is equal to the material at risk (MAR) multiplied by an appropriate source release fraction (ARF x RF). Source term =(MAR)(ARF x RF). Within classification procedures, the source term is typically expressed in an equivalent isotope of Pu-238 (Pu-238_{eq}).

special nuclear material (SNM) - Plutonium, Uranium-233, Uranium enriched in isotope 233 or 235; any material artificially enriched by any of these elements; or any other material which the U.S. Nuclear Regulatory Commission (NRC), pursuant to the provisions of Section 51 of the Atomic Energy Act, determines to be special nuclear material, not including source material

target - that which is threatened or at risk from theft, diversion, or damage. A target such as a quantity of Plutonium is also a hazard, as defined previously.

total effective dose equivalent (TEDE) - the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). Deep dose equivalent to the whole body may be used as effective dose equivalent for external exposures.

uncontrolled access - SRS locations where the general public can obtain unescorted access and it cannot be assured that the area can be evacuated and access control established within one hour of any operational emergency declaration

Responsibilities

Safeguards, Security, and Emergency Services (SS&ES) Level 2 Manager

The SS&ES Level 2 Manager is responsible for

- interfacing with the Local Emergency Planning Committee to identify any external hazards impacting the Facility
- supporting DOE-SR in negotiations with Georgia and South Carolina regarding any changes to the Emergency Planning Zone as determined by the EPHA
- maintaining a core group list of qualified EPHA Team members to be used for establishing teams for various facilities
- developing standard implementing procedures to be used by the facilities in the development and approval of EPHAs

- reviewing approved deviations for impact on order compliance packages and implementation plans in accordance with Procedure Manual 8B.
- providing signature approval of the EPHA

SS&ES Facility Security and Emergency Services Level 3 Manager

The SS&ES Facility Security and Emergency Services Level 3 Manager is responsible for

- appointing the Facility Emergency Preparedness Coordinator from SS&ES Staff
- ensuring consistency in the site conduct of operations for EPHA development and implementation
- approving any deviations from this procedure in the development of an EPHA and ensuring any deviation is clearly stated within the EPHA
- providing signature approval of the EPHA

Facility Emergency Preparedness Coordinator (EPC)

The Facility EPC is responsible for

- ensuring applicable Emergency Services Compliance Schedules are revised based on each new fiscal year's budget
- ensuring the facility includes any EPHA development, review and revision into the fiscal year budget
- tracking the progress of the EPHA within the applicable facility and SS&ES schedules
- transmitting approved EPHAs to document control for controlled distribution
- coordinating annual review/revisions to EPHAs within the facility.

Facility Manager

The Facility Manager owns the EPHA document and is responsible for

- providing support for EPHA development in accordance with this procedure and applicable Compliance Schedules
- ensuring that the EPHA Project deliverables are incorporated into the line organization integrated schedule and budget
- integrating the EPHA task with other Authorization Basis Document tasks
- assigning an EPHA Coordinator and SMEs for the facility
- appointing an EPHA Team Leader
- ensuring the EPHA is reviewed/revised on an annual basis and as required based on Design Authority Technical Reviews and other facility modification documents
- providing signature approval of the EPHA

Facility Operations Manager

The Facility Operations Manager is responsible for

- providing Operations support for the development of the EPHA
- ensuring the EPHA is reviewed by operations personnel and reflects the current instrumentation and configuration of the facility
- providing signature approval of the EPHA

Facility Technical Manager

The Facility Technical Manager is responsible for

- providing technical support for the development of the EPHA, this includes supplying personnel for the EPHA development team
- ensuring the EPHA is reviewed annually by Technical Support personnel and reflects the current information and authorization analysis data for the facility
- formally documenting annual EPHA review to the Facility Manager
- providing signature approval of the EPHA

SS&ES Material Protection, Control, and Accountability (MPC&A) Level 3 Manager

The MPC&A Level 3 Manager is responsible for reviewing the EPHA to determine agreement with events identified in any applicable Radiological Toxicological Sabotage (RTS) report and/or Vulnerability Analysis.

Subject Matter Experts (SMEs)

The Subject Matter Experts (SMEs) are individuals considered “experts” in a specific field based on their level of knowledge and experience (including training, education and other qualifications). The facility EPHA Coordinator uses SMEs to gather the requisite technical information needed for the development of the EPHA.

Procedure

This procedure is divided into the following subsections:

A. Emergency Preparedness Hazards Assessment
B. EAL Instrument Sensitivity
C. Hazards Assessment Format
D. Temporary/Transitory Facility Hazards
E. Quality Assurance
F. Hazards Assessment Control
G. Training

A. Emergency Preparedness Hazards Assessment (EPHA)

Classified information identification and protection controls are not to restrict the scope of the development of the EPHA. Classify the EPHA accordingly or develop a separate classified section of the EPHA.

The EPHA identifies and analyzes hazards that are significant enough to warrant consideration in a facility's operational emergency management program. The process includes a screening step whereby insignificant hazards are excluded from detailed consideration. The EPHA determines the requirement for facility EALs. The EPHA is the technical basis for the EALs.

1. Prerequisites

The following prerequisites will be in place before starting the EPHA process.

a. Integration with other Authorization Basis Documentation

The Facility Manager reviews the current schedule for other authorization basis documentation development and, where possible, integrates the EPHA with this schedule to increase efficiency and reduce cost.

b. EPHA Team Identification

SS&ES and the Facility Manager shall identify the EPHA Team after funding is available; document any restrictions on team members allotted time for performance of EPHA tasks (i.e., concurrent tasks); and adjust the EPHA completion schedule appropriately.

Select EPHA Team members based upon their experience in hazards assessment type work, facility knowledge, and discipline. Personnel assigned to the EPHA Team should be assigned for the duration of the schedule to maintain consistency and reduce cost. From team members, the Facility Manager shall appoint a lead.

c. EPHA Team Training

At least one member of the EPHA Team will be experienced in the following areas:

- barrier analysis
- dispersion modeling
- facility mission, systems and processes
- Procedure Manual E7

2. Facility Description/Boundaries

a. Summarize a clear, accurate, and unambiguous written and schematic description of the facility and its operations that are to be the subject of the EPHA. Provide sufficient detail to support the identification and characterization of all hazards and a determination of their potential consequences.

The facility description included in the facilities current Authorization Basis Documentation or Facility Design Description (FDD) may be sufficient. In this case, write a brief summary description of the facility with a reference to the applicable document that contains further detailed descriptions or copy the entire description into the EPHA.

b. Define the facility boundary. The principal considerations are the material processing boundaries and corresponding physical (structural or geographical) boundaries. A facility boundary includes all buildings, structures, support equipment, and auxiliary systems that support a common mission. In most cases, the boundaries of the facility and operations in question have been previously defined (e.g., a security boundary or fence). Reexamine these boundaries with the objectives of the EPHA in mind.

Several structures or component units with a common or related purpose may constitute a single "facility." For example, the waste tank farms are defined as one facility because they are composed of a number of units of approximately the same nature and purpose under common management and operational control.

In cases where a physical boundary does not exist or for hazards associated with transportation incidents (outside the facility boundary) use a distance of 100 meters for the facility boundary.

Consider as a single facility a complex of dissimilar buildings, operations, and equipment if they are physically adjacent, under common management, and have a common programmatic mission. For example, Separations facilities with the canyon and associated outside facilities, ventilation buildings, and sand filters.

If a single building or structure contains several tenant activities or units, such as process lines, hot cells, or hazardous material storage, it may be reasonable to consider the entire structure as one facility (e.g., Savannah River Technology Center) even though the constituent units may normally have little interaction with one another.

The EPHA clearly identifies what constitutes the subject facility. See Attachment B, Facility Boundary Guidelines, for further guidance on defining a facility boundary.

c. To negate the need to calculate a distance from the release point to the nearest facility boundary for each release scenario, determine one common distance to the nearest facility boundary as follows:

- Using the latest revision of the Savannah River Site Atlas, or other approved map, estimate the geometric center of the Facility or the primary release point (e.g., Main Building Stack).
- Determine the distance from this center to the nearest facility boundary.
- Compare the distance calculated to 100 meters, select the larger of the two and document this distance in the EPHA.

For example, for a facility that is a perfect circle with a radius of 150 meters, the distance to the facility boundary for all accidents analyzed in the EPHA is 150 meters. Justify and document any deviation from this method in the EPHA.

d. Define the nearest site boundary. Use the following distances for nearest site boundary for the Areas identified:

AREA	DISTANCE (kilometers)	AREA	DISTANCE (kilometers)
A	0.67	L	9.16
B	5.18	M	1.30
C	9.33	N	10.88
D	1.66	P	9.21
E	10.51	R	7.92
F	9.39	S	10.94
H	11.54	TNX	0.60
K	8.86	Z	9.98

For any area not identified above, calculate the distance to the nearest site boundary using the site boundary definition and the same methodology outlined in step c. Document this distance in the EPHA.

e. Identify independent segments. Segments are independent if barrier failures and human errors in one segment do not propagate into another segment. Segmentation is helpful during accident analysis in properly estimating inventories released when barriers fail.

Segmentation of the facility is also necessary to document the EPHA in its proper format and is used as a work control tool during the development of the EPHA. For facilities where segmentation is needed more from a work control standpoint than accident analysis, it is not necessary to prove independence. The accident analysis section of the EPHA must specifically take into account segments that are not independent during source term estimation calculations.

3. Identification and Screening of Hazards

a. Identify maximum inventories of nonradioactive hazardous materials. Expected or maximum historical quantities may be used if physical or administrative limits do not exist. The inventory includes purchased, process, and waste stream nonradioactive hazardous materials. The Site Chemical Inventory is the basic source of information for all purchased chemicals.

HADs, SARs, BIOs, Technical Safety Requirements (TSRs), and subordinate facility procedures are a source of inventory information for non-purchased process related and waste stream nonradioactive hazardous materials along with system descriptions, process flow sheets, SMEs, and facility walkdowns.

The use of safety analysis inventories (e.g., SARs, BIOs) directly for EPHA analysis may be overly conservative as authorization basis inventories may have additional safety margin that is unnecessary for EPHA analysis.

b. Identify maximum inventories of radioactive materials. Include, as applicable, both physical limits (e.g., tank capacity) and associated administrative limits (e.g., maintain tank level <75%). Expected or historical quantities are normally used where physical and administrative limits do not exist. The inventory includes purchased, process, and waste stream radioactive hazardous materials.

HADs, SARs, BIOs, Technical Safety Requirements (TSRs), and subordinate facility procedures are a source of inventory information. Material Control and Accountability (MC&A) records are the primary source of information on current holdings and authorized limits for Special Nuclear Material (SNM). MC&A also maintains the records for all accountable site sources and other accountable material. Test plans, process safety assessments, or other controlling documentation for hazards of a transient or intermittent nature also contains relevant hazardous material inventory information.

The use of Authorization Basis inventories (e.g., SARs, BIOs) directly for EPHA analysis may be overly conservative as most authorization basis inventories contain additional safety margin that is unnecessary for EPHA analysis.

For facilities having a documented Vulnerability Analysis or RTS report, note the identified targets that are also hazardous materials (e.g., radioactive materials at risk from theft, diversion, or sabotage) in the list of facility hazards. The target list may be classified. Consider pertinent information from these vulnerability analyses in the EPHA and classify the EPHA accordingly.

c. Identify hazards associated with transportation activities. This will include both radiological and nonradiological hazardous materials. The transportation list of hazardous materials includes both those generated from within the facility (receiving and outgoing shipments) and those generated from other facilities but passing within the boundary of the facility being analyzed.

d. Identify any external hazards. SS&ES consults the Local Emergency Planning Committee (LEPC) to identify nearby facilities having hazardous material inventories that could affect the site. SS&ES considers railroads, highways, and other transportation arteries near the site as possible locations of hazardous material transportation accidents. SS&ES estimates the effects on the site of hazardous material events originating offsite and uses this as the basis for determining whether specific arrangements should be made with offsite authorities for notification and joint response. With exception of the Transportation EPHA, external hazards are addressed in response-related procedures.

e. Hazards associated with fire by-products. Building fires may produce toxic by-products from the burning of furniture, paint, etc. Fires in office buildings or industrial facilities that do not contain large inventories of hazardous materials may be categorized as an operational emergency if they result in significant structural damage with suspected personnel injuries or death. However, they will not normally be classified. To determine if the EPHA needs to analyze the release of toxic materials from fires, the results of the Fire Hazards Analysis (FHA), conducted to meet the requirements of DOE O 420.1, should be reviewed. If the FHA results indicate that extraordinary protective actions by emergency responders (e.g., fire department) will be needed in the downwind area, the toxic material release should be included in the EPHA.

f. Eliminate the need to analyze insignificant hazards using screening thresholds.

1. Hazardous Chemicals

(a) Eliminate chemicals not present in quantities exceeding Threshold Quantities (TQs) listed in either 29 CFR 1910.119 or 40 CFR 68.130 or Threshold Planning Quantities (TPQs) listed in 40 CFR 355.

If a container or storage vessel holds a mixture or solution of a chemical of concern, multiply the concentration of the chemical of concern, in weight percent, by the mass in the vessel to determine actual quantity for comparison to TQ / TPQ values.

(b) Document ERPG-1, ERPG-2, and ERPG-3 values (or equivalents) for each chemical not eliminated.

2. Radiological Screening

(a) For radioactive materials, use the method and quantities listed in 10 CFR 30.72, Schedule C to determine the ratio of the amount of a radionuclide present to its allowed amount. Do not screen the radionuclides if the summation of the ratios is ≥ 1.

It is not necessary to calculate and sum all ratios if a simple calculation shows that one or a few nuclides ratio(s) equal or exceed 1.

(b) If the summation ratio is ≥1, the number of radionuclides carried through the EPHA can be reduced by calculating their contribution to dose as follows:

- Multiply each of the Isotopes Curie content (e.g., Ci/gal, Ci/g) by the most restrictive (based on clearance class) inhalation Dose Conversion Factor (DCF) listed in DOE/EH-0071 to obtain the total potential dose (e.g, rem/gal).
- Determine the percent contribution of each isotope to the total dose.
- Retain the isotopes contributing the greatest percentage so that ≥95% of the total dose is included. Eliminate smaller contributions not necessary to reach 95%.
- Tabulate the results and include in the screening section of the EPHA.

Depending on the analysis to be performed, it may be easier to calculate a Pu-238 equivalent (Pu-238_{eq}) isotope for the entire inventory in order to reduce the number is isotopes to be carried through. A Pu-238_{eq} uses the same DCFs as listed above and is calculated as follows:

$$Pu-238_{eq} = \frac{1}{DCF_{Pu-238}} \sum_{i} (A_i)(DCF_i)$$

where:

DCF_{Pu-238} = The most restrictive Exposure-to-Dose Conversion Factors for Inhalation/CEDE per Unit Intake for Pu-238 (or other isotope) as taken from DOE/EH-0071

A_i = The number of Curies of the *i*th isotope

DCF_i = The Exposure-to-Dose Conversion Factor for Inhalation for the *i*th isotope

The above methods assume that the inhalation dose is the dose of interest. These same methods can be applied to ingestion doses, direct doses or any other specific dose where information is available that allows the dose to be normalized to a single or fewer isotopes.

3. Eliminate and document in the EPHA (or reference the appropriate document in the EPHA) those materials for whose maximum facility inventory are less than the screening quantity.

4. Upon completion of the screening process, some facilities may have no identified hazards requiring further characterization and analysis. In this case, document the results of the screening process and the basis for the conclusion that no further analysis is needed. Route the EPHA for approval as per Section F.

4. Barrier Identification

Assemble and document information that describes and quantifies the remaining hazards to support the development of accident analysis of possible releases. The Facility Defense-in-Depth (DID) evaluation may provide much of the information needed in this section. For those facilities that do not have a DID, the information obtained to complete the Barrier Identification section of the EPHA provides a feed into the DID.

a. Include both radioactive and nonradioactive hazardous materials in a tabulation with the following information on each:
   1. The material storage and/or process location(s).
   2. A description of the conditions under which the material is stored or used. Include process systems or containers that hold the material and barriers/mitigative features that may affect its release or dispersion (e.g., shipping containers, buildings, berms, sumps, or catch basins). Identify, where applicable, security and access controls for the storage and use locations.
   3. A description of engineered controls, safeguards, or safety systems designed to prevent or mitigate a hazardous material release. This includes both automatic and manually activated mitigating systems (e.g., fire sprinklers, filters, scrubbers, isolation dampers) as well as passive mitigating features and engineered geometry or configuration controls for fissionable materials.
   4. A description of administrative controls that would prevent or mitigate the initiation of a hazardous material release. This includes such things as limits on the total quantity of a material in a single place or container, or restrictions on where certain materials can be used or stored.

b. For facilities where criticality accidents are credible, the inventory of interest is the total yield from the postulated criticality event. DOE-HDBK-3010-94, Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities, contains methods to calculate this yield and to determine what fraction of the yield can escape to the environment.

c. Where the material consists of irradiated fuel containing mixed fission products, analyze the relevant factors that define the radiotoxicity of the mixture (e.g., enrichment, burnup, and age). Select a limiting case, such as one that produces the largest impact.

d. For those facilities having a documented Vulnerability Analysis or RTS, the identified targets may include both hazardous materials and essential parts of the system of barriers, controls, and protection features that keep them in a safe condition. The target list is potentially a source of information regarding quantities of certain hazards and the conditions under which they are stored, handled, and used.

e. Include other materials and hazard sources, such as flammable or explosive materials and energy sources in the characterization. Consider their potential for initiating releases of radioactive or chemically toxic materials, contributing to dispersal of those materials, or degrading the effectiveness of safety systems.

f. Assess available information concerning the reactive properties of the hazardous materials.

5. Accident Analysis

Using a Barrier Challenge/Failure analysis, determine the processes (i.e., combinations of events and conditions) that could cause the release of each hazardous material characterized and the magnitudes of those possible releases.

SAR analyses are nearly always an incomplete representation of the spectrum of operational emergencies for which emergency planning is required by DOE Order 151.1. Normally, the SAR does not perform quantitative analysis of higher probability, lower consequence events and "beyond design basis" events that, from a facility-design standpoint, would be beyond credible. DOE Standard 3009 accident binning or specific probabilistic risk analysis performed for the SAR to determine credibility of an accident does not include several of the initiators (terrorism, sabotage, malevolent acts, etc.) that emergency planning requires. Therefore, the use of a $<10^{-6}$ frequency or beyond extremely unlikely binning for beyond credible accidents, as calculated for SAR analysis, as exclusion criteria in the EPHA is not appropriate. Use SAR analyses as input to the EPHA. Characterize and consider the rest of the accident severity spectrum.

a. Identify Primary Barriers

This is generally the barrier closest to the material. In the case of gaseous or liquid materials, the tank, cylinder, process piping or other container is usually the primary barrier. For materials that are prevented from being released by their own structure or physical form, consider that form or structure as the barrier.

b. Identify Failure Modes of Primary Barriers

The initial step in this analysis is to postulate failure modes of the primary barrier. The second step is to identify possible causes of each primary barrier failure mode. In the example of a tank or container that contains a gaseous or liquid material, possible causes of failure might include corrosion, design or manufacturing flaw over pressure, external impact (missile, forklift, crane load), operator error, excessive temperature, or water hammer.

While performing this analysis, compile a list of the indications of barrier failure or challenge. This list will include instrumentation that gives indication of barrier failure along with the instruments associated ranges of indication. Summarize the indications of barrier failure/challenge in tabular form. Use this list for EAL development.

c. Estimate the Magnitude of Release from Primary Barrier

For each cause of failure, develop a quantitative estimate of the Material at Risk (MAR). Consider the physical properties of the material, such as volatility, viscosity, melting point, vapor pressure, temperature and pressure conditions under which the material stored, and the postulated mode of failure.

Use the maximum inventory when estimating the release from a barrier, if administrative controls limit the amount of material in a tank, or a concentration in a process, perform another analysis with the administrative controls amount as the maximum inventory. Document both results in the EPHA.

If multiple containers of the same hazardous material exist in the facility, consider the same event causing release of the contents of more than one container (e.g., seismic event or a forklift ramming two or more barrels) and that the failure of one container could lead to failure of others. This evaluation step estimates the maximum amount of a material released from the primary barrier as a function of time for each event or failure mode, considering the physical, chemical, and thermodynamic properties of that material.

1. Radiological Source Terms

   DOE-HDBK-3010-94 provides Airborne Release Fractions (ARFs), Respirable Fractions (RFs), and Airborne Release Rates (ARRs) applicable to many types of releases. The bounding ARF-RFs, and ARRs listed in the DOE-HDBK-3010 are normally most appropriate for use. Accident-specific ARF-RFs and ARRs derived in other authorization basis documents can also be used. If no applicable ARF-RF or ARR can be found, those cited in DOE-STD-1027 may be used. DOE-HDBK-3010-94 defines the RF as "the fraction of airborne radionuclides as particles that can be transported through air and inhaled into the human respiratory system." The RF is commonly assumed to include particles "10 µm Aerodynamic Equivalent Diameter (AED) and less." The final source term (ST) is typically calculated as follows.

   $$ST = (MAR)(DR)(ARF)(RF)(LPF)$$

   Or

   $$ST = (MAR)(DR)(ARR)(t)(RF)(LPF)$$

   where:
   ST = Source Term (Ci or Bq)
   MAR = Material at Risk (Ci or Bq)
   DR = Damage Ratio (fraction)
   ARF = Airborne Release Fraction
   RF = Respirable Fraction
   LPF = Leak Path Factor (fraction)
   ARR = Airborne Release Rate (fraction/hour)
   t = Release Duration (hours)

The Damage Ratio (DR) is the fraction of the MAR actually impacted by the accident-generated conditions. A degree of interdependence exists between the definitions of MAR and DR. If it is predetermined that certain types of material would not be affected by a given accident, some analysts will exclude this material from the MAR. The DR is estimated based upon engineering analysis of the response of structural materials and materials-of-construction for containment to the type and level of stress/force generated by the event. Standard engineering approximations are typically used. These approximations often include a degree of conservatism due to simplification of phenomena to obtain a useable model, but the purpose of the approximation is to obtain, to the degree possible, a realistic understanding of potential effects.

The LPF is a factor that can be used to take credit for holdup of material within some secondary confinement that reduces the final amount of material released to the environment. There can be several LPFs for some accident conditions (e.g., the fraction transported from a package to the cell or enclosure; the fraction leaked from the enclosure, cell, or glovebox to the operating area around the enclosure or room; the fraction leaked from the room to the building; the amount captured in the building exhaust filters). Where multiple leakpaths are involved, their cumulative effect is often expressed as one value that is the product of all leak path multiples. The LPF is a calculated, standard, or engineering judgement value based upon (1) established relationships between size of the particulate material, airborne transport mechanisms, and losses by deposition mechanisms, or (2) specified filtration efficiencies.

Realistic values should be used in developing the DR and LPF for the particular event.

Use the following assumption for radiological accident events involving multiple release mechanisms, (e.g., an instantaneous release followed by a longer-term release):

- Use the dominating release mechanism (e.g., detonation) for the release duration with other contributing mechanisms (e.g., spill, resuspension) added together to form one source term for analysis.

- Determine the length of time for the release. For re-suspension events, limit the time of the event to 2 hours. In lieu of better information, use 30-minute release times for fire events. The release time is a required input for determining downwind consequences in the next section.

2. Chemical Source Terms

The conceptual approach embodied in the source term equations presented above for radioactive materials can also be applied to chemicals. However, no compendium of values for ARF, ARR, and RF currently exists; these parameters will need to be derived from the material properties using basic physical and chemical principles. Alternatively, given the MAR and release scenario, any of several computer codes, such as ALOHA, can be used to determine chemical source terms and model their transport and dispersion. Chemical source terms for reaction product formation (e.g., two chemicals spilling and mixing) are normally determined by manual calculation using conservative assumptions.

d. Assess the Effects of Secondary Barriers and Mitigating Features

Assess and document the effects of secondary barriers and mitigating features on the maximum amount of material released from the primary barrier. Depending on the hazardous material in question and the storage mode or process, additional barriers or mitigating features may or may not have to be defeated if a release to the atmosphere is to occur.

For example, in the case of an outdoor, free-standing acid tank, there are no secondary barriers to consider. A breach of the tank wall discharges the acid directly to the environment. In the case of radioactive materials within a glovebox, inside a building, the glovebox exhaust filters, the glovebox itself, the room ventilation system, and the building walls may be barriers and mitigating features of interest.

Characterize the effectiveness of secondary barriers and mitigating features. For example, an exhaust filter may have a rated or tested efficiency for particles of a given size that will apply to all release conditions in which the ventilation system is operating and is the release pathway (e.g., High Efficiency Particulate Air (HEPA) Filters assume a 99.9% efficiency for the first stage and 99.8% efficiency for subsequent stages where sand filters assume a 99.5% efficiency). However, building walls may be characterized as either intact, in which case one set of release scenarios applies, or not intact, which lead to a completely different set of release possibilities.

The type of event postulated determines how much mitigation the secondary barriers provide. The barrier analysis process may point out the need to modify or enhance facility mitigating features or instrumentation used to monitor barrier states.

e. Initiating Events and Scenarios

Evaluate possible initiating events and accident scenarios that could lead to the release of hazardous materials (e.g., spontaneous failure of a barrier(s), failure of administrative controls, impact of external events, and/or malevolent acts).

Incorporate any contributing events or conditions that could influence the progression of the scenario or alter the magnitude or nature of the consequences. For example, failure of fire suppression systems to activate following initiation of a fire would change the accident progression. Likewise, different levels of combustible loading in a given area might increase or decrease the magnitude of the fire. Either or both events might affect the possible level of damage to the facility or quantity of hazardous material released.

For events that take a finite amount of time between the initiator and the barrier failure (e.g., a loss of purge flow to a tank resulting in a buildup to a flammable mixture), calculate that time. The time is used to determine the likely progression of the event. For example, if rapid buildup of flammable gas in a waste tank vapor space is possible, it is reasonable to postulate that a reaction occurs at the concentration that produces the largest energy release, which could be well above the lower explosive or flammable limit. However, a slow buildup in concentration makes it more likely that the gas will be ignited sometime after the lower explosive/flammable limit has been exceeded but before the optimum (stoichiometric) condition is achieved, thus producing a lower energy release. These situations should be noted and the factors leading to selection of a lower energy release scenario should be fully justified.

Events that take a considerable amount of time to develop (e.g., greater than one operating shift), to the point where facility intervention cannot be ignored, do not require complete analysis and are listed in Section 6 of the EPHA along with the justification as to why further analysis is not necessary.

For each combination of hazard and release type identified, select initiating events and accident scenarios ranging from minor to severe.

f. Malevolent Acts

Malevolent acts (theft, sabotage, or terrorism) including the use of explosives or flammable material are possible release initiators within the scope of emergency planning. It is not intended that all inventories be evaluated with malevolent event initiators. Both moderate and extreme scenarios should be identified and analyzed to establish EALs for events resulting from malevolent acts. “Moderate” scenarios are those that could be initiated by a single individual using materials or tools readily available in the facility, or small quantities of flammables. “Extreme” scenarios, such as those used in vulnerability assessments and/or radiological and toxicological sabotage assessments, should provide the analyst with an upper bound on the severity of potential consequences.

In most cases, malevolent act scenarios will produce releases and consequences similar to those that could be caused by accidental or other external initiators. Therefore, identifying a malevolent act as a potential initiator does not necessarily mean that a separate detailed analysis of that scenario is needed. For example, an explosion and fire that releases a hazardous material from a storage location might be postulated to result from an aircraft or vehicle crash. However, if approximately the same level of damage and source term might also be caused by an act of sabotage in the same location, the malevolent act can simply be considered a second initiator for the same basic fire/explosion condition.

The use of the barrier challenge/failure analysis method for EPHA accident analysis will implicitly analyze the vast majority of moderate malevolent acts. Within Section 6.0 of the EPHA, the potential events that would challenge/fail a barrier are not normally detailed, as the list can become quite long. In addition, the listing of events lends little to the development of Emergency Action Levels, the end product of an EPHA. If events are identified where the only initiator to a release is a malevolent act, it is explicitly stated in the EPHA. Otherwise, no notation is made.

For Interim EPHAs (IEPHA) that are based on the current Authorization Basis, the barrier challenge/failure method of analysis is not used. For IEPHAs, a worst-case moderate malevolent act is identified from existing analysis or performed specifically for the IEPHA.

g. Conservatism of Analysis

It is expected that the accident analysis within an EPHA will be conservative in nature. This will differ from the “bounding” type analysis contained within some authorization basis documents. An example of conservative analysis versus bounding would be the MAR, during a seismic type event, for 1000 liquid waste drums that are banded four to a pallet, stored outside, and stacked three high. A bounding MAR would be the contents of all 1000 drums where a conservative assumption could be the contents of 1/4 of the drums. Unlike a bounding analysis, a conservative analysis requires more sound engineering judgement. It is expected that any assumptions based on engineering judgement be stated, with any available justification, within the EPHA.

6. Estimate Potential Event Consequences

Estimate potential consequences of the hazardous material release scenarios developed in the preceding section to determine the area(s) potentially affected.

a. Document in the EPHA the methods and calculation models used in estimating consequences.
b. EPHA consequence assessment is performed in accordance with the procedure TP-95-002, “Consequence Assessment for Emergency Preparedness Hazards Assessments”.

c. The release calculations yield a quantitative estimate of the consequences (e.g., radiation dose, or peak concentration of a toxic chemical) of each release at each receptor of interest. The consequences at these locations form the bases for emergency planning and preparedness. Analyze the following for each facility and transportation incident occurring within the facility boundary under both 95% adverse and 50% meteorological conditions.

1. Thirty (30) meters from the release. The consequence at this receptor location provides the demarcation between an accident that would require emergency response organization involvement (e.g., ALERT) and one that would not.
2. Distance from the release to the facility boundary. The facility boundary is the demarcation between the facility and its immediate vicinity and the remainder of the site. The consequence at this receptor location provides the demarcation between an ALERT and Site Area Emergency declaration.
3. Distance from the release to the closest site boundary. The consequence at this receptor location is the demarcation for a General Emergency declaration.
4. Point of maximum dose. The maximum dose for ground level releases will, obviously, be the point closest to the release. Elevated releases, on the other hand, will produce a maximum dose at the plume touchdown point. The touchdown point varies based on meteorological conditions and the release height. The isodose concept takes into account the areas between the defined receptor locations (30m, facility boundary, site boundary) and requires an emergency declaration if the PAC is exceeded in these zones.

   See Attachment C, Isodose Concept, for a graphic representation of the relationship between the receptor points and emergency classification.

5. The maximum distance for which a PAC is exceeded for a given event.
6. Determine other onsite receptor locations of interest for the facility being analyzed. Give consideration to the following:
   - Adjacent Facilities with significant occupancy (e.g., Central Training Facility).
   - Protected Area Boundaries where Rally Points are normally located.
   - Emergency Response Facilities (e.g., Emergency Operations Center, Shelters).
   - Crackerneck Wildlife Management Area
   - Locations where precautionary PACs of 100 mrem and ERPG-1 are exceeded.

   The use of a graphical output such as dose versus distance can be included in the consequence assessment calculation in the EPHA to determine potential downwind doses/concentrations for other receptors of interest.

d. Calculate the consequences of the hazardous material releases at the selected receptor locations using approved dispersion models (e.g., ALOHA and HOTSPOT).

e. Compare the results at the 30-meter, facility boundary, site boundary, and point of maximum dose receptor locations to the applicable PAC. Attachment D, "Protective Action Criteria for use in facility EPHA", provides an explanation of the PACs.
f. Determine the potential emergency class corresponding to each analyzed event.
g. Summarize the results in tabular form per the EPHA Style guide to aid in the correlation of potential accident impacts with appropriate event classification criteria (i.e., EALs) and protective response actions. Provide separate tables for the 50% and 95% meteorological conditions.

7. Emergency Planning Zone (EPZ) Determination

The Nuclear Regulatory Commission (NRC) and the Federal Emergency Management Agency (FEMA) have established the EPZ requirements for U.S. power reactors. The analysis that led to the establishment of the standard plume exposure pathway planning zones for large, domestic power reactors is documented in NUREG-0396, EPA 520/1-78-016. The report concluded that a 10 mile plume exposure (airborne) pathway EPZ was adequate because projected doses from the traditionally defined design basis accidents would not exceed the higher Protective Action Guide levels then in effect (5 rem whole body, 25 rem thyroid dose).

Due to the inherent differences between power reactors and SRS facilities, changes in EPA Protective Action Guidelines (PAGs), and the inclusion of chemical hazards into the EPHA, a facility specific EPZ evaluation is performed during the EPHA process.

A larger EPZ does not necessarily provide for better protection of the population than a smaller one. The following points must be understood and carefully considered by those responsible for establishing the geographic extent of any facility EPZ.

- For a given wind speed, the elapsed time between initiation of a hazardous material release and the onset of consequences at a receptor location is directly proportional to the distance between the source and receptor. Hence, the greater the distance from the source, the more time will be available to carry out protective actions.
- If distance (and available time) is great enough, ad hoc protective actions will be approximately as effective in reducing health impacts as those actions that have been planned and prepared for in detail. As the effectiveness of a preplanned protective action approaches that of an ad hoc action, the efficiency of planning/preparedness efforts (expressed in terms of reduced health impacts per unit investment in planning/preparedness) approaches zero.
- Because resources available for protective action planning and preparedness are always limited, use of those resources should be concentrated in the geographic areas where the greatest reduction in health impact per unit expenditure can be achieved.

Base the choice of EPZ for each facility on objective analyses of the hazards associated with that facility, and not on arbitrary factors such as historical precedent or distance to the site boundary.

As a matter of practical necessity, the EPZs for a DOE facility or operation should be developed in cooperation with the responsible state, local, and tribal authorities and other tenant site facilities.

EPZs may be based on risk criteria agreed upon by state and local authorities. Risk-based methods of prioritizing emergency planning and preparedness efforts provide assurance that resources are dedicated to the proper areas and issues. However, such methods require a major investment in a comprehensive Probabilistic Risk Assessment (PRA) for the facility. Facilities for which a PRA has already been prepared or is in progress may choose to use the results to establish their EPZs in cooperation with state and local authorities.

The following issues should be considered when developing and proposing an EPZ:

- Each state, tribal, and local government has a statutory responsibility to protect its citizens. All states, as well as most counties, cities, and towns, have emergency plans and some means to respond to hazardous material emergency conditions within their jurisdictions. Even if detailed planning specific to the affected geographic area has not been done, there exists a level of general planning and preparedness for dealing with hazardous material emergency conditions, such as transportation accidents, that serves as the basis for ad hoc tactical response.
- An EPZ associated with a particular DOE facility or operation should be thought of as an area within which government and facility managers determine that special planning and preparedness efforts are warranted, as a means of apportioning preparedness resources to the areas where they are most needed.
- Defining an EPZ for a given type of protective response action, such as evacuation, sheltering, or food pathway intervention, does not mean that implementation of that particular response action will be required in all cases. If an emergency occurs, responsible authorities will assess the actual conditions existing at that time and determine whether protective response action is warranted.
- In the most severe conditions, protective response actions may be needed in areas outside the EPZ. Therefore, the EPZ should be sufficiently large that the planning and preparedness for actions within the defined EPZ provide authorities with a reasonable basis for extending their preplanned response activities to areas outside the EPZ if warranted by the actual conditions.

If the facility EPHA indicates no emergency higher than the Alert class, an EPZ need not be defined for the facility. For those facilities that do not choose the risk-based approach, the EPZ will, as a minimum, include the area where people would be at risk of death or severe injury from the severe releases under 95% adverse meteorological conditions.

Steps for developing a technically defensible plume exposure pathway EPZ are as follows.

a. From the results of the consequence assessment, the distance at which a threshold for early lethality (TEL) would be exceeded for the most severe analyzed release (excluding those which result from "extreme" malevolent acts) under 95% adverse meteorological conditions. This distance is the smallest EPZ radius that should be considered.
b. Determine the distance at which PAC would be exceeded under 95% adverse meteorological conditions for the most severe analyzed release (excluding beyond design basis natural phenomena events and events resulting from "extreme" malevolent acts). This distance or 10 miles, whichever is smaller, is the largest EPZ radius that should be considered.
c. Within the limits of the largest and smallest EPZ radii, consider other factors and adjust the size and shape in accordance with the following principles.
    1. The full spectrum of emergencies that contribute to the facility offsite risk should be considered. Even if a comprehensive PRA has not been done, local knowledge of the probability or risk contribution of the most severe analyzed event relative to the other events that comprise the balance of the site/facility risk may be used in a semi-quantitative way to determine whether the EPZ size should be closer to the maximum or minimum values determined in the previous steps.
        - If the most severe analyzed release would result from a single failure event or is believed to have a relatively high probability of occurrence, an EPZ radius closer to the maximum than the minimum value should be selected.
        - If the probability of the most severe analyzed release is judged to be extremely low or if it contributes a minor fraction of the total offsite risk from site emergencies, an EPZ radius closer to the minimum than the maximum value is indicated.
    2. The hazards judged to contribute most heavily to the offsite risk should be considered, as follows.
        - If the hazard is radiological, an EPZ radius closer to the minimum than the maximum value should be selected because of the wide margin (a factor of 100) between the thresholds for protective action and early lethality.
        - If the hazard is non-radiological, an EPZ radius closer to the maximum than the minimum value should be selected because of the narrower margin (typically a factor of 3 to 10) between the concentration thresholds for protective action and lethality and the potential for severe irreversible effects resulting from exposure to concentrations between the protective action and lethality thresholds.
    3. Definition of an EPZ is meaningful only if significant planning and preparedness measures are implemented within it. This commitment and responsibility to expend resources planning and preparing for the protection of people must be factored into EPZ size. Among the planning and preparedness activities that the site should expect to support on behalf of the population within the EPZ are the following.
        - Identification of responsible onsite and offsite emergency response organizations and the mechanisms for activating their services.
        - Establishment of effective communication networks to promptly notify the public within the EPZ and the responsible authorities.

- Development and delivery of public information and education materials to ensure timely and correct response to warnings.
- Implementation of training programs and provision of equipment for offsite emergency workers.
- Identification of predetermined response actions.
- Development and testing of response procedures.

4. The cost of implementing an EPZ is usually directly related to the geographic size of the EPZ. If creating a larger EPZ means that scarce resources are allocated to the protection of people who are at minimal risk, a larger EPZ may actually be less effective at mitigating overall risk to the population than a smaller one.
5. If distance from the source and the time available to respond are great enough, protective actions carried out on an ad hoc basis will be approximately as effective in reducing risk as those actions that have been planned and prepared in detail. Also, planning and preparedness for the EPZ will provide a basis for more effective response activities outside the EPZ if conditions should warrant.
6. The EPZ should conform to the physical and jurisdictional realities of the site and surrounding area.
7. The EPZ size should give confidence that planning and preparedness will be sufficiently flexible and detailed to deal with a wide range of types and magnitudes of emergency conditions. Four significant considerations that cannot be readily stated as quantitative guidance are presented below in the form of questions to be used as “tests of reasonableness” for the proposed EPZ size.
   - Is the EPZ large enough to provide a credible basis for extending response activities outside the EPZ if conditions warrant?
   - Is the EPZ large enough to support an effective response at and near the scene of the emergency (i.e., to preclude interference from uninvolved people and activity, facilitate onsite protective actions, optimize on-scene command, control, and mitigation efforts)?
   - Is the EPZ likely to meet the expectations and needs of offsite agencies?
   - What enhancement of the facility and site preparedness stature would be achieved by increasing the size of the EPZ? What resources, costs, and liabilities might a larger EPZ engender? Would a larger EPZ result in a large increase in preparedness without correspondingly large increases in cost or other detriment?

d. Document the consideration of each of the tests and any adjustments to the EPZ size that was made. The resulting value and its bases provide the beginning point for discussions with state, local, and tribal authorities.

e. Where several facilities are located in close proximity to one another and the nature of the hazards is the same at each; the largest impact from an event at any of the facilities may be used to define the EPZ for the entire area. Though it is possible that under certain conditions (e.g., major earthquake) releases from several facilities might occur at the same time with consequences that are additive, the EPZ size should not be based on concurrent events at separate facilities.

f. Where a number of individual facilities and activities are located in close proximity to one another, a composite EPZ for the group of facilities or the entire site should be defined to simplify communications and offsite interactions.

g. Onsite transportation accidents involving hazardous materials should be handled as follows:
   1. Transportation of hazardous materials within the site may be analyzed either in an EPHA for the fixed facility with which the materials are associated or in a special EPHA covering all transportation activity on the site.
   2. Emergency plans and procedures should include criteria by which to categorize and classify a range of onsite transportation accidents.
   3. The EPZ for a site should not be extended beyond the site boundary solely on the basis of potential consequences of a transportation accident if the transportation activity is comparable (in terms of materials, quantities, and mode of shipment) to that normally conducted on public routes.
   4. Further guidance on the classification of onsite transportation events is provided in EMPP 6Q-002.

h. The planning process should recognize and provide for the need to carry out protective actions in limited portions of the EPZ for specific events or conditions. Dividing the EPZ into sectors by direction and radial distance and using natural or jurisdictional boundaries to define protective action zones are suggested ways to provide a finer planning and response structure.

i. Document in the EPHA consideration of each of the previous tests and the resulting EPZ determination. Include in the EPHA a graphical representation of the facility specific EPZ determination.

j. EPZ calculations will provide for potential releases by aquatic or other non-atmospheric pathways if these analyses were performed in the EPHA. Emergency plans and procedures will provide for timely communications with those entities, such as health departments or utility companies in downstream communities that draw water from an affected river, regarding any release and its implications.

8. Emergency Action Level (EAL) Development

EALs are developed in accordance with EMPP 6Q-002, Standards for Development and Maintenance of Emergency Action Level (EAL) Procedures. Section 8 of the EPHA is used to summarize the technical basis, list EAL indicators, and document all EALs resulting from the EPHA process.

B. EAL Instrument Sensitivity

Reduce the documentation generated in this section to a concise, readable form and attach to the EPHA as an Appendix.

1. Tabulate EALs versus Instrument indication

Using the instrument list developed in A.5.b and other instrumentation identified while completing section 8 of the EPHA, tabulate all the resulting EALs against their associated instrumentation. Use of a form, such as in Attachment E, submitted to SMEs (e.g., system cognizant engineer) for completion may be useful.

2. Assess adequacy of Instrumentation

a. Assess the adequacy of determining barrier failure/challenge and/or an event occurrence based on the identified instrumentation. Rank the instrumentation identified as to its relative value in determining barrier integrity or event occurrence.
b. Assess the adequacy of available instruments to estimate the potential source term due to a barrier failure or event occurrence (e.g., effluent-monitoring equipment).

C. Hazards Assessment Format

The EPHA is formatted in accordance with the EPHA Style Guide. The EPHA is published as a Technical Report in accordance with Procedure Manual E7. The style guide dictates the format of the document (e.g., applicable sections, fonts, margins, table formatting) to insure consistency between facility EPHAs. The EPHA contains the sections as outlined below.

- Technical Report Cover Sheet
- Technical Report Approval Sheet
- Table of Contents
- List of Tables
- List of Acronyms
- List of Abbreviations

1.0 INTRODUCTION (including a revision summary)

2.0 SUMMARY

3.0 FACILITY DESCRIPTION

4.0 IDENTIFICATION AND SCREENING OF HAZARDS

5.0 HAZARD BARRIER IDENTIFICATION

6.0 ACCIDENT ANALYSIS

7.0 CONSEQUENCE ASSESSMENT

8.0 EMERGENCY CLASSES AND EALs

9.0 EPZ DETERMINATION

10.0 REFERENCE

- APPENDICES (as applicable)

  (A) Figures
  (B) Supporting Calculations
  (C) Facility Instrumentation Review
  (D) Glossary of Terms

An EPHA document numbering system has been established in accordance with Procedure Manual E7. Call Document Control for the applicable number.

D. Temporary/Transitory Facility Hazards

Temporary and/or transitory hazards, such as short-duration storage of hazardous materials, the short-term assembly and testing of weapons devices, or special process testing within a facility, will be covered by specific updates (as an addendum) to the EPHA and associated emergency planning documents (e.g., classification procedure, protective action procedure).

To avoid duplication of effort, the test plans or other controlling authorization basis documents for such hazards can be configured to serve as temporary addenda to the site and/or facility EPHA and emergency plans as applicable.

When using other controlling authorization basis documents in lieu of an EPHA, the SS&ES Level 2 Manager will have signature approval of those documents to ensure the requirements of this procedure are met.

E. Quality Assurance

1. SS&ES is responsible for ensuring all Quality Assurance requirements for software (e.g., dispersion modeling codes) used in EPHA development are met.
2. Facility/engineering personnel perform all calculations for the EPHA in accordance with Manual E7.

F. Hazards Assessment Control

1. Review and Approval of the EPHA

a. The EPHA undergoes an internal review by the EPHA team and selected SMEs within the Facility prior to being routed for formal review and comment.
b. All EPHAs are formally reviewed in accordance with Procedure Manual E7 procedure 2.41, "Interface Coordination", by the following personnel:
   - Facility Manager
   - Facility Technical Manager
   - Facility Operations Manager
   - SS&ES Facility Security and Emergency Services Level 3 Manager

- SS&ES Site Security and Emergency Services Level 3 Manager
- SS&ES Emergency Preparedness Coordinator (EPC)
- SS&ES Material Protection, Control, and Accountability Level 3 Manager
- DOE-SR Safety Division Representative
- DOE-SR Senior Facility Representative

Allow two (minimum) to six (maximum) weeks for this review cycle depending on the complexity of the document and extent of any revision. Comments received after the review cycle should not delay the approval of the document but rather be incorporated into the next revision.

c. The EPHA Team Leader coordinates the comment review cycle, responds to all comments and dispositions comments as appropriate.

d. Upon completion of the review cycle, the EPHA is approved by the following personnel:
   - Facility Manager
   - Facility Technical Manager
   - Facility Operations Manager
   - SS&ES Level 2 Manager
   - SS&ES Facility Security and Emergency Services Level 3 Manager

2. Revision Control

a. Approved EPHAs are reviewed when any change in the facility or its operations results in a positive USQ and revised as required. Reviews are also required prior to a change in hazardous material inventories occurring which may or may not exceed bounding quantities identified in the facility authorization basis. Such changes may very well result in an increased consequence, a change in distance to PAC, or a change of emergency classification.

The EPHA is also reviewed and revised as necessary on an annual basis. The annual review allows for a $\pm$ 25% window in its performance. Any reviews that will extend >25% beyond the annual due date requires notification to DOE-SR Safety Division and concurrence from the SS&ES Facility Security and Emergency Services Level 3 Manager.

b. Annual reviews shall be conducted by the cognizant engineering organization. Reviews shall address the method(s) utilized during the process, a listing of documents analyzed during the review process, a summarization of review findings, and a conclusion as to the technical validity of the EPHA.

Annual reviews shall be formally documented from the Facility Technical Manager to the Facility Manager, and shall include (as a minimum) the following distribution:

- Facility Operations Manager
- SS&ES Facility Security and Emergency Services Level 3 Manager
- SS&ES Emergency Preparedness Coordinator (EPC)
- DOE-SR Facility Representative
- DOE-SR Safety Division Representative

Annual review documentation shall be maintained for a minimum period of three (3) years or until a revision to the EPHA is approved.

c. Annual reviews should be coordinated to coincide with annual reviews of facility authorization basis documents in order to maximize resource utilization. Annual reviews shall be identified in the facility integrated operating schedule and should be initiated to allow sufficient time to complete the review by the annual due date. SS&ES maintains a copy of the EPHA review/revision schedule for all SRS facilities.

d. All revisions of EPHAs shall follow the review and approval process as detailed in F. 1 above (*Subsection F, Hazards Assessment Control).*

G. Training

Facility personnel in roles of event classification (e.g., FEC, AEC, Engineering Advisor) shall maintain a fundamental understanding of EPHA methodology.

Records

Records generated as a result of implementing this procedure are processed in accordance with Procedure Manual 1B, MRP 3.31, “Records Management”.

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- WSRC-TR-97-0124, WSRC Technical Basis for the Savannah River Site Emergency Planning Zone
- NFPA HAZ-91, Fire Protection Guide to Hazardous Materials, Tenth Edition, 1991
- NRT-2, *Technical Guidance for Hazards Analysis, Emergency Planning for Extremely Hazardous Substances*, U. S. EPA
- NUREG-0654/FEMA REP 1, *Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants*, Revision 1
- Procedure Manual 8B, *Compliance Assurance Manual*
- Procedure Manual E7, *Conduct of Engineering and Technical Support*
- Procedure Manual 1Q, *Quality Assurance Manual*
- Procedure Manual 11Q, *Facility Safety Document Manual*
- Procedure Manual 20Q, *Health and Safety Manual for Hazardous Waste Operations*
- SRT-ETS-950015, Minimum Distances to Site Boundary From Various SRS Release Points, A. A. Simpkins, dated 1/20/95
- WSRC-SCD-7, *Savannah River Site Emergency Plan*

Requirements Control System

1. DOE Order 151.1, Comprehensive Emergency Management System, Change 2, 8/21/96

Attachments

Attachment A.	Acronyms
Attachment B.	Facility Boundary Guidelines
Attachment C.	Isodose Concept
Attachment D.	Protective Action Criteria for Use in Facility Hazards Assessment
Attachment E.	EAL Instrument Listing

Attachment A. Acronyms

AIHA	American Industrial Hygienist Association
ARF	Airborne Release Fraction
ARR	Airborne Release Rate
BIO	Basis for Interim Operations
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
DID	Defense-in-Depth
DR	Damage Ratio
EAL	Emergency Action Level
EDE	Effective Dose Equivalent
SS&ES	Safeguards, Security, and Emergency Services
EPA	Environmental Protection Agency
EPHA	Emergency Preparedness Hazards Assessment
EPZ	Emergency Planning Zone
ERPG	Emergency Response Planning Guideline
GE	General Emergency
HEPA	High Efficiency Particulate Air (filter)
IEPHA	Interim Emergency Preparedness Hazards Assessment
LPF	Leak Path Factor
MAR	Material-at-Risk
MPC&A	Material Protection, Control, and Accountability
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulation Guide
PAC	Protective Action Criteria
RD	Release Designation
RF	Respirable Fraction
SAE	Site Area Emergency
SAR	Safety Analysis Report
SME	Subject Matter Expert
SNM	Special Nuclear Material
TEDE	Total Effective Dose Equivalent
TEL	Threshold for Early Lethality
TPQ	Threshold Planning Quantity
TQ	Threshold Quantity
TSR	Technical Safety Requirement
USQ	Unreviewed Safety Question

Attachment B. Facility Boundary Guidelines (1 of 2)

Discussion

1. For many facilities and activities, there will be little or no question about what constitutes the facility operational and physical boundaries. The guidelines presented here help establish boundaries where they have not previously been defined or need revision based on the facilities location relative to other facilities.
2. The boundary definition adopted for a given facility determines whether certain events and conditions are classified as an Alert or SAE. In developing facility boundary definitions, keep in mind that the process of determining emergency classes shall always enhance communications and promote common understanding of the general level of severity or magnitude of the event, both within the DOE and contractor community, and for the general public and news media.
3. Implicit in the DOE Order emergency class definitions and discussion is the assumption that DOE facilities are located within larger tracts (sites) over which DOE has access control authority. There is a logical progression in severity from events that affect the facility but not the larger site (e.g., Alert), to those that affect the site outside the facility but not offsite areas (e.g., SAE), to those that affect offsite areas (e.g., GE). This progression reflects the assumption that a buffer of DOE-controlled land exists between each DOE facility and the site boundary. Some DOE facilities may not have this buffer, and the relationship between facility boundary and site boundary may become one where they are both the same. Adjust Emergency declarations accordingly using the more restrictive classification scheme.

Definition of Facility Boundary

1. The definition of a facility boundary considers material processing operation boundaries and physical boundaries (e.g., structural or geographical). For emergency planning purposes, several structures or component units with a common or related purpose may constitute a single facility. On the other hand, a complex of dissimilar buildings, processes, and equipment may be considered as a single facility if they are physically adjacent, under common management, and contribute to a common programmatic mission.
2. The "facility boundary" concept is easy to apply to a facility that consists of a single building or structure. However, many facilities consist of large laboratory or manufacturing complexes that may include several buildings, structures, or installations.
3. If a single building or structure contains several tenant activities or units, such as process lines, hot cells, or hazardous material storage, it may be reasonable to consider the entire structure as one facility even though the constituent units may have little to do with one another.
4. Facility boundary receptor locations will meet several tests:
   a. Personnel whose normal work location is within the specified facility boundary are directly associated with the operation of the facility in question. Therefor, some offices, shops, and support facilities are part of the facility for hazards assessment purposes.

Attachment B. Facility Boundary Guidelines (2 of 2)

b. If a physical boundary is not obvious or logical for a particular facility, the hazards assessment will utilize a nominal 100 meter radius from the perimeter of the structure for analysis purposes to determine the emergency classes for facility events.

c. It is useful to define a facility to include the entire fenced security area that surrounds the facility of interest. This approach is reasonable if the security area is:

(1) Small with respect to the size of the site (i.e., distance to the facility boundary is short with respect to the site boundary distance); and

(2) Includes few personnel not directly involved with the operations and management of the facility; and

(3) If the distance from the structure to a physical boundary does not exceed about two hundred meters. If so, another boundary within that distance is defined.

5. The following are examples of what shall <u>not</u> be considered as a facility for hazard assessment purposes:

a. Individual rooms, process areas, or laboratories within a larger building or structure. Even if the room/laboratory is different (for hazardous materials or operations) from the rest of the building or it is under different programmatic control or management, it is preferable that the room/laboratory be treated as a component of a readily recognizable physical entity (building or complex) for which there are established building manager/emergency director functions. Where more than one organization occupies the same facility or complex, assign primary responsibility for the EPHA and emergency plan to one organization. All other organization's EPHA plans are then subordinate to the primary organization.

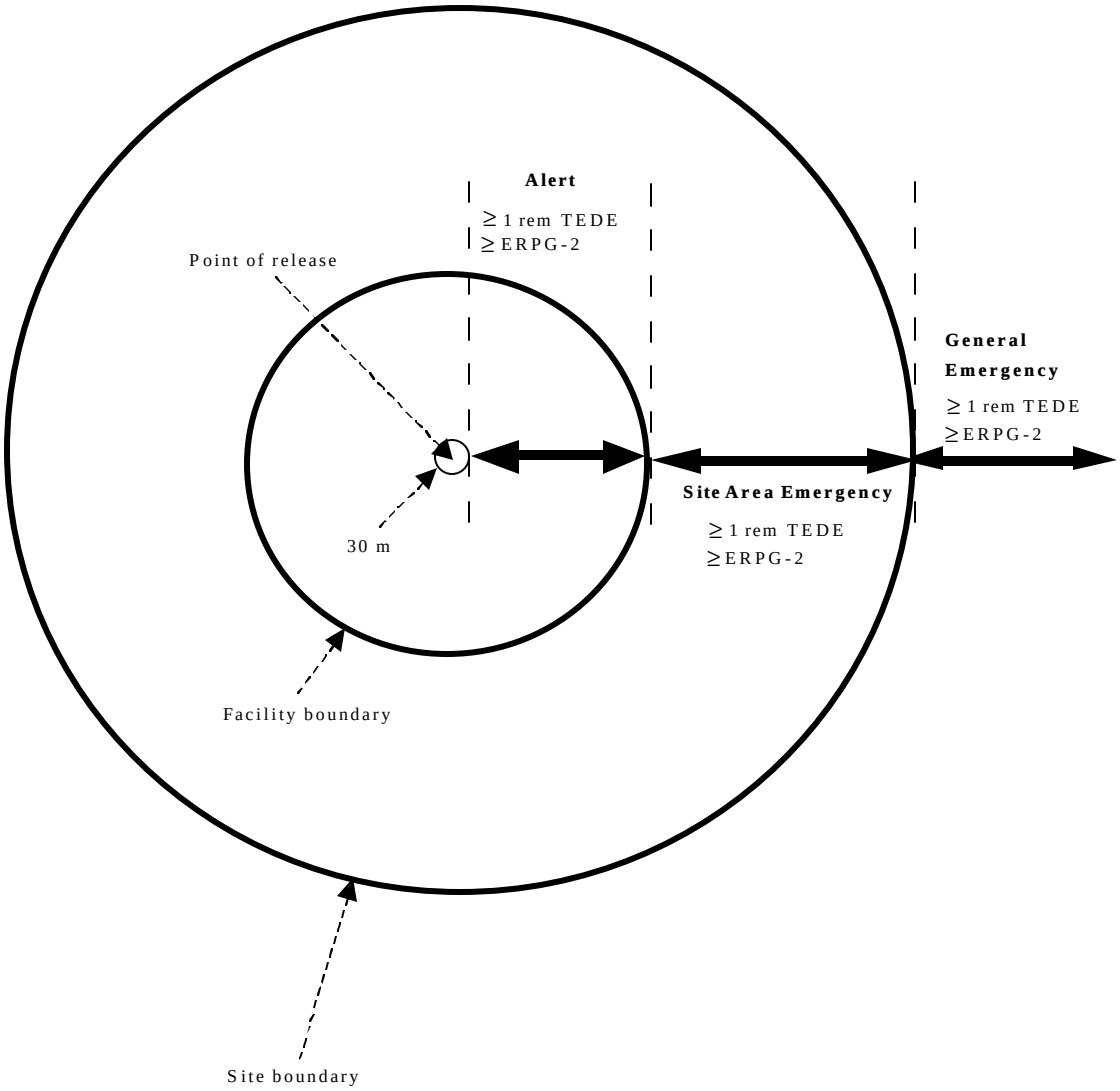
b. Separate storage or support structures that are physically near and functionally subordinate to a facility having an EPHA. Examples include a warehouse or waste storage building on the site of a major material processing facility. It is preferable that the support structure be treated, for hazard assessment purposes, as a component of the material processing facility. However, if the support structure occupies a large area with respect to the area occupied by the rest of the facility, or its functions are significantly different, treat the support structure as a separate facility. Examples include: a tank farm that receives waste from a fuel reprocessing plant, or a storage yard for uranium hexafluoride cylinders next to an enrichment plant.

c. Large geographic areas enclosing multiple structures, operating areas or components.

d. Distances between individual structures that exceed about two hundred meters are treated as separate facilities.

Attachment C. Isodose Concept

CLASS	ISODOSE	WHERE
Alert	> 1 rem TEDE ≥ ERPG-2	At 30 meters to 100 meters
SAE	≥ 1 rem TEDE ≥ ERPG-2	At 100 meters to site boundary
GE	≥ 1 rem TEDE ≥ ERPG-2	At and beyond the site boundary



Attachment D. Protective Action Criteria for Use in Facility Hazards Assessment (1 of 2)

Introduction

The Protective Action Criteria (PAC) used in the accident analysis section of the EPHA are the same as those used for classification of operational emergencies. The PACs include a radiological and nonradiological threshold.

Radiological PAC

The bases for radiological PACs are the EPA Protective Action Guidelines, DOE Order 151.1 and the DOE Emergency Management Guide. The radiological PACs to be used are:

1. A projected dose of 1 rem total effective dose equivalent (TEDE) to standard man, where the TEDE is the sum of the effective dose equivalent (EDE) from exposure to external sources and the committed effective dose equivalent (CEDE) from inhalation;

- or -

2. A projected committed dose equivalent (CDE) to the adult thyroid of 5 rem;

   Although the radiological PAC is defined in terms of TEDE, some dispersion models (e.g., HOTSPOT) only calculate the CEDE from the release. The CEDE only accounts for the 50 year committed dose from inhalation of radionuclides. For non-reactor type accidents, as in the non-criticality accidents at SRS, the CEDE is by far the major portion of the TEDE and can be considered equivalent for purposes of the EPHA.

Nonradiological PAC

The bases for nonradiological PACs are the DOE Order 151.1 and the DOE Emergency Management Guide.

ERPG values are developed and approved by the American Industrial Hygiene Association (AIHA). The ERPG value to be used as the PAC is the ERPG-2 value.

ERPG-2 is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action. For the purpose of applying the ERPG-2 exposure levels, the definition is expanded to mean a 15-minute peak concentration of the substance in air that equals or exceeds the ERPG-2 value for that substance.

Attachment D. Protective Action Criteria for Use in Facility Hazards Assessment (2 of 2)

The AIHA has issued only a small number of ERPG values. Equivalent ERPG values for many chemicals of interest to SRS have been calculated. These equivalent values, called Temporary Emergency Exposure Levels (TEELs) are treated the same as AIHA approved ERPG values. A current listing of ERPG and TEEL values can be viewed from the Universal Resource Locator (URL):

http://tis-hq.eh.doe.gov/web/chem_safety/doe_reg.html

If a chemical is encountered that does not have a current ERPG or TEEL calculated, use the hierarchy identified in the Emergency Management Guide to develop an equivalent ERPG value.

Threshold for Early Lethality (TEL) Criteria

The EPZ determination section of the EPHA makes use of the maximum distance at which a facility accident could produce TELs as one element in the determination of EPZ size. The definitions below are intended only for use in the facility hazards assessment process.

TELs are defined as:

1. For radiological releases: A dose equivalent of 100 rem TEDE.
2. For non-radiological releases: A peak 15 minute concentration of the substance in air that equals or exceeds the ERPG-3 or equivalent value (e.g., TEEL-3) for that substance.

Attachment E. EAL Instrument Listing

System:_____

Event Description(s): _____

_____

_____

Description	Tag Number	Type	Units	Range	Alarm Setpoints

Cognizant Engineer:_____

Extension:_____ **Mail Code:**_____