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Hazard Classification Methodology

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Hazard Classification Methodology

This document outlines the hazard classification methodology used to determine the hazard classification of the NIF LTAB, OAB, and support facilities on the basis of radionuclides and chemicals. The requirements and criteria are derived from the following documents:

DOE Order 5480.23, "Nuclear Safety Analysis Reports", April 10, 1992 [DOE, 1992a].
DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports", December 1992 [DOE, 1992b].
DOE Order 5481.1B, "Safety Analysis Review System", May 19, 1987 [DOE, 1987].
DOE-EM-STD-5502-94, "Hazard Baseline Documentation", 1994 [DOE, 1994].

The hazard classification determines the safety analysis requirements for a facility, including the DOE Order governing the safety analysis, the scope and content of the Safety Analysis Report, and the level of review and approval for the Safety Analysis Report. Figure 1 summarizes the different hazard classification categories and the associated safety analysis requirements.

The hazard classification process generally takes place in two steps. First, an inventory screening is performed, and an initial hazard classification is assigned on this basis. Then, a second step, where a bounding accident is analyzed, is usually performed to finalize the classification. The details of how these two steps are carried out for the different types of hazards (radionuclides, chemicals) are outlined in the body of this document.

Initial Hazard Classification: Inventory Screening

An initial hazard classification is assigned to a facility on the basis of facility inventories. The criteria for the inventory screening differ, depending on the type of hazard. The process for each is described below.

Radionuclide Inventory Screening

The facility radionuclide inventories are first examined to evaluate whether or not the facility is a nuclear facility. [DOE, 1992a] defines three hazard classifications for nuclear facilities:

Category 3: Hazards analysis shows the potential for only significant localized consequences; this encompasses facilities with quantities of radioactive materials, which meet or exceed the Category 3 thresholds.

Category 2: Hazards analysis shows the potential for significant onsite consequences; this encompasses facilities with the potential for nuclear criticality events or with sufficient quantities of radioactive material (in excess of Category 2 thresholds) and energy that onsite emergency planning activities would be required.

NUCLEAR FACILITIES

Hazard Classification: "Category 1, 2, or 3" (1, 2, or 3)

Documentation Requirements: Safety Analysis Report under DOE Order 5480.23, Technical Safety Requirements under DOE 5480.22; DOE approval required

NON-NUCLEAR FACILITIES1

Hazard Classification: "Low, Moderate, or High" (L, M, or H)

Documentation Requirements: Safety Analysis Report under DOE Order 5481.1B; DOE approval required for moderate and high hazard facilities

RADIOLOGICAL FACILITIES2

Hazard Classification: "Radiological" Categorization obtained through Screening (between DOE-STD-1027-92 and 40CFR302 values) or Preliminary Hazards Analysis (PHA)

EXCLUDED FACILITIES3 (no safety analysis documentation required)

Exclusion through inventory screening3 (below 40CFR302 de minimus values) or PHA analysis	Exclusion through inventory screening (below 40CFR302, 40CFR355 values) or PHA analysis

1 May require PSM Process Hazards Analysis per 29CFR1910.109 and .119.
2 DOE approval of PHAs and screening documentation is not required.
3 Facilities with radionuclide inventories below 40CFR302 levels may still be classified as "Radiological" for the purpose of 10CFR835.

Figure 1: Hazard Classification Categories and Safety Analysis Documentation Requirements

Category 1: Hazards analysis shows the potential for significant offsite consequences; this encompasses Category A reactors and facilities designated by DOE.

Threshold values for radionuclide screening are provided in [DOE, 1992b]. The Category 3 and Category 2 thresholds are minimum values for the inventory of a radionuclide, which if exceeded, would cause a facility to be initially classified as Category 3 or Category 2. For nuclides that do not have a threshold listed, and for which no firm guidance on what should be used is provided, values are available in most cases from DOE. In certain instances, it may be necessary to calculate a threshold. This can be done by scaling from the threshold of another nuclide, using dose conversion factors.

When multiple nuclides are present at a facility, [DOE, 1992b] requires that the sum of the ratios of the individual nuclide inventories to their respective threshold values be calculated. If the sum of the ratios exceeds one, then the next higher classification, relative to that determined on the basis of single nuclide inventories alone, would be initially assigned. For example, if individual inventories at a facility fall below the Category 3 thresholds for all nuclides, but the sum of the ratios of the individual nuclide inventories to the Category 3 threshold values exceeds one, the facility would be classified as Category 3. Similarly, if individual inventories are greater than the Category 3 thresholds, but are below Category 2 thresholds, and the sum of the ratios of the individual nuclide inventories to the Category 2 threshold values exceeds one, the facility would be classified as Category 2. There are no threshold values for hazard Category 1. This classification is reserved for Category A reactors or any other facility deemed to be of this hazard level by DOE.

DOE [1992b] allows certain inventories to be excluded from consideration for the purpose of hazard classification. Sealed radioactive sources meeting DOT and ANSI standards may be excluded from the summation of a facility's radioactive inventory, as long as supporting documentation is available [DOE, 1992a]. Materials contained in exempted, commercially available products need not be considered as part of a facility's inventory [DOE, 1992b]. Additionally, material contained in DOT Type B shipping containers may also be excluded [DOE, 1992b].

The presence of significant quantities of radionuclides determines if a facility is classified as a nuclear facility. If so, it will be designated as Category 1, 2, or 3. Facilities having radionuclide inventories less than Category 3 threshold levels, but above a de minimus value, are classified as Radiological. [DOE, 1994] selected de minimus values as the reportable quantities provided in 40CFR302.4, Appendix B [CFRa]. Thus, facilities classified as Radiological for the purpose of safety analysis have inventories between 40CFR302 reportable quantities and Category 3 thresholds. If a facility has a very small radionuclide inventory, below the 40CFR302 reportable quantities, it would be classified as Excluded. However, if multiple nuclides are present, the sum of the ratios of the various nuclides to the radiological thresholds (40CFR302 reportable quantities) would have to remain below one in order for the facility to remain excluded. Hazards in excluded facilities are covered by OSHA regulations. Note that for the purpose of 10CFR835 [CFRb], the de minimus values do not apply. All facilities containing radionuclides, including those with inventories below the 40CFR302 values, would be labeled as Radiological for 10CFR835 purposes only. Radiological (for the purpose of safety analysis) and Excluded facilities are not required to prepare a Safety Analysis Report in accordance with DOE Orders 5480.23 [DOE, 1992a] or 5481.1B [DOE, 1987].

The top portion of Figure 2 summarizes the initial radionuclide classification process.

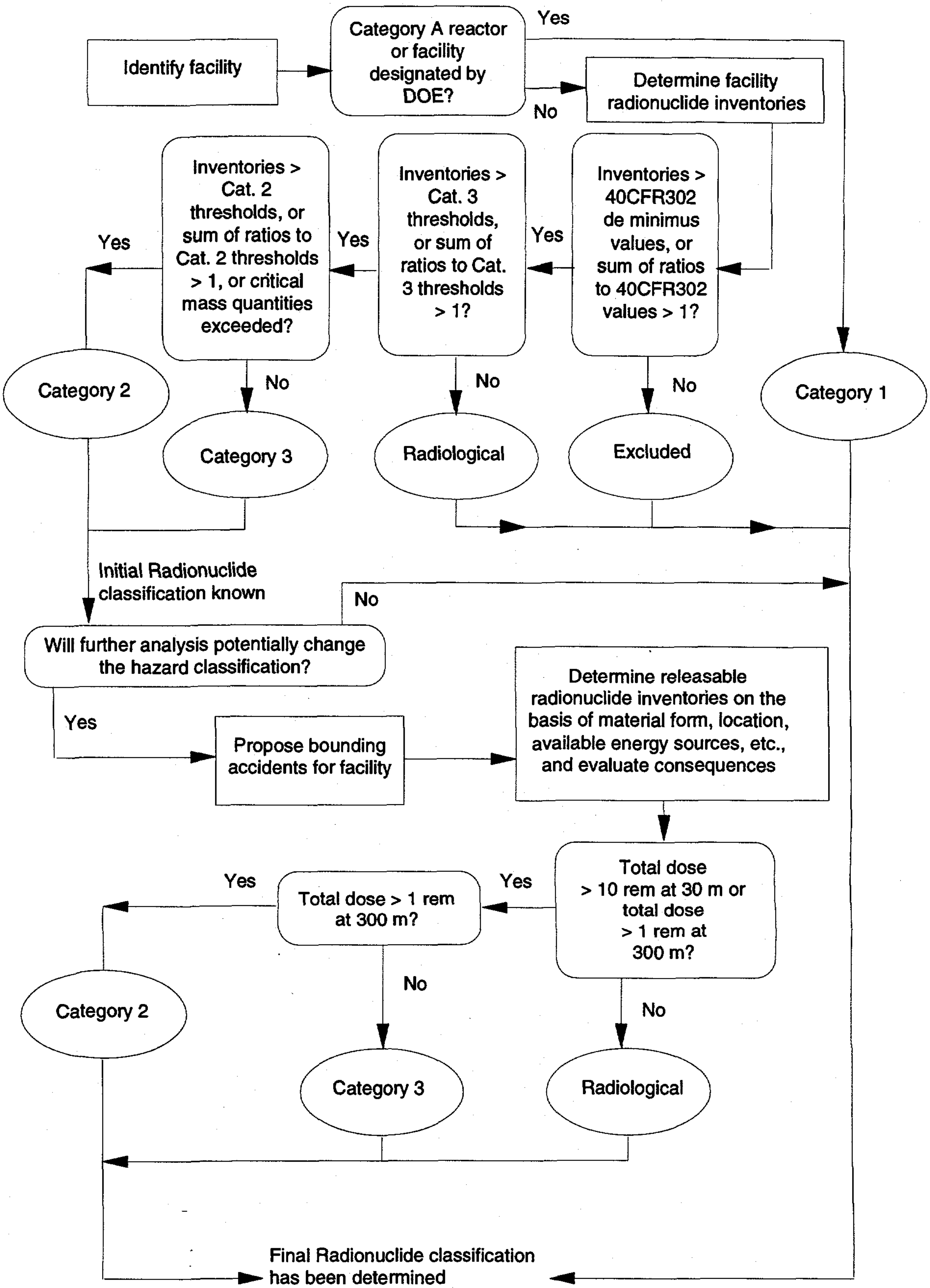

Figure 2: Classification Process on the Basis of Radionuclides

Chemical Inventory Screening

The facility chemical inventories should be examined to determine the facility chemical classification. [DOE, 1987] defines the following classifications applicable to facilities with toxicological hazards:

Low Hazard:	Hazards analysis shows the potential for only minor onsite and negligible offsite impacts to people or the environment; this includes facilities with quantities of hazardous materials that meet or exceed the Low Hazard thresholds.
Moderate Hazard:	Hazards analysis shows the potential for considerable potential onsite impacts to people or the environment, but at most only minor offsite impacts; this includes facilities with significant quantities of hazardous material (in excess of Moderate hazard thresholds) and energy.
High Hazard:	Hazards analysis shows the potential for onsite or offsite impacts to large numbers of persons or for major impacts to the environment.

Usually, for any given substance, the release of a quantity of less than one pound will not result in a serious impact to any receptor. Therefore, as an initial step in the hazard classification process for chemicals, materials present in quantities less than one pound will be screened out. Any chemical known to be particularly hazardous, which is present in less than a one pound quantity, may be evaluated further in the final hazard classification step.

For the purpose of inventory screening, a set of chemical-specific threshold values has been adopted, which meet the definitions of Low and Moderate hazard. A set of thresholds for High hazard has not been developed, as none of the facilities are expected to approach this hazard level. Reportable Quantities as specified in 40CFR302 [CFRa] and in 40CFR355 [CFRc] are used as Low hazard thresholds. The Low hazard thresholds are minimum values for the inventory of a chemical, which if exceeded, would cause a facility to be initially classified as Low hazard. Threshold Quantities as specified in 29CFR1910.119 [CFRd] and Threshold Planning Quantities as provided in 40CFR355 [CFRc] are used as Moderate hazard thresholds. These threshold lists in [CFRa], [CFRc], and [CFRd] were not developed for the purpose of inventory screening for hazard classification. Nevertheless, they identify sets of chemicals as being hazardous for one reason or another. Thus, the chemical inventory comparison using these lists will consider most extremely hazardous materials. Chemicals not on these lists are generally less hazardous, and are not considered in the initial hazard classification process. They may be examined, depending on the quantity at the facility and on the toxicity of the material, in the final hazard classification process.

If a facility does not have significant quantities of hazardous chemicals (i.e., less than the Low Hazard threshold, and no particularly toxic materials (not on lists) present, and no substantial quantity of any material (not on lists) present), its chemical classification will be Excluded. Excluded facilities are not required to prepare a Safety Analysis Report in accordance with DOE Order 5481.1B [DOE, 1987].

The top portion of Figure 3 summarizes the initial chemical classification process.

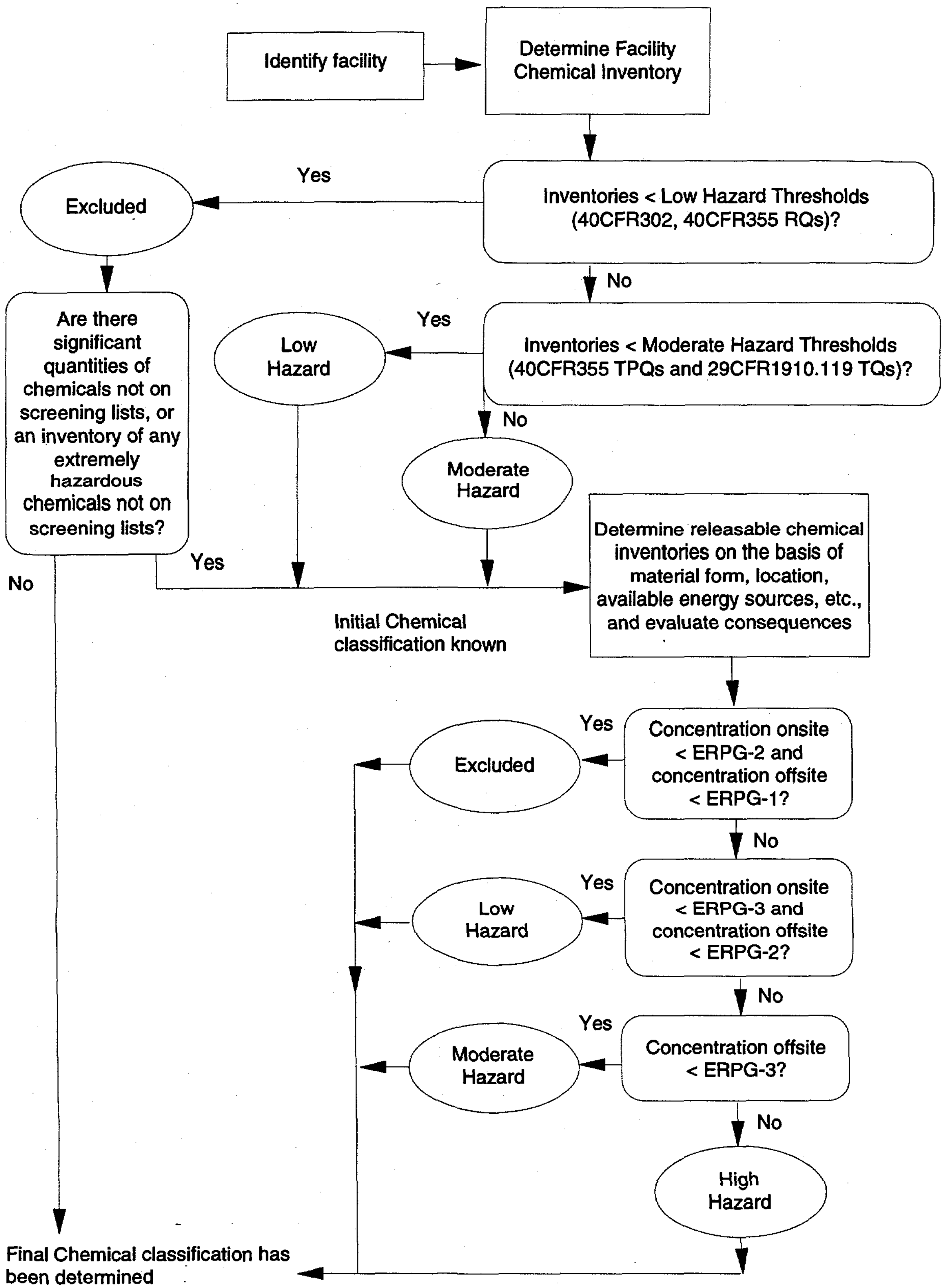

Figure 3: Classification Process on the Basis of Chemicals

Final Hazard Classification: Bounding Event

After an initial hazard classification is assigned, the classification can be finalized based on a bounding accident documented in a Preliminary Hazards Analysis (PHA), or in the Safety Analysis Report (the classification should at least be reviewed in the SAR). For facilities containing radionuclides and chemicals, an unmitigated release of available hazardous material would be analyzed. For the purpose of hazard classification, "unmitigated" means that material quantity, form, location, dispersibility, and interaction with available energy sources should be considered, but active safety features that will prevent or mitigate a release should not be considered. Passive safety features may be considered. Such additional analysis would provide the basis for the actual inventory at risk in a facility and would evaluate a credible release fraction based on physical and chemical form and available dispersive energy sources.

When doing the bounding accident analysis, the graded approach should be utilized. That is, only the level of sophistication that is necessary to give an acceptable result should be used. For example, a simple, very conservative release scenario should be considered first for hazard classification. If the impacts of this type of event result in a low classification, then additional analysis is not warranted. However, if this same type of scenario resulted in a high classification, then better definition of the scenario would be appropriate. This discussion also applies to the tools used for analysis. Conservative screening tools should be used initially. If the resulting hazard classification is high, and it is possible that a more sophisticated analysis would lead to a lower classification, then the additional effort is warranted.

The location of receptors considered for hazard classification based on a bounding accident is variable. Two receptor locations are considered. The first receptor location represents the location for either localized or onsite impact evaluation, and varies for the different types of hazards. The locations at which impacts from the bounding accident are evaluated for the different hazards are summarized here:

Type of Hazard	First Receptor Location
Radionuclides	30 m
Chemicals	100 m

There is a difference between the (immediate) worker and the co-worker worth clarifying here. The co-worker is considered to be working at a facility different to the one being classified. The immediate worker is at the facility being classified, and impacts to this individual do not drive hazard classification.

The hazard classification process also considers a second receptor. For classification on the basis of radionuclides, the second receptor is located 300 m from the release point (DOE, 1992b). For chemical hazards, the second receptor is located at the site boundary. This information is summarized in the table to follow:

Type of Hazard	Second Receptor Location
Radionuclides	300 m
Chemicals	site boundary

The use of bounding accidents can lower or raise the classification from that initially obtained or it can confirm the initial classification. Accidents are selected to explore only the hazards of greatest significance, or those that were not part of the initial hazard classification process. For example, in the case of chemical hazard classification, not all chemicals have hazard classification thresholds. In some instances, it may be useful to explore accidental releases of some of the other chemicals, particularly those present in large quantities at the facility or those that are known to be relatively toxic.

Note that it is not always necessary to perform this second step in the hazard classification process. For example, for a facility classified as Category 2 because of kilogram quantities of plutonium, it is highly unlikely that the classification could be lowered to Category 3 on the basis of a bounding accident. Or, if chemical inventories show that a facility is Excluded, and there are no large quantities of chemicals without thresholds, or there are no known extremely hazardous chemicals without thresholds, then the Excluded classification will become the final classification and no further analysis is necessary.

Radionuclide Hazards

A final hazard classification for facilities containing radionuclides is assigned on the basis of a bounding analysis of a potential accident. The bottom portion of Figure 2 illustrates this process. The facility radionuclide inventories are examined to assess releasable inventories on the basis of material form, location, and available energy sources. The consequences of the release determine the final radionuclide classification. DOE [1992b] interprets nuclear classifications on the basis of consequences of releases as follows:

Radiological: Total dose at 30 m from the facility is less than 10 rem and at 300 m, the total dose is less than 1 rem.

Category 3: Total dose at 30 m from the facility exceeds 10 rem and at 300 m, the total dose is less than 1 rem.

Category 2: Total dose at 300 m exceeds 1 rem.

As was the case before, Category A reactors or other facilities deemed to be of similar hazard level by DOE will be classified as Category 1. A bounding accident analysis need not be performed for facilities in this category.

In evaluating the dose, the Total Effective Dose Equivalent (TEDE) will be determined, which will consist of the Effective Dose Equivalent (EDE) from external exposure due to cloudshine (during plume passage) and the 50-yr CEDE from material inhaled during plume passage.

Meteorological conditions are important in determining impacts of airborne releases. In particular, atmospheric stability and wind speed are key parameters. Atmospheric stability refers to the degree of turbulence or mixing in the atmosphere. This ranges from a stability classification known as "A," applicable to highly unstable conditions with a high degree of mixing, to a classification known as "F," applicable to very stable conditions with minimal mixing. DOE [1992b] recommends the use of Class D atmospheric stability (neutral conditions, midway between slightly unstable and slightly stable conditions) and a wind speed of 4.5 m/s for calculation of impacts for the purpose of hazard classification.

Note that if the initial classification is determined to be Radiological or Excluded on the basis of radionuclide inventories, or if it is clear that further analysis will not alter the initial classification, the bounding accident analysis is not needed to confirm the classification. However, the analyst is free to carry out this step, if desired, to provide supplemental information.

Chemical Hazards

A final hazard classification for facilities containing chemicals is assigned on the basis of a bounding analysis of a potential accident. The bottom portion of Figure 3 illustrates this process. The facility chemical inventories are examined to assess releasable inventories on the basis of material form, location, and available energy sources. The consequences of the release determine the final chemical classification. The criteria for hazard classification are as follows:

Excluded: Individual concentrations of chemicals fall below the ERPG-2 level (or its equivalent) onsite and fall below the ERPG-1 level (or its equivalent) offsite.

Low Hazard: Individual concentrations of chemicals are ≥ ERPG-2 and < ERPG-3 onsite or are ≥ ERPG-1 and < ERPG-2 offsite.

Moderate Hazard: Individual concentrations of chemicals are ≥ ERPG-3 onsite, or are ≥ ERPG-2 and < ERPG-3 offsite.

High Hazard: Individual concentrations of chemicals are ≥ ERPG-3 offsite.

The ERPG-1 level is a toxic exposure level developed by the American Industrial Hygiene Association (AIHA) for emergency planning purposes. At the ERPG-1 concentration level of a hazardous material, nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or without perceiving a clearly defined objectionable odor. ERPGs are only available for a limited number of chemicals. In the absence of an actual ERPG value, the following hierarchy of alternatives is suggested to determine an ERPG-1 equivalent [Craig, 1993]:

1. PEL-STEL, OSHA
2. TLV-STEL, ACGIH
3. TLV-TWA x 3, ACGIH.

The ERPG-2 level is a toxic exposure level developed by the American Industrial Hygiene Association (AIHA) for emergency planning purposes. At the ERPG-2 concentration level of a hazardous material, 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 ability to take protective action. ERPGs are only available for a limited number of chemicals. In the absence of an actual ERPG value, the following hierarchy of alternatives is suggested to determine an ERPG-2 equivalent [Craig, 1992]:

1. EEGL (60 min), NAS
2. LOC, EPA/FEMA/DOT
3. PEL-C, OSHA
4. TLV-C, ACGIH
5. TLV-TWA x 5, ACGIH.

The ERPG-3 level is a toxic exposure level developed by the American Industrial Hygiene Association (AIHA) for emergency planning purposes. At the ERPG-3 concentration level of a hazardous material, nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects. ERPGs are only available for a limited number of chemicals. In the absence of an actual ERPG value, the following hierarchy of alternatives is suggested to determine an ERPG-3 equivalent [Craig, 1993]:

1. EEGL (30 min), NAS
2. IDLH, NIOSH.

The acronyms are defined as follows:

ACGIH	American Conference of Governmental Industrial Hygienists
DOT	Department of Transportation
EEGL	Emergency exposure guidance level
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
IDLH	Immediately dangerous to life or health
LOC	Level of concern
NAS	National Academy of Sciences
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL-C	Permissible exposure limit, ceiling
PEL-STEL	Permissible exposure limit, short-term exposure limit
TLV-C	Threshold limit value, ceiling
TLV-STEL	Threshold limit value, short-term exposure limit
TLV-TWA	Threshold limit value, time-weighted average.

As noted above, meteorological conditions of Class D atmospheric stability and a wind speed of 4.5 m/s are to be used for determining consequences of chemical releases for the purpose of hazard classification.

Not all chemicals need to be evaluated in the context of a bounding accident. Only those that are present in significant quantities, or which are particularly toxic, should be considered. If the initial classification is determined to be Excluded on the basis of inventories, and there are no significant quantities of chemicals not on the screening lists, and no inventory of any extremely hazardous chemical not on the screening lists, the bounding analysis is not needed to confirm the classification. However, the analyst is free to carry out this step, if desired, to provide supplemental information.

Summary

This document provides the methodology for the NIF LTAB, OAB, and support facility classification for the purpose of safety analysis. The types of hazards of interest for the hazard classification process are radionuclides and chemicals (i.e. hazards that might have an impact outside the facility). Table 1 summarizes the notation used for identifying facility hazard classification. Multiple labels may be used for a single facility. For example, according to Table 1, a Radiological, Low Hazard facility would be identified as R/L.

This methodology will be used for classification of the NIF LTAB, the OAB, and NIF support facilities.

Table 1. Notation Used for Hazard Classification.

	Radionuclide classification				
			Nuclear		
Classification Due to Chemicals	Excluded	Radiological	Category 3	Category 2	Category 1
Excluded	E	R/E	3/E	2/E	1/E
Low	L	R/L	3/L	2/L	1/L
Moderate	M	R/M	3/M	2/M	1/M
High	H	R/H	3/H	2/H	1/H

References

CFRa, 40CFR302.4, "*Designation of Hazardous Substances,*" Environmental Protection Agency, Code of Federal Regulations.

CFRb, 10CFR835, "*Occupational Radiation Protection*", Code of Federal Regulations.

CFRc, 40CFR355, "*Emergency Planning and Notification, Appendix A: The List of Extremely Hazardous Substances and Their Threshold Planning Quantities,*" Environmental Protection Agency, Code of Federal Regulations.

CFRd, 29CFR1910.119, "*Process Safety Management of Highly Hazardous Chemicals, Appendix A: List of Highly Hazardous Chemicals, Toxins, and Reactives,*" OSHA, Dept. of Labor, Code of Federal Regulations.

Craig, D.K., 1993, "Toxic Chemical Hazard Classification and Risk Acceptance Guidelines for use in D.O.E. Facilities" (April 1993 Recommendations of the Westinghouse M&O Subcommittee on Nonradiological Risk Acceptance Guidelines Development).

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