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WP 12-12

Revision 3

Development and Maintenance of an Emergency Planning Hazards Assessment

Cognizant Department: Emergency Management

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TABLE OF CONTENTS

CHANGE HISTORY SUMMARY ii

1.0 INTRODUCTION 1

2.0 RESPONSIBILITIES 1

2.1 Emergency Management Manager 1
2.2 Nuclear Safety Manager 2

3.0 PROCESS 2

3.1 Emergency Planning Hazards Assessment 2
3.1.1 Integration with Other Safety Documentation 2
3.1.2 Facility Description and Operations 2
3.1.3 Hazard Characterization 4
3.1.4 Accident Analysis 7
3.1.5 Estimate Potential Event Consequences 13
3.1.6 Emergency Planning Zone Determination 15
3.1.7 Emergency Action Level Development 18
3.2 Hazards Assessment Format 18
3.3 Temporary/Transitory Facility Hazards 19
3.4 Quality Assurance 19
3.5 Hazards Assessment Control 19
3.5.1 Review and Approval of the EPHA 19
3.5.2 Revision Control 20

4.0 RECORDS 21

5.0 REFERENCES 22

Attachment 1 - Terms and Definitions 23

Attachment 2 - Abbreviations 31

Attachment 3 - Protective Action Criteria for Use in Facility Hazards Assessment 33

Attachment 4 - EPHA Technical Review Guidelines 35

CHANGE HISTORY SUMMARY

Revision No.	Date Issued	Description of Changes
3	1/17/11	Editorial revision to update organizational information

1.0 INTRODUCTION

This document establishes requirements and methods for development and maintenance of an Emergency Planning Hazards Assessment (EPHA). An EPHA is the technical basis for an Emergency Planning (EP) program, Emergency Action Levels (EALs), and the Emergency Planning Zone (EPZ).

Provisions of this document apply to Washington TRU Solutions LLC (WTS) for management and operations at the Waste Isolation Pilot Plant (WIPP), and to subcontractors performing work for WTS when required by subcontract or applicable law.

Instructions provided in this document include methods and requirements document how to:

- Develop facility description/boundary
- Perform hazard characterization
- Estimate potential event consequences
- Develop EPZs
- Document and approve the EPHA

Facilities/activities with hazardous materials that exceed predetermined criteria (as determined by a Hazards Survey performed in accordance with WP 12-11, Development and Maintenance of Hazards Surveys, must perform an EPHA in accordance with U.S. Department of Energy (DOE) Order 151.1C, *Comprehensive Emergency Management System*.

2.0 RESPONSIBILITIES

2.1 Emergency Management Manager

- Support the Carlsbad Field Office (CBFO) in negotiations with New Mexico regulating agencies regarding the EPZ.

- Provide signature approval of the EPHA.

- Prepare and submit the EPHA to the CBFO Field Manager for approval.

- Develop implementing procedures to be used in development and approval of EPHAs.

- Ensure that the EPHA is reviewed by operations personnel and that it reflects the current configuration of the facility.

- Ensure that the EPHA is reviewed at least every three years and updated prior to significant changes to the site/facility or hazardous material inventories.

2.2 Nuclear Safety Manager

- Provide technical support for review of the EPHA. for consistency with current Documented Safety Analysis information.

3.0 PROCESS

3.1 Emergency Planning Hazards Assessment

The EPHA provides a quantitative analysis of hazards significant enough to warrant consideration in an operational emergency (OE) hazardous material program. The EPHA is the technical basis for establishing EALs and EPZs.

3.1.1 Integration with Other Safety Documentation

The Site Operations and Disposal manager reviews the schedule for safety documentation development and, where possible, integrates the EPHA with this schedule to increase efficiency and reduce cost.

3.1.2 Facility Description and Operations

3.1.2.1 Written Facility Description

The written facility description should include general information related to the site mission, operations, and physical characteristic, including an assessment of the site exposure to external and natural phenomena hazards. It should include the location of the facility relative to site boundaries, the nearest public access locations, and transportation networks such as highways. Particular attention should be paid to including facility specific information critical to the understanding and reconstructing the consequence calculations and to information necessary to aid emergency planners. This information should include, but not be limited to, descriptions and physical parameters for facility containment/confinement systems; potential leak paths and release points; protective/mitigative systems or features; technical, physical or administrative limits on use/storage of hazards materials; and installed process monitors, alarms and/or detection systems. Provide sufficient detail to support characterization of hazards and determination of potential consequences.

The facility description included in current Safety Documentation (e.g., supporting calculations and/or reports) 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.

3.1.2.2 Boundary Descriptions

The Waste Handling Building and the underground are the areas of concern to WIPP . These facilities have similar functions and have potential hazardous material release paths, and are the only facilities with hazardous material concerns.

The point of hazardous material release to the atmosphere from the Waste Handling Building is the ventilation exhaust, Station C, while the hazardous material release from the underground is the exhaust shaft vent, Station A or Station B.

The emergency classification scheme of the DOE G 151.1-2, *Technical Planning Basis* (EMG) requires the definition of receptor distances from release points in order to differentiate between potential harm to facility workers (immediate workers), site personnel (on-site workers), and the public. This is accomplished by using representative distances to each of these receptors in calculating the consequences of a release.

The WIPP Site Boundary distinguishes the perimeter of the 16 sections (or 10,240 acres) established by the WIPP Land Withdrawal Act (WLWA). This tract includes properties outlying the Property Protection Area (PPA), the Exclusive Use Area (EUA) and the Off-Limits Area. This sector is designated at point of ingress and egress, as a Multiple Land Use Area, and is managed accordingly.

DOE G 151.1-2 states that if the general public can gain unescorted access to areas of the DOE site, those areas should be considered as "off-site" for purposes of emergency classification. Because the sector between the site boundary and the EUA is a multiple land use area, members of the public may have unescorted access to that portion of the WIPP site. Therefore, for the purpose of emergency classification areas immediately outside the EUA are considered off-site.

The boundary of the EUA is 285 meters from the exhaust shaft exhaust, 350 meters from the Waste Handling Building exhaust, and is physically marked by a barbed wire fence. Therefore, a standard "analysis radius" of 300 meters will be considered off-site for emergency classification purposes.

The PPA boundary encompasses an area of approximately 35 acres that contains the WIPP surface structures. A chain-linked fence topped with barbed wire surrounds it. To promote consistency of event classification, per DOE G 151.1-2, a standard "analysis radius" of 100 meters is used to represent the facility boundary receptor for all facilities.

Other boundaries of interest that have limited public access are the Off-Limits Area and the Land Withdrawal Area (LWA) boundaries. The distances to these boundaries from the center of the site are nominally 1,000 meters and 3,000 meters, respectively. The 3,000 m boundary of the LWA is considered the site boundary for WIPP.

In addition to site and facility boundaries, certain on-site receptor distances are of interest for classifying emergencies.

- The EMG suggests 30 meters from a facility release point as the receptor distance for determining an *Alert* classification (an event is classified as an Alert if the Protective Action Criterion [PAC] is exceeded at 30 meters).

- An event is classified as at least a Site Area Emergency (SAE) if the PAC is exceeded at a nominal distance of 100 meters from the release point.
- The EMG guidance was strictly followed in that an OE is classified as a General Emergency (GE) if the applicable PACs are exceeded at the 300 meters because areas that the public are afforded unescorted access within the Site Boundary are considered "off-site" for emergency class definition.

The distances from the nearest facility to receptor locations areas are as follows:

Receptor Point	**Distance**	**Emergency Classification Consideration**
	30 meters	ALERT evaluation point
PPA	100 meters	(SAE evaluation point) Facility Boundary
Exclusive Use Area	300 meters	(GE evaluation point) Off-Site
Off-Limits Area	1,000 meters	
Land Withdrawal Area	3,000 meters	Site Boundary

3.1.2.3 Identify independent segments

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

Segmentation may also be used as a work control tool during 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.

3.1.3 Hazard Characterization

A description of the screening processes used in the Hazards Survey and the results of its application must be included or referenced in the EPHA. Chemicals or radioactive material that cannot be screened out must be retained for quantitative analysis in the EPHA.

3.1.3.1 Hazards Associated with Chemical By-Products of Fire

Building fires often produce toxic by-products from combustion of construction materials and furnishings. Fires in office buildings or industrial facilities may be categorized as an OE if they result in significant structural damage or personnel injury (without regard to the presence of hazardous materials); however, they will not normally be classified.

Radionuclides, while their chemical form may be changed by fire, their activity is not. Radionuclides are retained for quantitative analysis. Also, the chemical form of the

radioisotope is considered when deciding which Dose Conversion Factor to choose (i.e., choose the correct Lung Clearance Class).

3.1.3.2 Hazardous Materials Requiring Quantitative Hazards Assessment

Radioactive materials that require further analysis in an EPHA include the radioactive materials listed in DOE-STD-1027-92 in quantities greater than the Category 3 values given in Attachment 1, Table A.1 of that Standard.

Chemical materials that require further analysis in an EPHA include chemicals with an assigned Health Hazard rating of 3 or 4 based on National Fire Protection Association (NFPA) 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*. Chemicals without an assigned Health Hazard rating require further analysis in an EPHA if the quantity is greater than a quantity that can be "easily and safely manipulated by one person" (see 29 *Code of Federal Regulations* §1910.1450[b], "Occupational Exposure to Hazardous Chemicals in Laboratories").

The characterization of both radioactive and chemical hazardous materials should include the following information:

- The maximum quantity of the material in appropriate units (pounds, kilograms, curies, etc.) and its storage or process locations.
- The equivalent isotope contribution to the dose is calculated to reduce the number of radionuclides carried through the EPHA. This is calculated as follows:
  - Multiply each isotope's specific activity (e.g., Ci/gal, Ci/g) by the applicable inhalation Dose Conversion Factor (DCF) listed in FGR-13 to obtain the total potential dose (e.g., rem/gal). If the applicable lung clearance class is unknown, use the most restrictive.
    - ➢ Determine percent contribution of each radionuclide to total dose.
    - ➢ Retain radionuclides so that ≥ 95 percent of the total dose is included.
    - ➢ Tabulate results and include in the EPHA.
  - In general, when dose is primarily due to inhalation of particulates, analysis should be performed using Pu-239 as the equivalent radionuclide for the entire inventory (an indicator of solubility). This provides for ease of comparison of doses between scenarios and even different facilities.
  - However, when a significant contribution to dose is from external beta/gamma sources, such as submersion or ground shine, consider using a Hotspot mixture file in lieu of an equivalent isotope. A significant

contribution to external dose can be determined by summing radionuclides that contribute significant dose from either submersion in a plume or exposure to ground shine. Criticality is an example of significant external dose. If the external dose exceeds 10 percent of the total dose, these radionuclides should be included in the source term.

- Only radionuclides with a common deposition velocity may be combined into an equivalent isotope. If the inventory has noble gas, do not combine it with particulates to form an equivalent radionuclide (use a mixture file instead). A Pu-239$_{eq}$ (Pu-239 Equivalent) is calculated as follows:

$$Pu-239_{eq} = \frac{1}{DCF_{Pu-239(M)}} \sum_i (A_i)(DCF_i)$$

Where:
$Pu\text{-}239_{eq}$ = Pu-239W equivalent activity (Ci)
$DCF_{Pu\text{-}239(M)}$ = Dose Conversion Factor for Pu-239M
A_i = number of Curies of the *i*th radionuclide
DCF_i = Dose Conversion Factor for the *i*th radionuclide

- Document any radionuclides that are incorporated into the 95 percent equivalent isotope.

- Tritium and noble gas, as they often have an ARF/RF of one, should normally be excluded from the equivalent isotope calculation. Otherwise, for some events (e.g., fire) where particulates may have a relatively low ARF/RF, these gases might be excluded from the source term when they could be significant (relative to the particulates). Iodine isotopes should also be excluded from the equivalent isotope calculation as thyroid dose has a unique PAC (5 rem).

• A description of the conditions under which the material is stored or used, including process systems or containers that hold the material and barriers tha may impact its release or disperson, such as shipping containers, building, erms, sumps, or catch basins. Where applicable, security and access controls for the storage and use locations should be identified.

• The properties of the material that are needed for determination of source term and consequence analysis, such as the physical form and chemical characteristics of the material (e.g., solid, liquid, gaseoue, particle size, flammability, chemical reactivity, density), radiological characteristics, and the temperature and pressure conditions under which it is stored, processed, used, or transported.

• A description of engineered controls, safeguard, or safety systems designed to prevent or mitigate a hazardous material release. These may include both automatic and manuualy activated mitigative systems (e.g., fire sprinklers, filters, isolation dampers), as well as passive mitigative features and engineered

geometry or configuration controls for fissionable materials. Instruments and systems that would detect actual or potential emergency conditions should be identified.

- A description of administrative controls that would prevent or mitigate the initiation of a hazardous material release, such 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.

Upon completion of hazards characterization, some facilities may have no hazards requiring further analysis. In this case, document the conclusion that no further analysis is needed and route the EPHA for approval.

3.1.4 Accident Analysis

Using barrier analysis, determine processes (i.e., combinations of events and conditions) that could cause the release of each hazardous material characterized and magnitudes of those releases.

DSA analyses may be an incomplete representation of the spectrum of emergencies for which emergency planning is required by DOE Order 151.1C. A DSA may not perform quantitative analysis of higher probability, lower consequence events and beyond design basis events that, from a facility-design standpoint, are incredible. Use of a $<10^{-6}$ frequency or *beyond extremely unlikely* binning for accidents as exclusion criteria in the EPHA is inappropriate. A full accident severity spectrum must be considered in an EPHA.

3.1.4.1 Initiating Events, Accident Scenarios, and Release Mechanisms

Evaluate possible initiating events and accident scenarios that could lead to release of hazardous material (e.g., barrier failure, failure of administrative controls, external event, or malevolent act). All potential release mechanisms (e.g., spill, fire, explosion) should be considered.

Incorporate contributing events or conditions that could influence progression of the scenario or alter the magnitude or nature of 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 long time between initiation and barrier failure (e.g., loss of purge flow to a tank resulting in a buildup to a flammable mixture) estimate that time. The time may be used to determine the likely progression of the event. For example, if rapid buildup of flammable gas in a 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 slower buildup in concentration makes it more likely that the gas will be ignited soon 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 factors leading to selection of a release scenario should be justified.

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

Assess available information concerning reactive properties of hazardous materials. 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 hazardous materials, contributing to dispersal of those materials, or degrading the effectiveness of safety systems.

Each release scenario will be represented by combinations of Hazardous Substance Material at Risk (MAR) value, the failure mode, the initiating event or condition, and the release condition(s).

3.1.4.2 Malevolent Acts

The EPHA must address malevolent acts. The DOE Emergency Management Guide defines two degrees of malevolent acts: *moderate* and *extreme*. *Moderate* scenarios are those that could be initiated by a single individual using material readily available in the facility. Moderate malevolent acts are typically bounded by worst-case operational events. *Extreme* scenarios provide the analyst with an upper bound on the severity of potential consequences. In most cases, malevolent acts should produce releases and consequences no worse than those caused by accidental initiators. For example, catastrophic failure of a chemical storage tank may be postulated due to a seismic event. However, if approximately the same source term might also result from an act of sabotage, such as running a truck into the tank, the malevolent act would simply be another initiator for tank failure.

It is not intended that *all* inventories be evaluated with malevolent event initiators, but scenarios should be identified and analyzed to establish EALs for events resulting from malevolent acts.

Historically extreme malevolent acts were addressed primarily through reference to the applicable safeguards and security documents. However, the dose assessment criterion for safeguards and security documents has changed from the 50-year chronic dose used in EPHAs (the Total Effective Dose Equivalent - TEDE) to a 24-hr acute dose. Therefore, another method is needed to ensure compliance with DOE O 151.1C and meet expectations of the Guide.

The Design Basis Threat (DBT) analyzed in the safeguards and security documents often involves sabotage using a large quantity of explosives or a large-scale fire. Explicit analysis of the DBT within an EPHA would make it classified, which is

undesirable. As indicated in DOE G 151.1-2, a scenario initiated by a malevolent act would result in consequences similar to those caused by other initiators. Some DOE sites have chosen to postulate a large aircraft crash as the initiator of a worst-case extreme malevolent act. After evaluating the level of damage, source term, and consequence that could be expected from a worst-case aircraft crash[1], it is apparent that this same outcome would be expected from any initiator that could cause an energetic, unmitigated release of a facility's hazardous material inventory (e.g., extreme malevolent act, earthquake).

For example, consider a structure storing radioactive material. A postulated explosion or aircraft crash may damage the structure — rendering ventilation inoperable, allowing an unfiltered ground level release. Fuel from the aircraft could result in a full facility fire involving all material at risk. Rather than postulate a specific extreme malevolent act such as an aircraft crash or bomb, a worst-case scenario can be postulated that is based upon an unmitigated release (i.e., unfiltered, ground level) of the MAR. A respirable release fraction could then be applied to the inventory. This respirable source term could then be used for the worst-case extreme malevolent act. The source term should bind the worst-case design basis source term from the EPHA. Also, as this scenario is assumed to be initiated only by an extreme malevolent act (or a beyond design basis natural phenomenon, such as an earthquake), it would not be an input to the Emergency Planning Zone determination.

3.1.4.3 Identify Primary Barriers

This is generally the barrier closest to the material. In the case of gases or liquids, a tank, cylinder, process piping, or other container is usually the primary barrier. For materials that are prevented from being released by their physical form, consider that form as the barrier (e.g., fuel assemblies).

3.1.4.4 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 gas or liquid, 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.

3.1.4.5 Estimate Magnitude of Release from Primary Barrier

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

[1] Accident Analysis for Aircraft Crash into Hazardous Facilities, DOE-STD-3014-96 October 1996.

Use the maximum inventory when estimating release from a barrier. If administrative controls limit inventory or concentration, perform the analysis with the administrative controls amount as the maximum inventory.

If multiple containers of the same hazardous material exist in the facility, consider an event causing release of the contents of more than one container (e.g., forklift ramming two or more barrels). 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.

3.1.4.6 Assess Effects of Secondary Barriers and Mitigating Features

Assess and document 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 a cage of compressed gas cylinders, there are no secondary barriers. A breach of the gas cylinders discharges directly to the environment. While in the case of radioactive waste within a hot cell being remotely handled, the hot cell itself, the ventilation system, and the 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 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 99.97 percent efficiency while sand filters assume a 99.5 percent 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.

3.1.4.7 Estimate Source Term

A. 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. As the maximum inventory/ concentration is typically used for MAR, median ARFs/RFs, and ARRs listed in the DOE-HDBK-3010 are typically most appropriate for use. Accident-specific ARFs/RFs and ARRs derived in other safety basis documents may also be used. The final respirable 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 accident-generated conditions. A degree of interdependence exists between definitions of MAR and DR. If it is predetermined that certain types of material would not be affected by a given accident, some analysts exclude this material from 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 approximation is to obtain, to the degree possible, a realistic understanding of potential effects.

The LPF can be used to credit 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 glove box 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 leak paths 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 judgment 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 a 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., explosion) for the release duration with contributing mechanisms (e.g., spill, resuspension) added to form one source term.

- Estimate the duration of release. As the "release" is to the environment, building exhaust times should be considered in the determination. In lieu of better information, use 30 minutes for fires, 10 minutes for spills, and 3 minutes for explosions. Release duration is a required input for determining downwind consequences.

For facilities where criticality accidents are postulated, the inventory of interest is the total fission yield. 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 can escape to the environment.

B. Chemical Source Terms

EPA 550-B-99-009, *Risk Management Program Guidance for Offsite Consequence Analysis* may be used to develop worst-case scenarios for chemical source terms. Guidance in EPA 550-B-99-009 defines a worst-case scenario as:

- Release of the largest quantity of a regulated substance from a vessel or process line failure, and

- Release that results in the greatest distance to the endpoint.

For substances in vessels, assume release of the largest amount in a single vessel. For substances in pipes, assume release of the largest amount in a pipe. The largest quantity should be determined taking into account administrative controls rather than absolute capacity of the vessel or pipe. Passive mitigation (e.g., dikes) may be credited.

If the material is stored in drums, the total amount of material is to be evaluated.

Given the MAR and release scenario, ALOHA (or other approved method) may be used to determine chemical source term and model its dispersion.

3.1.4.8 Conservatism of Analysis

It is expected that EPHA accident analysis will be *conservative* or *worst-case*. This may differ from *bounding* analyses contained in other safety documentation. An example of conservative versus bounding analysis would be the MAR, during a seismic type event, for 1,000 waste drums that are banded four to a pallet, stored outside, and stacked three high. A bounding MAR would be the contents of all 1,000 drums where a conservative assumption could be contents of one fourth of the drums. Assumptions based on engineering judgment should be stated in the EPHA.

3.1.5 Estimate Potential Event Consequences

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

A. Document in the EPHA methods and calculation models used in estimating consequences.

B. EPHA consequence assessment is performed in accordance with the applicable procedure.

C. Release calculations yield a quantitative estimate of consequence (e.g., radiation dose, or concentration of a toxic chemical) at each receptor of interest. Consequences at these distances form the bases for emergency planning. Analyze the following for each incident occurring within the facility boundary under adverse (95 percent) meteorological conditions.

1. Thirty meters from the release. The consequence at this receptor provides a demarcation between an accident that would require classification (e.g., Alert) and one that would not. [Alternatively, the Alert classification may be tied to 10 percent of PAC at the facility boundary; the Emergency Management manager determines which threshold is to be used sitewide.]

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. Consequences at this receptor provide the demarcation between an Alert and Site Area Emergency.

3. Distance from the release to the closest site boundary. The consequence at this receptor is the demarcation for a General Emergency.

To account for dose contribution from submersion and ground shine, TEDE at the site boundary must be calculated when both of the following conditions occur.

- Inhalation dose (CEDE) at the site boundary exceeds 0.6 rem*; and
- External dose due to submersion in a cloud or from groundshine is greater than 10 percent of the total dose.

*NOTE: Calculations show that ground shine dose for a pure gamma source could be up to 40 percent of total dose. Use of 0.6 rem CEDE instead of 1 rem TEDE precludes inadvertent omission of ground shine dose.

4. Determine the dose/concentration at other receptor locations of interest. Other receptors of interest are locations where members of the public may be within a protective action zone; or, adjacent facilities that may have a significant transient population and no emergency response organization.

   Examples of receptor locations of interest include:

   - Off-Limits Area.
   - Land Withdrawal Area, which at times may have members of the public present.

   Graphical output, such as dose versus distance, may be included in consequence assessment calculations to determine potential downwind consequences for other receptors of interest.

D. Calculate consequences of hazardous material releases at selected receptor locations using an approved dispersion model (e.g., ALOHA/Hotspot), and under 95 percent adverse and 50 percent average meteorological conditions. The following information was taken from DOE/WIPP-08-3378, *Waste Isolation Pilot Plant Waste Handling Emergency Planning Hazards Assessment.*

Meteorological Input Parameters

Meterological Conditions	Stability Class	Wind Speed (m/s)	Inversion Layer (m)
Average	F	6.8	1,000
Adverse	F	2.2	1,000

E. Compare results at the 30-meter, facility boundary, site boundary, and point of maximum dose receptor locations to applicable PAC.

Attachment 3, Protective Action Criteria for use in Facility Hazard Assessment, provides an explanation of PAC.

F. If a release exceeds PAC for the adverse meteorological conditions, reanalyze the release in accordance with Section A.5.c through A.5.e using 50 percent average meteorological conditions. If a release does not exceed PAC for adverse meteorological conditions, reanalysis of the scenario for average meteorological conditions is not required.

G. Determine the potential emergency class corresponding to each analyzed event.

H. Include the maximum distance to PAC.

I. Summarize results in tabular form to aid in correlation of potential accident impacts with appropriate event classification criteria (i.e., EALs) and protective response actions. Provide separate tables for 50 percent average and 95 percent adverse meteorological conditions as appropriate.

3.1.6 Emergency Planning Zone Determination

The EPHA must include a determination of the size of the Emergency Planning Zone (EPZ). The EPZ is the geographic area surrounding the site/facility for which special planning and preparedness actions are taken or need to be taken to reduce or minimize the impact to on-site personnel and public health and safety in the event of a classifiable OE involving hazardous materials. Assumptions, methodology, models, and evaluation techniques used in the EPHA must be documented. A facility-specific EPZ evaluation is performed during the EPHA process.

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 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 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. (DOE G 151.1-2)

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 off-site risk should be considered. Even if a comprehensive probability risk assessment 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 off-site 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 off-site 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. 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.

4. 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.

5. The EPZ should conform to the physical and jurisdictional realities of the site and surrounding area.

6. 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 on-site protective actions, optimize on-scene command, control, and mitigation efforts)?

   - Is the EPZ likely to meet the expectations and needs of off-site 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 off-site interactions.

G. 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.

H. 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.

3.1.7 Emergency Action Level Development

EALs are developed in accordance with applicable procedures. Section 7 of the EPHA is used to summarize the technical basis, list EAL indicators, and document all EALs resulting from the EPHA process. Include in each EAL the maximum distance to PAC for that EAL.

3.2 Hazards Assessment Format

The EPHA is published as a Technical Report, including Cover Sheet.

- Approval Sheet
- Table of Contents
- List of Tables
- Abbreviations

1.0 INTRODUCTION (including a revision history)

2.0 DESCRIPTION OF THE SITE, FACILITIES, PROCESSES, AND OPERATIONS

3.0 IDENTIFICATION AND SCREENING OF HAZARDS

4.0 ACCIDENT ANALYSIS

5.0 CONSEQUENCE ASSESSMENT

6.0 EMERGENCY CLASSES AND EALs

7.0 EPZ DETERMINATION

8.0 REFERENCES

- APPENDICES (as applicable)

(A) Figures

(B) Calculations

(C) EPHA Definitions

3.3 Temporary/Transitory Facility Hazards

Temporary or transitory hazards, such as short-duration storage of hazardous materials or weapons devices, or special process testing within a facility, will be covered by specific updates (as an addendum) to the EPHA and associated EPIP.

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

When using other safety documents in lieu of an EPHA, the Emergency Management manager will have signature approval of those documents to ensure requirements of this document are met.

3.4 Quality Assurance

Emergency Management is responsible for ensuring Software Quality Assurance (SQA) requirements are met for models used in EPHA development.

Facility/engineering personnel perform all calculations for the EPHA in accordance with WP 13-1, Washington TRU Solutions LLC Quality Assurance Program Description.

3.5 Hazards Assessment Control

3.5.1 Review and Approval of the EPHA

The EPHA undergoes internal review by an EPHA team and selected facility technical experts prior to being routed for formal review and comment. At a minimum, the EPHA development organization and the facility EPHA support organization shall conduct a technical review of the EPHA using Attachment 4 as a guideline.

EPHAs are formally reviewed by:

- Site Operations and Disposal manager/Designee
- Emergency Management manager
- Nuclear Safety Manager
- CBFO Security and Emergency Operations manager
- Others, as deemed necessary

Allow from two to six weeks for this review cycle depending on the extent of revision. Comments received after the review cycle should not delay approval of the document

but rather be incorporated into the next revision. The EPHA Coordinator responds to and dispositions comments as appropriate.

Upon completion of the review cycle, the final EPHA is approved by:

- Emergency Management manager
- CBFO Security and Emergency Operations manager

To ensure consistency, draft EALs should be reviewed concurrently with the EPHA.

An effective date for the EPHA should coincide with the associated Categorization and Classification of Operational Emergencies Procedure(s).

3.5.2 Revision Control

EPHAs should be reviewed (and revised as required) when a change results in a USQ or when a PISA is declared. Reviews are required prior to significant increases in hazardous material inventories or significant changes in processes involving hazardous material. Such changes may result in an increased consequence, increased distance to PAC, or change of emergency classification. Note that changes that increase, increase the distance to PAC or change the emergency classification may also result from a negative USQ Determination due to the bounding nature of most DSA analyses.

The EPHA must also be reviewed every three years. This review allows for a nine-month window in its performance. A review that will extend more than nine months beyond the due date requires notification to CBFO Security and Emergency Operations and concurrence from the Emergency Management manager.

Triennial reviews shall be conducted by the cognizant facility organization and shall consider at a minimum the following:

- New hazardous material brought into the facility in excess of the WP 12-11 screening quantities
- For existing hazardous material, a significant increase (> 10 percent) in maximum inventory
- Processes involving hazardous material that may have been modified, added, or deleted
- Changes to the facility that may impact EALs (e.g., instrumentation or ventilation)

The cognizant organization documents review of facility changes. Documentation should address methods used, a listing of documents reviewed, and summary of review findings.

Results of the review by the cognizant organization shall be reviewed with the facility EPHA to determine impacts to the facility's emergency planning basis, emergency classification, and protective actions. If the review identifies changes that may impact the technical validity of the EPHA and EALs, an evaluation shall be performed that may include identification of hazards, accident analysis, and consequence assessment to determine if a revision to the EPHA is required.

If an EPHA does not need to be revised because the review determined there to be no significant impact on the technical validity of the EPHA. The review must be documented. The documented review shall be approved by the Emergency Management manager. The review letter should include the following distribution:

- Site Operations and Disposal manager
- Emergency Management manager
- Nuclear Safety Manager
- CBFO Security and Emergency Operations manager

Triennial review documentation shall be maintained for a minimum of three years or until a revision to the EPHA is approved.

Triennial reviews should be coordinated to coincide with reviews of facility safety documents in order to maximize resources. Triennial reviews should be identified in the commitment tracking system and should be initiated to allow sufficient time to complete the review by the due date. Emergency Management maintains a copy of the EPHA review/revision schedule for WIPP services.

NOTE: Immediate changes are allowed only when the change is inconsequential. Inconsequential Changes are defined as minor non-intent changes to correct format, punctuation, spelling, grammar, or typographical errors or to add necessary references or clarification notes.

An immediate change may be made to an existing EPHA if the change is approved by the Emergency Management manager. Once the Emergency Management manager has approved the change, the revised EPHA is approved as described above.

Major revisions of EPHAs shall follow the review and approval process detailed above.

4.0 RECORDS

The EPHA and supporting record file generated as a result of implementing this document are processed and maintained in accordance with the Emergency Management Records and Inventory Disposition Schedule.

5.0 REFERENCES

- Title 10 *Code of Federal Regulations* Part 71 "Packaging and Transportation of Radioactive Material"
- Title 29 *Code of Federal Regulations* §1910.1450(b), "Occupational Exposure to Hazardous Chemicals in Laboratories"
- Title 49 *Code of Federal Regulations*, *Transportation*
- DOE O 151.1C, *Comprehensive Emergency Management System,* November 2005
- DOE-G-151.1-2, *Technical Planning Basis*, U.S. DOE, July 11, 2007
- DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, U.S. DOE, October 1994
- NFPA 704, *Standard System for the Identification of the Hazards of Materials for* Emergency *Response*
- WP 12-11, Development and Maintenance of Hazards Surveys, Washington TRU Solutions LLC
- WP 12-NS.01, Changes to the WIPP Documented Safety Analysis
- WP 13-1, Washington TRU Solutions LLC Quality Assurance Program Description

Attachment 1 - Terms and Definitions

See also Attachment 2, Abbreviations.

Acute exposure guideline level (AEGL) – Airborne concentration above which adverse health effects are predicted. One-hour AEGLs are the preferred PAC for chemical exposures, followed by ERPGs, then TEELs.

> **AEGL-1** – Airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic non-sensory effects. However, effects are not disabling but transient and reversible upon cessation of exposure.
>
> **AEGL-2** – Airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
>
> **AEGL-3** – Airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

Aerodynamic equivalent diameter (AED) – Diameter of sphere of density 1 g/cm3 that exhibits the same terminal velocity as particle in question.

Alert – An Alert is declared when events are predicted, are in progress, or have occurred that result in one or more of the following:

- Actual or potential substantial degradation in the level of control over hazardous materials.

  (a) The radiation dose (1 rem TEDE) from any release to the environment of radioactive material or a concentration in air (AEGL-2, ERPG-2, or TEEL-2) of other hazardous material is expected to exceed a site-specific criterion corresponding to either:

  - 10% of PAC at or beyond the facility boundary (100 m); or
  - PAC at or beyond 30 m from the release.

  (b) PAC is not expected to be exceeded at or beyond the facility boundary (100 m).

- 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.

Attachment 1 - Terms and Definitions

- 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.

Committed dose equivalent (CDE) ($H_{T,50}$) – Dose equivalent calculated to be received by a tissue or organ over a 50-year period after intake of a radionuclide. Does not include contributions from external sources.

Committed effective dose equivalent (CEDE) ($H_{E,50}$) – Sum of committed dose equivalents to various tissues ($H_{T,50}$), each multiplied by a weighting factor (w_T) - that is, $H_{E,50} = \Sigma\, w_T\, H_{T,50}$.

Consequence – Result or effect (especially projected exposure to radiological or chemical hazards) of a release of hazardous materials to the environment.

Controlled Area – Any area for which a DOE security badge is required to gain access.

Documented Safety Analysis (DSA) – 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 regulations.

Effective dose equivalent (EDE) (H_E) – Sum of products of dose equivalent received by specified tissues (H_T) and weighting factor (w_T) - that is, $H_E = \Sigma\, w_T\, H_T$. Includes dose from internal and external sources.

Emergency action level (EAL) – Specific, predetermined, and observable criteria used to detect, recognize, and classify hazardous material emergencies

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

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

Emergency Response Planning Guideline (ERPG) – Estimate of the concentration 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-1** – Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing other

Attachment 1 - Terms and Definitions

than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

ERPG-2 – 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 – 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.

Equivalent isotope – An analytic technique of summing the dose potential from all the radionuclides of interest in a source term into a single "equivalent" radionuclide in order to facilitate quick consequence assessment of that source term.

Exclusive Use Area (EUA) – Defines an area of approximately 290 acres that contains the PPA. It is surrounded by a barbed wire fence and is restricted to use by the DOE only. For WIPP emergency management planning and response, the EUA boundary is 300 m.

Facility boundary – Boundary, determined by this document, which represents the receptor location that differentiates between an Alert and Site Area Emergency declaration. For WIPP emergency planning and response, the facility boundary is 100 m.

General Emergency – A General Emergency shall be declared when events are predicted or 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 nonradiological) to the environment. The radiation dose (1 rem TEDE) from any release of radioactive material or a concentration in air (AEGL-2, ERPG-2, or TEEL-2) from any release of other hazardous material is expected to exceed the applicable Protective Action Guide or Emergency Response Planning Guideline at or beyond300 m.

- 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.

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.

Attachment 1 - Terms and Definitions

Hazards survey – Identifies hazards significant enough to include in an EPHA (see WP 12-11, Development and Maintenance of Hazards Surveys).

Initial isolation distance –[From the Table of Initial Isolation & Protective Action Distances in the Green section of the ERG] Distance within which all persons should be considered for evacuation in all directions from the actual spill. It is a distance (radius) which defines a circle (Initial Isolation Zone) within which persons may be exposed to dangerous concentrations upwind of the source and may be exposed to life threatening concentrations downwind of the source.

Initial isolation zone – Area surrounding an incident in which persons may be exposed to dangerous (upwind) and life threatening (downwind) concentrations of material.

Land Withdrawal Area – Defines an area of 16 sections totaling 10,240 acres that surrounds the site boundary. The Land Withdrawal Area encourages public use.

Lung clearance class (e.g., S. M, or F) – A classification scheme for inhaled material according to its clearance time, fast, moderate, or slow from the pulmonary region of the lung to the blood and the GI tract.

Material-at-risk (MAR) – Amount of hazardous material that is available to be acted on by a given physical stress. Multiply the MAR by the appropriate 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.

Movement –Transport that occurs only within the area covered by a facility safety basis (typically the facility fence).

Off-Limits Area – Boundary defines an area of approximately 1,450 acres. This area is not fenced and is posted "No Trespassing," but is leased for grazing.

Office of Secure Transportation (OST) shipment – Shipment of material controlled by the Office of Secure Transportation (formerly Office of Transportation and Safeguards) in the NNSA Service Center in Albuquerque.

Off-site – Area outside 300 m. For transportation events, thoroughfares on site property to which the public has uncontrolled access are considered off-site.

Off-site shipment – Transport of material that leaves controlled areas of the site.

On-site – Any area within the boundaries of WIPP to which access is controlled.

Attachment 1 - Terms and Definitions

Operational emergency (OE) – Major unplanned or abnormal event or condition occurs that involves or affects DOE/NNSA facilities and activities by causing or having the potential to cause serious health and safety or environmental impacts; requires resources from outside the immediate/affected area or local event scene to supplement the initial response; and, requires time-urgent notifications to initiate response activities at locations beyond the event scene. In general, to be considered an OE, an event or condition involving the uncontrolled release of a hazardous material must: immediately threaten or endanger personnel who are in close proximity of the event; have the potential for dispersal beyond the immediate vicinity of the release in quantities that threaten the health and safety of on-site personnel or the public in collocated facilities, activities, and/or off-site; and have a potential rate of dispersal sufficient to require a time-urgent response to implement protective actions for workers and the public. An OE involving release of significant quantities of hazardous materials within the WIPP Controlled Area may require further classification as an Alert, Site Area Emergency, or General Emergency.

Property Protection Area (PPA) – Boundary defines an area of approximately 35 acres that contains the WIPP surface structures. A chain-linked fence topped with barbed wire surrounds it.

Protective action (PA) – Physical measures (remain indoors, shelter, evacuation,

relocation) taken to reduce potential health hazards from the plume exposure pathway. This excludes action taken to secure the scene to isolate a hazard (e.g., barricades, roadblocks). When using the ERG, precautionary measures taken to isolate the immediate area are not PA; but, protective measures taken either under the EVACUATION heading in the Orange section or using Protective Action Distances in the Green section are PA.

Protective action criterion (PAC) – Radiological dose or toxic material concentration level that acts as a trigger, for a receptor point of interest, to declare an OE and issue or recommend protective actions to protect workers or the public. PACs are:

- For radiological dose, 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.

- For chemical concentration, the AEGL-2, ERPG-2, or, TEEL-2 (in order of preference) is the trigger for classification of operational emergencies and off-site protective action recommendations.

Protective action distance (PAD) – From the Table of Initial Isolation & Protective Action Distances found in the Green section of the ERG - downwind distance from a spill within which Protective Actions should be implemented. In the ERG, PADs are

Attachment 1 - Terms and Definitions

defined only for Toxic Inhalation Hazards (TIH) - materials that are highlighted in the Yellow & Blue sections. In this procedure, for non-highlighted substances, evacuation distances in the Orange section may be used in lieu of PADs.

Protective action zone (PAZ) – Area downwind from the incident in which persons may become incapacitated and unable to take protective action or incur serious or irreversible health effects. For purposes of this document the PAZ includes the Initial Isolation Zone.

Release – Airborne effluent 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 time-urgency of airborne releases. The hazard assessment considers releases to an aquatic or ground pathway having a time-urgent affect on workers or the public (e.g., to a community water supply).

Respirable fraction – Fraction of airborne particles that can be transported through air and inhaled into the respiratory system; assumed to include particles 10-µm Aerodynamic Equivalent Diameter (AED) and less.

Safety basis – The documented safety analysis and hazard controls that provide reasonable assurance that a DOE nuclear facility can be operated safely in a manner that adequately protects workers, the public, and the environment. Reference WP 12-NS.01, Changes to the WIPP Documented Safety Analysis.

Segment – Demarcation used in hazards assessment where the system, section, building, etc., is not affected by failure of other systems, sections, buildings, etc.

Site – Area over which the DOE has access control authority. This includes any area that has been designated as a National Security Area.

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:

- Actual or potential major failure of functions necessary for the protection of workers or the public. The radiation dose (1 rem TEDE) from any release of radioactive material or concentration in air (AEGL-2, ERPG-2, or TEEL-2) from any release of other hazardous material is expected to exceed the applicable PAC beyond the facility boundary (100m). The PAC is not expected to be exceeded at or beyond 300 m.

- 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.

Attachment 1 - Terms and Definitions

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

Source term – The amount of respirable material released to the environment. The source term takes into consideration the Material at Risk, the Damage Ratio (fraction), Airborne Release Fraction, Respirable Fraction, Leak Path Factor (fraction), Airborne Release Rate (fraction/hour), and in some cases the Release Duration (hours). There can be both a chemical and a radiological source term.

Temporary emergency exposure limit (TEEL) – Since AEGLs & ERPGs exist for relatively few chemicals, SCAPA developed TEELs so consequence assessments could be conducted. TEELs are an estimate of the concentration above which one could reasonably anticipate observing adverse effects, as described in definitions for TEEL-0, TEEL-1, TEEL-2, and TEEL-3, as a consequence of exposure to a specific substance. SCAPA recommends that for application of TEELs, concentration at the receptor be calculated as the peak 15-minute time-weighted average.

TEEL-0 – Threshold concentration below which most people will experience no appreciable risk of health effects.

TEEL-1 – Maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

TEEL-2 – Maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

TEEL-3 – Maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

Total effective dose equivalent (TEDE) – 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.

Toxic inhalation hazard (TIH) – Gas or volatile liquid known to be so toxic to humans as to pose a transportation health hazard. When dealing with a TIH (highlighted entries in the ERG), isolation, and evacuation distances appear in the Green section. The guides (Orange section) also remind the user to refer to the Green section for evacuation-specific information involving highlighted materials.

Transport – Relocation of material by vehicle such as a truck or railcar.

Attachment 1 - Terms and Definitions

Type B packaging – Packaging designed to retain the integrity of containment and shielding required by 49 CFR regulations when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR Part 71.

Attachment 2 - Abbreviations and Acronyms

AEGL	Acute Exposure Guideline Level
AIHA	American Industrial Hygienist Association
ARF	Airborne Release Fraction
ARR	Airborne Release Rate
CBFO	DOE Carlsbad Field Office
CDE	Committed Dose Equivalent
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
CTF	Central Training Facility
DCF	Dose Conversion Factor
DOE	U.S. Department of Energy
DR	Damage Ratio
DSA	Documented Safety Analysis
EAL	Emergency Action Level
EDE	Effective Dose Equivalent
EMG	emergency management guide
EPA	Environmental Protection Agency
EPHA	Emergency Planning Hazards Assessment
EPIP	Emergency Plan Implementing Procedure
EPZ	Emergency Planning Zone
ERG	Emergency Response Guidebook
ERPG	Emergency Response Planning Guideline
EUA	Exclusive Use Area
GE	General Emergency
HEPA	High Efficiency Particulate Air
LPF	Leak Path Factor
MAR	Material-at-Risk
PAC	Protective Action Criteria
PISA	Potential Inadequacy in Safety Analysis
RD	Release Designation
RF	Respirable Fraction
SAE	Site Area Emergency
SME	Subject Matter Expert

Attachment 2 - Abbreviations and Acronyms

TEDE	Total Effective Dose Equivalent
TEEL	Temporary Emergency Exposure Limit
TEL	Threshold for Early Lethality
USQ	Unreviewed Safety Question
WIPP	Waste Isolation Pilot Plant
WTS	Washington TRU Solutions LLC

Attachment 3 - Protective Action Criteria for Use in Facility Hazards Assessment

Introduction

Protective Action Criteria (PAC) used in the EPHA are the same as those used for classification of operational emergencies. PAC include radiological and non-radiological thresholds.

Radiological PAC

The bases for radiological PAC are EPA Protective Action Guidelines (PAGs):

1. 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.

   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 WIPP, 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 PAC are DOE Order 151.1C and the DOE Emergency Management Guide.

For chemicals, the protective action criteria, listed in order of preference, must be used: Acute Exposure Guideline Levels (AEGLs) promulgated by the EPA; Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association; and Temporary Emergency Exposure Limits (TEELs) developed by DOE. For these criteria, the exposure level to be used represents no irreversible health effects.

Specific criteria, in order of preference, are:

1. 60-minute AEGL-2
2. ERPG-2
3. TEEL-2

Attachment 3 - Protective Action Criteria for Use in Facility Hazards Assessment

Threshold for Early Lethality (TEL)

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:

For radiological releases: - 100 rem TEDE.

For nonradiological releases:

- 60-minute AEGL-3
- ERPG-3
- TEEL-3

Attachment 4 – EPHA Technical Review Guidelines

General Guidelines

1. Reviewer Qualifications:

   - Did not participate in the development of the portion of the EPHA being reviewed
   - Is knowledgeable in the discipline for which they review
   - Is capable of performing similar analytical activities
   - Has security clearance for access to sufficient information to perform the review

2. The Reviewer shall review the calculations against the guidance provided in this document. The Reviewer shall ensure that any spreadsheets, or imbedded calculations have been adequately evaluated for accuracy and verified and validated if necessary.

3. At a minimum, the following elements shall be addressed when performing a review:

   - Were inputs correctly selected and identified?
   - Were assumptions necessary to perform the activity adequately described and reasonable?
   - Were engineering judgments identified, technically justified, and supported?
   - Was an appropriate analytical method used?
   - Were the inputs correctly incorporated into the EPHA?
   - Where appropriate, did a mathematical check yield the same results?
   - Were the output documents reasonable compared to the inputs?
   - Were the necessary input and assumptions specified in the EPHA or in supporting procedures or documentation?

4. The process of extracting data from tables or graphs is not considered to be a calculation. However, the evaluation of the appropriated selection and application of the extracted data is part of the review process.

Conduct a review of the EPHA in accordance with the attached checklist or one containing at a minimum the information contained in the checklist. Note any items on

Attachment 4 – EPHA Technical Review Guidelines

the checklist that are not performed in the EPHA or contain errors. Once completed with the review, provide the EPHA coordinator the checklist, calculations, and notations made during the review.

EPHA TECHNICAL REVIEW CHECKLIST	YES	NO
Technical Report Cover Sheet	☐	☐
Document revision number correct	☐	☐
Document date in agreement with present revisions title page and headers within main document	☐	☐
Table of Contents – Pagination is in agreement with the main document	☐	☐
List of Tables – In agreement with tables used in the main document	☐	☐
List of Acronyms – In agreement with acronyms used in the main document and appendices	☐	☐
List of Abbreviations – In agreement with abbreviations used in the main document and appendices	☐	☐
1.0 INTRODUCTION		
1.1 Purpose	☐	☐
1.2 Scope	☐	☐
1.3 Background	☐	☐
1.4 Revision History - Updated to reflect major items revised	☐	☐
2.0 SUMMARY		
Section 2.0 Hazardous Materials Present – in agreement with Section 4.0	☐	☐
Section 2.0 EAL Classification - match tables in Section 7.0	☐	☐
3.0 FACILITY DESCRIPTION		
3.1 Process Description	☐	☐
3.2 Facility Boundary Description – Distances include facility boundary, site boundary, and other receptors of interest.	☐	☐
3.3 Segment Identification – EPHA segmentation in agreement with Sections 5.0 and 6.0 segmentation.	☐	☐

Attachment 4 – EPHA Technical Review Guidelines

EPHA TECHNICAL REVIEW CHECKLIST	YES	NO
4.0 HAZARD CHARACTERIZATION		
4.1 Chemical – Material listed agrees with Area Hazards Survey.	☐	☐
4.2 Radioactive – Material listed agrees with Area Hazards Survey.	☐	☐
4.3 Reactive Materials – A list of reactive materials is present.	☐	☐
4.4 Hazardous Materials Remaining for Analysis		
A table is present identifying the hazardous materials remaining for analysis. The materials are in agreement with Sections 4.1 and 4.2.	☐	☐
5.0 ACCIDENT ANALYSIS		
Barriers that maintain control over hazardous material are identified; failure modes considered.	☐	☐
The barrier analyses, its results, and resulting release designations are described in Section 5.0.	☐	☐
Source terms have been calculated and agree with source terms in EAL statements. Verify correct source term has been used in all consequence assessment calculations.	☐	☐
6.0 CONSEQUENCE ASSESSMENT		
6.1 Methodology Description	☐	☐
6.2 Results	☐	☐
Section 6.0 tables containing consequence assessment results should be in agreement with consequence radiological and chemical calculations within Appendix B.	☐	☐
7.0 EMERGENCY CLASSES AND EALs		
Section 7.0 the emergency classes and action levels should be in agreement with Section 6.0 table of consequence assessment results sorted by accident severity.	☐	☐
Section 7.0 the emergency classes and action levels should be in agreement with the EPIP matrix for the facility.	☐	☐
Maximum Distance to PAC is listed within each EAL.	☐	☐
Emergency Classification Thresholds have been calculated and documented for each classifiable accident.	☐	☐
8.0 EPZ DETERMINATION		
Section 8.0 should follow the methodology used in determining the EPZ.	☐	☐

Attachment 4 – EPHA Technical Review Guidelines

EPHA TECHNICAL REVIEW CHECKLIST	YES	NO
9.0 REFERENCES		
References are updated to reflect the present document name.	☐	☐
References include a comprehensive list of the documents referenced in the EPHA.	☐	☐
APPENDICES (as applicable)		
Appendix A - Figures		
Figures are updated and reflect the present conditions at the facility (i.e., facility boundary and/or EPZ boundary).	☐	☐
Appendix B - Supporting Calculations		
Source term radiological and chemical calculations	☐	☐
Consequence radiological and chemical calculations	☐	☐
Appendix C - Glossary of Terms		
Glossary is in agreement with facility specific and general EPHA definitions.	☐	☐

Technical Reviews Conducted by:

Print Name	Signature	Date