Department of Energy
Washington, DC 20585

May 7, 2007

The Honorable A. J. Eggenberger
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

On June 26, 2006, you requested the Department of Energy (DOE) review DOE Standard (STD) 1027, Change Notice 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Report*, to ensure defense nuclear facilities are applying the standard consistently and correctly.

In a letter dated October 25, 2006, we forwarded you a list of potential areas for improvement in DOE-STD-1027 that included those identified in your June 26 letter and others identified by the Chief of Defense Nuclear Safety and the Chief of Nuclear Safety, and committed to establish a working group to evaluate them. Furthermore, we committed to establish a path forward to: (1) revise DOE-STD-1027, as appropriate, (2) identify any defense nuclear facilities affected by problems implementing DOE-STD-1027, and (3) ensure the standard is correctly implemented to prevent problems in the future.

The DOE-STD-1027 working group has completed its evaluation and has recommended several improvements in DOE-STD-1027. These improvements are summarized in Enclosure 1. Most of the recommended changes are consistent with the intent and fundamental elements of DOE-STD-1027 but provide amplifying guidance. For these changes, the Office of Health, Safety and Security has developed supplemental guidance for DOE-STD-1027 for use in supporting consistent implementation of DOE-STD-1027 throughout DOE (Enclosure 2). This guidance can also be utilized by DOE elements to evaluate whether any current facilities hazard categorizations may need to be revised to ensure that the areas of DOE-STD-1027, which may have been misinterpreted (Enclosure 3), did not result in inappropriate hazards categorizations.

We also plan on revising DOE-STD-1027 to incorporate the supplemental guidance and the other improvements, which impact the intent or fundamental elements of the standard. However, this will be an extended effort; and we therefore believe the issuance of the supplemental guidance is warranted at this time.

If you have further questions on our efforts on this issue, please contact me at (301) 903-3777 or have your staff contact Dr. James O'Brien at (301) 903-1408.

Sincerely,

Glenn S. Podonsky
Chief Health, Safety and Security Officer
Office of Health, Safety and Security

Enclosures

Enclosure 1
Summary of Recommended Improvements in DOE-STD-1027

Category 1: Clarifications

1. Initial Hazard Categorization

- Revise implementation overview flow chart to include additional details and add supporting guidance.
- Cite DOE-STD-1120-2005, *Integration of Environment, Safety, and Health into Facility Disposition Activities,* for the specifics of hazard categorization for Environmental Restoration activities (STD-1120 adopts the Office of Environment Management's approved Inactive Waste Site final hazard categorization process).
- Incorporate Nuclear Safety Technical Position (NSTP) 2002-2, *Methodology for Final Hazard Categorization for Nuclear Facilities from Category 3 to Radiological.*
- Clarify applicability of exemption for sealed sources and commercially available products.

2. Final Hazard Categorization

- Identify when material in Type B containers[1] do not need to be included in facility inventory for hazard categorization.
- Provide directions for how to apply passive features in the final hazard categorization process.
- Provide instructions for how to apply "nature of the process" considerations in determining whether there is a criticality potential that would require the facility to be a Hazard Category 2 facility.

3. Other Improvements

- Provide instructions for protecting the conditions, parameters, and assumptions that form the basis for the hazard category of the facility.
- Provide guidance for when criticality controls would be appropriate in below Hazard Category 2 facilities.

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[1] Type B containers are defined in 10 CFR 71, *Packaging and Transport of Radioactive Material,* and are required to be capable of surviving severe accidents.

Category 2: Editorial and Update of References

- Reflect 10 CFR 830, *Nuclear Safety Management,* Documented Safety Analysis Requirements

- Update other outdated references

Category 3: Changes impacting the intent of STD-1027 and/or Fundamental Elements

- Change the method for categorizing facilities based upon criticality risks, i.e., initially categorize facilities with a potential for a criticality event but radionuclide inventories below Hazard Category 2 levels at the Hazard Category 3 level (currently these are categorized at the Hazard Category 2 level).

- Provide guidance on how facilities may be segmented for hazard categorization purposes.

Enclosure 2
Supplemental Guidance

SUPPLEMENTAL GUIDANCE FOR DOE STANDARD 1027,

Hazard Categorization and Accident Analysis Techniques
for Compliance with DOE Order 5480.23,
Nuclear Safety Analysis Reports

TO ADDRESS AREAS IN NEED OF CLARIFICATION AND IMPROVEMENT

May 2007

U.S. Department of Energy
Office of Health, Safety and Security
Office of Nuclear Safety and Environment

Abstract

The Department of Energy (DOE) developed this supplemental guidance to support consistent and appropriate implementation of DOE Standard 1027-92, Change 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* The Defense Nuclear Facilities Safety Board (DNFSB) and DOE have identified several areas where DOE Standard 1027 need clarification to support consistent implementation including:

- Sealed Source and Type B Shipping Container Exemptions;
- Applicability of Criticality Controls in Hazard Category 3 and Radiological Facilities;
- Application of Segmentation and Nature of Process in Final Hazard Categorization; and
- Adjustment of Threshold Quantities in Final Hazard Categorization.

Although DOE Standard 1027 is an effective tool for hazard categorization, it lacks details in some areas. This supplemental guidance provides clarification in these areas, consistent with DOE Standard 1027 and its requirements relating to categorization of nuclear facilities based upon the potential degree of consequences to workers and the public if a release of hazardous nuclear materials occurred. It also provides additional guidance for documentation of the rationale for hazard categorization decisions and for maintenance of important conditions and parameters (such as the radionuclide inventory and form, and energy sources potentially affecting dispersibility) which may impact the hazard categorization.

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1. PURPOSE

This supplemental guidance has been developed to help ensure consistent and appropriate implementation of Department of Energy (DOE) Standard 1027, Change 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

This supplemental guidance provides clarification in several areas consistent with DOE Standard 1027 and its requirements related to categorization of facilities based upon the potential degree of consequences to workers and the public if a release of hazardous nuclear materials occurred. It also provides additional guidance for documentation of the rationale for hazard categorization decisions and for maintenance of important parameters which may impact the hazard categorization.

This supplementary guidance is not intended to cause DOE sites to re-evaluate the hazard categorizations for current facilities unless significant errors are found in the categorization such that the facility has been inappropriately categorized at too low of a level. DOE is considering revising DOE Standard 1027 to incorporate this clarifying guidance and other potential improvements. If the Standard is revised, this guidance will no longer be necessary and should not be used as it was specific to Change 1 of DOE Standard 1027.

2. BACKGROUND

2.1 Defense Nuclear Facilities Safety Board (DNFSB) Concerns

In a letter to DOE dated June 26, 2006, the DNFSB identified a lack of clarity in aspects of DOE Standard 1027, as well as inconsistencies in DOE sites' interpretation and application of the ground rules described in the standard. Three areas of particular concern were identified:

- Sealed Source Exemptions;
- Applicability of Criticality Controls; and
- Technical Basis for Hazard Category 3 Threshold Quantities.

2.2 Standard 1027 Working Group

DOE responded to the DNFSB in a letter dated October 25, 2006, and provided a list of potential areas for improvement in DOE Standard 1027 that included those identified in DNFSB letter and others identified by the Chief of Defense Nuclear Safety (CDNS) and the Chief of Nuclear Safety (CNS). In December 2006, DOE established a working group to evaluate the areas for improvement. The working group membership is shown in Attachment 1.

To support this effort, the working group evaluated the standard to determine factors that contributed to confusion or inconsistent implementation. The working group concluded that DOE Standard 1027 is an effective tool for hazard categorization but in some areas did not contain sufficient detail.

2.3 Hazard Categorization Purpose and Uses

The purpose of DOE Standard 1027 is to categorize facilities based upon the potential degree of consequences to the public and workers so that appropriate levels of safety analysis and oversight of operations can be established.

2.3.1 Safety Analysis

The hazard categorization is used to determine the level of safety analysis required per 10 CFR 830, *Nuclear Safety Management* (10 CFR 830 safety analysis requirements superseded those specified in DOE Order 5280.23, *Nuclear Safety Analysis Report,* which the current DOE Standard 1027 references). The rigorous safety basis requirements of 10 CFR 830 only apply to Hazard Category 1, 2, and 3 nuclear facilities because only these facilities have the potential for significant consequences. Further, Hazard Category 1 and 2 facilities are required to have a quantitative accident analysis in their safety analyses because these facilities have the potential for significant consequences outside of the facility. As stated in DOE Standard 3009 the largely qualitative level of effort in hazard analysis is appropriate and sufficient for accident analysis of Hazard Category 3 facilities.

2.3.2 Oversight

The hazard category of a facility is also used to determine the level of oversight DOE provides. For example, guidelines for facility representative oversight of nuclear facilities (provided in DOE Standard 1063, *Facility Representatives*) are:

Nuclear Hazard Categorization:	*Facility Activity Level:*		
	High	**Medium**	**Low**
1	Continual Oversight	Frequent Oversight	Intermittent Oversight
2	Frequent Oversight	Intermittent Oversight	Occasional Oversight
3	Intermittent Oversight	Occasional Oversight	Seldom Oversight

3. SCOPE OF SUPPLEMENTAL GUIDANCE

This supplemental guidance addresses all areas needing clarification identified in DOE's October 25, 2006, letter to the DNFSB as supplemented and refined by a working group evaluating the standard.

The guidance below is consistent with DOE Standard 1027 and some information has been taken verbatim from the standard. In those case where the standard included the term "shall" (meaning specified action is required), it has been retained in this supplemental guidance. This supplemental guidance does not place new requirements on DOE or its contractors and does not remove any requirements. Any inconsistencies in this supplemental guidance with DOE Standard 1027 are unintentional, and case any exist, the requirements in DOE Standard 1027 control.

Additional guidance is provided for:

- Initial Hazard Categorization;
- Final Hazard Categorization;
- Treatment of Sealed Sources;
- Treatment of Commercially Available Products;
- Segmentation;
- Nature of Process; and
- Criticality Controls.

This supplementary guidance does not provide any amplifying directions as related to categorization of Hazard Category 1 facilities, as no concerns were identified in this area.

4. SUPPLEMENTAL GUIDANCE

4.1 Initial Hazard Categorization

Note: This section of the supplemental guidance is primarily related to Section 3.1 of DOE Standard 1027.

The initial hazard categorization enables facility managers to determine quickly the likely facility hazard categorization.

For initial hazard categorization, the facility radioactive material inventory shall be compared against the Threshold Quantities (TQs) identified in Table A.1 of Attachment 1 of DOE Standard 1027. In this comparison, facility managers shall sum the ratios of each isotope to its TQ (i.e., isotope inventory/isotope TQ), and categorize the hazard appropriately if the sum-of-the-ratio is greater than or equal to a value of 1.0. DOE Standard 1027 also requires an evaluation of certain fissile material inventory against the thresholds for criticality.

Initial hazard categorization is a simple screening step that does not involve detailed computations. The consideration of material form, location, dispersibility and interaction with available energy sources called for in final hazard categorization is not applicable to initial hazard categorization.

The only modifications to inventory included in the initial hazard categorization are the exemption of radionuclides in sealed sources that meet the criteria specified in Attachment 1 of DOE Standard 1027 and radionuclides in commercially available products that meet the criteria in 10 CFR 30. Even though the radioactive inventory of sealed sources can be excluded from a facilities radioactive materials inventory compared against the Table A.1 of Attachment 1 of DOE Standard 1027 thresholds, the fissile material in sealed sources cannot be excluded from comparison to the fissile material limits in DOE Standard 1027. Section 4.1.1 provides details on the treatment of sealed sources. Section 4.1.2 provides details on the treatment of commercially available products.

4.1.1 Treatment of Sealed Sources

Note: This section of the supplemental guidance is primarily related to Attachment 1 of DOE Standard 1027.

Sealed radioactive sources that meet any of the following testing specifications may be excluded from summation of a facility's radioactive inventory as part of the initial categorization:

- Department of Transportation (DOT) Special Form criteria per 49 CFR 173.469;
- Nuclear Regulatory Commission (NRC) Special Form criteria 10 CFR 71.75;
- ANSI N43.6/ISO 2919 Annex E Special Form criteria; or
- ANSI N43.6/ISO 2919 Class 4, Class 5 or Class 6 (or Class X equivalent) performance criteria for temperature, impact, and puncture.

Facilities that apply the exclusion for sealed radioactive sources should:

- Maintain copies of documentation for each excluded sealed source or special form that demonstrates the source is engineered to pass and continues to meet the appropriate ANSI/International Organization for Standardization (ISO) or special form performance criteria. Examples include current certification documents (e.g., special form certificates, ANSI/ISO certifications, Certificate of Competent Authority) or engineering, test, and safety analysis documentation. Sealed sources and special forms can be excluded only as long as they continue to meet the ANSI/ISO or special form performance criteria.

  Note: Normally the ANSI/ISO or special form compliance documentation or certification provided by a manufacturer, supplier, or regulator is sufficient if the source is within its specified service life, or a service life is not specified and the source is not subject to inherent age-related degradation mechanisms (e.g., internal gas/pressure buildup, corrosion) or environments. At a minimum, service life limitations shall be addressed by the manufacturer, supplier, regulator, or user for all actinide alpha sources/special forms, or sources/special forms used in a corrosive or extreme environment.

- Maintain the minimum quality assurance requirements in accordance with ANSI N43.6, ISO 2919, 10 CFR 71, or 49 CFR 173 as applicable to sealed radioactive sources and special forms; and
- Develop and implement procedures to address leaking sealed radioactive sources. Special attention should be placed on excluded sealed radioactive sources that could change the facility hazard category if breached. These procedures should identify appropriate controls that are to be promptly initiated to ensure protection of the public

and workers and contingencies for additional hazard analysis (and potentially re-categorization of the facility) if the leaking source can not be remediated in a timely manner.

Pu-238 Fueled Clad units designed for use in a General Purpose Heat Source may also be excluded from initial hazard categorization if they can be shown to meet/exceed the criteria for exempt sealed sources described above.

Even though the radioactive inventory of sealed sources can be excluded from a facilities radioactive materials inventory compared against the Table A.1 of Attachment 1 of DOE Standard 1027 thresholds, the fissile material in sealed sources can not be excluded from comparison to the fissile material limits in DOE Standard 1027. Fissile material in sealed sources must be accounted for in the determination of hazard category status relative to criticality safety concerns.

4.1.2 Commercially Available Products

Note: This section of the supplemental guidance is primarily related to Attachment 1 of DOE Standard 1027.

The following commercially available products may be excluded from summation of a facility's radioactive inventory as part of the initial categorization:

- Commercially available products containing byproduct material as described in 10 CFR 30 Parts 30.14-30.21.
- Commercially available products containing source material as described in 10 CFR 40.13.

The exemption is only applicable to the receipt, possession, use, transfer, ownership, or acquisition of commercially available products. The exemption is not extended to a commercially available product that is modified or altered from its intended use (i.e., removal of sources from a smoke detector).

The commercially available products exemption is only applicable to the sum of radioactive inventories at Hazard Category 2 and Hazard Category 3 facilities. Commercially available products must be accounted for in the determination of hazard category status relative to criticality safety concerns.

4.2 Final Hazard Categorization

Note: This section of the supplemental guidance is primarily related to Section 3.1.2 and Attachment 1 of DOE Standard 1027.

Once a hazards analysis has been performed as defined in Section 4 of DOE Standard 1027, the hazard categorization must be finalized. The purpose of the final hazard categorization is to ensure that facility and accident specific factors that could (1) either

change the fraction of material released in an accident or (2) change the amount of the total inventory of material subject to an accident are addressed to ensure the facility is properly categorized.

The first case (change in fraction of material released) is addressed by considering whether the release fractions that were utilized in derivation of the TQs used in the initial hazard categorization should be adjusted. Further guidance is given in Section 4.2.1. Note, conditions that may increase or decrease the hazard category must be considered.

In the second case (change in material subject to an accident), two conditions should be considered in determining the final hazard categorization: (1) whether the facility inventory can be reduced (for the purpose of hazard categorization) due to segmentation (e.g., where facility features preclude bringing material together or causing harmful interaction from a common severe phenomenon), and (2) whether the facility inventory can be reduced (for the purpose of hazard categorization) due to excluding inventory contained in Type B containers. Further guidance is given in Sections 4.2.2 and 4.2.3.

4.2.1 Modification of TQs for Final Hazard Categorization

4.2.1.1 Evaluation of TQs for Reducing a Facility from Hazard Category 2 to 3

DOE Standard 1027 states that "for final Categorization, for facilities initially classified as Hazard Category 2, if the credible release fractions can be shown to be significantly different than these values based on physical and chemical form and available dispersive energy sources, the threshold inventory values for Category 2 in Table A.1 may be divided by the ratio of the maximum potential release fraction to that found on Page A-9."

The release fraction assigned in DOE Standard 1027 for nonvolatile solids/powders/liquids (1E-3) is based on release fractions used by the NRC in NUREG-1140, as modified by DOE as described in DOE Standard 1027 Attachment 1. In verifying the appropriateness of the DOE Standard 1027 values, an evaluation was performed to verify that the 1E-3 value cited was an adequate average for hazard categorization purposes. This was done by considering various facility descriptions, applying the release fraction values to the materials in question and the accident stresses that such facilities might experience. The 1E-3 value is therefore considered appropriate for the typical processing and storage operations historically performed at DOE facilities.

Alternate release fractions than specified in DOE Standard 1027 should not be attempted unless there is some obvious gross inconsistency between a facility's material forms or circumstances and those of most of DOE's nuclear facilities that were considered in verifying the applicability of the DOE Standard 1027 release fraction value of 1 E-3. Examples might include exceptions such as contaminated soil, activated metals in a deinventoried facility, and vitrified glass.

If alternate release fractions are used, they must be appropriate for worst case conditions, considering all materials in the facility and all accident stresses to which those materials

might be subjected. DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities,* provides a useful source of information on Airborne Release Fractions/Rates and Respirable Fractions.

For the purpose of specifying alternate release fractions, applicable bounding airborne release fraction values should be assigned. Where DOE-HDBK-3010-94 identifies alternate release fractions significantly different than 1E-3, the applicability of that value should be verified for the form and stress under consideration. Where DOE-HDBK-3010-94 does not provide information directly applicable to a given situation, analysts may either (1) derive conservative analogies to information in DOE-HDBK-3010-94 or (2) present new data and relevant calculations. In either case, the proposed application of alternate release fractions must be conservative, clearly explained, justified and approved by DOE.

If an alternate release fraction is accepted by DOE, new TQs can be calculated by multiplying the DOE Standard 1027 TQs by the ratio of the maximum potential release fractions and the release fractions on Page A-8 and A-9 of DOE Standard 1027. The final hazard categorization can be reduced if the sum of the fractions (i.e., fraction of the actual radionuclide inventory to the new Hazard Category 2 TQs for each radionuclide) is less than 1.

Other assumptions and parameters used to determine the TQs in Appendix A.1 for Hazard Category 2 or 3 facilities (such as meteorological parameters and receptor distance) should not be altered.

4.2.1.2 Evaluation of TQs for Reducing from a Hazard Category 3 to a Less Than Hazard Category 3 Facility[1]

The Hazard Category 3 TQs are derived from the Annual Limits of Intake (ALIs) published for 757 radionuclides in International Commission of Radiation Protection (ICRP) Publication 30. The Los Alamos National Laboratory report (LA-12981-MS), *Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 List of 757 Radionuclides*, referenced in a footnote to Table A.1, shows the limiting pathway for each radionuclide. With the exception of two radionuclides (Ta-179, Ir-189), these pathways are inhalation, direct radiation, and food ingestion. Both inhalation and food ingestion pathways depend on an airborne release fraction. With the exception of noble gases, the direct radiation pathway is exposure to a point source. The Environmental Protection Agency (EPA) report, *Technical Background Document to Support Final Rulemaking Pursuant to Section 102 of the Comprehensive Environmental Response, Compensation, and Liability Act: Radionuclides: A Report to the Emergency Response Division, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency*, describes the parameters and models used for analysis. The release fractions for Hazard Category 3 threshold values must be determined from evaluation of the EPA Technical Background Document which lists, in Exhibit A-1, the release fractions by isotope (Exhibit 1 is reproduced in Attachment 2 of this Supplemental Guidance). The EPA Technical Background Document (in Chapter 4) discusses the methodologies used for different exposure pathways. The report considered

[1] The term "Radiological Facility" is typically used for "Less Than Category 3 Facilities"

inhalation, ingestion of drinking water and food, and direct exposure. The results of the exposure routes for individual isotopes are presented in Appendix E of the EPA report.

The Hazard Category 3 threshold values for radionuclides may be revised if the credible release fractions (airborne release fractions multiplied by the respirable fractions) are shown to be significantly different than the values used in the EPA Technical Background Document. The revisions should be based on the physical and chemical form of the released material, available dispersive energy sources for the facility, and credible exposure pathways. The selection of alternate release fractions should follow the guidance given above for Hazard Category 2 facilities. All potential accident scenarios must be considered under unmitigated conditions, using the most limiting credible pathways. All data and assumptions used to modify the Table A.1 Hazard Category 3 values must be supported in the hazard analysis including the basis and justification for alternate release fractions.

Other assumptions and parameters within the methodology in Appendix A.1 for Hazard Category 2 or 3 facilities (such as meteorological parameters and receptor distance) may not be altered.

4.2.1.3 Evaluation of TQs for Potentially Increasing Facility Hazard Categorization
The conditions, parameters, and assumptions that form the basis for the initial hazard category of the facility need to be evaluated to determine whether the hazard categorization should be increased.

Examples would include the following:

- Dispersibility (e.g., less conservative release fractions relative to the material that would be in the facility);
- Interaction with available energy sources that could result in release of materials from Type B containers or sealed sources; and,
- Other parameters that would result in less conservative assumptions associated with the methodology supporting Appendix A.1 threshold quantities.

The same methodology for adjusting the TQ described in sections 4.2.1.1 and 4.2.1.2 should be utilized for evaluating whether the hazard category needs to be increased.

Increases in hazard categorization may be considered for atypical situations where a large percentage of the facility inventory is subject to a release fraction well in excess of the nominal release fraction used in determining the threshold quantities.

Note that the 1 E-3 release fraction assigned in Attachment 1 of DOE Standard 1027 for the majority of solids, powders and liquids is cited as "an adequate average for hazard categorization purposes." The bounding release fractions reported in DOE-HDBK-3010-94 were evaluated in assigning the 1 E-3 average release fraction for the total facility inventory in typical processing, storage, and waste handling operations. For example, it is understood that waste drum fires can involve a release fraction of 1 E-2 for a fraction of material ejected from the drums, while the remainder experiences a release fraction of 5 E-4. Likewise, individual accumulations of powder or liquid may experience release fractions greater than

1 E-3, but the facility average release fraction will normally remain consistent with the original DOE Standard 1027 assessment. Therefore, simply identifying potential release fractions in excess of the 1 E-3 value for individual scenarios does not require re-evaluating facility hazard categorization.

4.2.2 Facility Segmentation

Segmentation can be applied in two general cases.

- A multiple structure facility - A facility consisting of multiple, physically separated structures, each containing radiological inventories. An example would be multiple storage bunkers with one common safety basis (one facility) in which bunker inventories are treated individually for the purpose of overall hazard categorization.

- A single segmented facility - A facility which consists of a single structure internally divided into non-interacting segments. An example would be a building containing two different radiological operations each with its own radiological inventory, and the inventories are not combined when determining nuclear hazard categorization.

Either case might apply to distributed radiological facilities such as environmental remediation sites.

Multiple structure facilities may be categorized independently if they are housed in physically separated structures that react to all credible accident scenarios independently (other than through combination of their plumes when suffering a common external event). Administratively, such independent activities may be collocated and have a single safety basis for efficiency, but for all intents and purposes they should be treated as if they were separate facilities and categorized accordingly.

DOE Standard 1027 also allows non-interacting segments of a single segmented facility to be categorized independently. Specifically, the standard states that:

> "The concept of independent facility segments should be applied where facility features preclude bringing material together or causing harmful interaction from a common severe phenomenon. .... the standard permits the concept of facility segmentation provided the hazardous material in one segment could not interact with hazardous materials in other segments. For example, independence of HVAC and piping must exist in order to demonstrate independence for facility segmentation purposes. This independence must be demonstrated and places the "burden of proof" on the analyst."

The standard does not provide guidance on how to make determinations relative to what "common severe phenomena" need to be considered and how to prove independence for severe phenomena such as earthquakes. Two approaches are possible. One approach is to essentially not allow segmentation within a facility because it cannot be absolutely proven that interactions (such as fire propagation) will not occur in severe accidents such as beyond design basis natural phenomena. A second approach is to not include extremely low

probability beyond design basis natural phenomena hazards in the segmentation analysis. Since the intent of standard is not clear on this matter, it is not appropriate for this supplemental guidance to address this issue; rather it would need to be addressed in a revision to the standard.

If segmentation of a facility is being considered for the purpose of categorization based upon the potential for criticality, then the segmentation must prevent not only physical interaction of fissile material operations, but also neutronic interaction between operations.

Note: In cases where exclusions described in the footnotes of DOE Standard 1027, Table A1, related to "segmentation or nature of process" result in a less than Hazard Category 3 facility determination, these exclusions are to be considered as part of a final hazard categorization. This assures that such provisions are based on the results of a hazard analysis and are subject to DOE approval.

4.2.3 DOT Shipping Containers

Type B Containers are not intended to be used for facility inventory control of nuclear material. However, facilities that want to exclude radionuclide inventory for long-term storage or pending shipment must demonstrate: (1) that facility accidents will not involve conditions that could challenge the integrity of the Type B containers; (2) that required maintenance/testing activities and configuration control associated with Type B containers will be met; (3) that excluded Type B containers remain closed at all times; (4) the containers being excluded have a current Certificate of Compliance; and (5) the materials stored are authorized by the certificate.

Notes:

1. The requirement relative to maintenance/testing must be in compliance with the requirements of the certificate. If the container in use is coming up on a required maintenance activity (e.g., replacement of o-ring), this activity would have to be performed in a facility set up to do the replacement and subsequent testing before returning the container to the storage facility. Otherwise, if the facility applying the exclusion is the one doing the storage/maintenance/testing, then the exclusion would not cover the maximum number of containers that could be opened at any given time and must be considered as part of the facility hazard categorization. Further, Section 3.1.2 of DOE Standard 1027 does allow consideration of the material that can be physically released from the facility in the final hazard categorization. The material available for release should include the maximum amount of material in Type B containers that are allowed to be opened at any given time and material in all uncertified Type B containers.

2. Type B containers that are in the process of being transported under a DOE-approved transportation safety document and are under DOT jurisdiction per 49 CFR 171.1.(c) should be considered out-of-scope of DOE Standard 1027.

3. Analysis must demonstrate that facility hazards (e.g., drops, punctures, fires, seismic, etc.) will not involve conditions that could challenge the integrity of the Type B containers. This analysis can be qualitative or quantitative based on the conditions

the container has been tested too. DOE may not need quantitative evaluations if the testing conditions have clear margin over any hazards likely to be seen in a facility. For Type B containers without overpack that survive all facility hazards, the need for heat protection provided by the facility's fire suppression system will be at the discretion of the operating contractor.

4. In accordance with DOE Standard 1027, fissile material in Type B containers needs to be included in the determination of hazard category status relative to criticality safety concerns.

5. The exclusion of Type B containers was not intended to factor into categorization decisions for new facilities (i.e., to avoid being categorized and therefore give no consideration to nuclear safety design criteria). Hazard categorization of new facilities should not consider Type B container exclusions at the expense of other facility engineering controls. The early phases of design may not have sufficient information to provide confidence in the hazard analysis that would support a final hazard categorization that relies on the survival of Type B containers.

4.2.4 Use of Nature of the Process in Final Hazard Categorization

If a facility contains more fissionable material than the single parameter sub-critical limits in ANSI/ANS-8.1 or ANSI/ANS-8.15, then a Criticality Safety Program is required by DOE O 420.1B. Nonetheless, the facility may still be shown to be Hazard Category 3 (or less than Hazard Category 3) if it was initially categorized as a Hazard Category 2 facility solely based upon the potential for criticality through an analysis that demonstrates nature of process precludes criticality, provided that no operational criticality safety controls or limits are needed.

In demonstrating that the nature of process precludes criticality, the analysis should demonstrate that a potential for criticality does not exist for a given material configuration, based on actual quantity, form, shape, and collocation with moderators and reflectors. The nature of the process cannot be utilized if there are any hazards that could result in a criticality occurring at the facility. Credibility arguments based upon operational criticality controls and safety management programs that mitigate the potential for a criticality accident do not meet the intent of precluding criticality by 'nature of process.'

An evaluation of the nature of process should consider whether planned activities, operational upsets, and derivative design basis abnormal environments could alter the characteristics of the facility, packaging, or fissile material such that controls are needed to address the potential for criticality. For example, controls may not be needed to address criticality hazards in normal environments because material is in a solid form and environment that renders it geometrically safe, and because normal processes would not alter that form. However, nature of process must also consider whether derivative design basis accident environments would alter the physical form or environment of the material such that criticality controls are required. The need for operational criticality controls, including design features such as "birdcages" and criticality-safe vessels," indicate that Hazard Category 2 facility classification is warranted.

4.3 Criticality Safety Programs in Less than Hazard Category 2 Facilities

The existence of a Criticality Safety Program for the facility, alone, does not invalidate the classification of the facility as a Hazard Category 3 or a radiological facility. However, the facility must have no criticality hazard. Thus, it must not depend upon procedural controls or process-specific criticality safety evaluations, limits, or controls in order to reduce risk of an inadvertent criticality. Only high-level controls at the facility level (e.g. Material at Risk limits) are needed to preclude a criticality hazard. An appropriately graded Criticality Safety Program for such a facility may have audits, inspections, criticality reviews, response to abnormal as-found conditions (such as unexpected accumulations of fissionable material), etc. without the need for operational criticality safety controls that must be relied upon to eliminate the criticality accident hazard. If the hazard of criticality must be otherwise controlled within a facility, then the facility is, by definition, a Hazard Category 2 facility.

4.4 Configuration Control of Conditions and Parameters Relied on for Hazard Categorization

The conditions, parameters, and assumptions that form the basis for the hazard category of the facility must be protected. For facilities that are adjusting the facility's category based on form, dispersibility, segmentation, etc., Technical Safety Requirements administrative controls (or other functionally equivalent contractor controls for less than Hazard Category 3 facilities) should be established to maintain the conditions, parameters, and assumptions that form the basis of the hazard categorization. Examples of these inventory control process elements and assumptions (and how they may be changed) are as follows:

- Radionuclide inventory (increase in material to be stored or processed, change in the process, new sample data or analysis, discovery of new or different materials [for example during decommissioning of a facility]);
- Form of material (change in how materials are contained, processed, or treated, or a newly discovered material characteristic);
- Dispersibility (change in container, process, or treatment, discovery of new or different materials, change in type or intensity of energy sources, change in project environment [drier or wetter than assumed]);
- Interaction with available energy sources (change in adjacent facility or process, change in process, change in location, change in conditions surrounding area);
- Segmentation (change in facility physical features, change in process, change in energy sources, change in operations), and;
- Changes in the nature of processes that may affect criticality safety assumptions.

If a configuration change is made or new information discovered that affects a condition, parameter, or assumption that helps form the basis for a hazard category downgrade, the approved hazard categorization must be re-evaluated. This hazard characterization basis must then be reviewed by DOE prior to making a change to ensure that the basis for the approval of the hazard category has not changed. The revised final hazard categorization must provide justification that demonstrates that the change or new information does not adversely affect the hazard category or establishes a new hazard category.

4.5 Department of Energy Approval

DOE Manual 411.1-1B, *Safety Management Functions Responsibilities and Authorities Manual,* specifies that that Cognizant Secretarial Officer must: (1) approve final facility hazard categorization for nuclear facilities, where this authority has not been delegated[2] and (2) ensure that the hazard categorization is performed consistent with 10 CFR 830.202(b)(3).

To support this review, the final hazard categorization should document sufficient background information for DOE to understand the nature of the facility and its operations and provide sufficient base information, including (1) definition of the bounding radionuclide inventories at a facility; (2) substantiation of any assumptions used in calculating inventories, and (3) provision of a defensible basis to support the hazard analysis and its associated final hazard categorization. Specific information should be included on:

- Basis for applying segmentation to downgrade a facility categorization (if utilized).
- Basis for modification of any TQs
- Basis for use of Type B containers to exclude radioactive material from hazard category inventories must be specifically approved by DOE.
- Basis for applying a nature of process argument to downgrade a facility categorization

6. REFERENCES

6.1 DOE Standard 1027-92, Change 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*

6.2 DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*

6.3 DOE Standard 3007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*

6.4 10 CFR 830, *Nuclear Safety Management*

6.5 DOE O 5280.23, *Nuclear Safety Analysis Reports*

[2] The NNSA Functions, Responsibilities and Authorities Manual delegates this authority to the NNSA site managers.

6.6 DOE Standard 1063, *Facility Representatives*

6.7 DOE Nuclear Safety Technical Position (NSTP) 2002-2, *Methodology for Final Hazard Categorization for Nuclear Facilities from Category 3 to Radiological*

6.8 NNSA Technical Bulletin 5-02, June 2005: *Criticality and Segmentation*

6.9 NNSA Technical Bulletin 5-03, September 2005: *Final Hazard Categorization and Sealed Sources*

6.10 NNSA Technical Bulletin 6-02, June 2006: *Criticality Safety Programs for Hazard Category 3 Facilities*

6.11 10 CFR 30, *Rules of General Applicability to Domestic Licensing of Byproduct Material*

6.12 49 CFR 173.469, *Tests for Special Form Class 7 (Radioactive) Materials*

6.13 10 CFR 71.75, *Qualification of special form radioactive material*

6.14 ISO 2919, *Radiation protection -- Sealed radioactive sources -- General requirements and classification*

6.15 ANSI N43.6, *Sealed Radioactive Sources*

6.16 Los Alamos National Laboratory report (LA-12981-MS), *Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 List of 757 Radionuclides*

6.17 49 CFR 171.1, *Applicability of Hazardous Materials Regulations (HMR) to persons and functions*

6.18 EPA Technical Report, *Technical Background Document to Support Final Rulemaking Pursuant to Section 102 of the Comprehensive Environmental Response, Compensation, and Liability Act: Radionuclides*, 1989

6.19 ANSI/ANS 8.1 *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*

6.20 ANSI/ANS 8.15, *Nuclear Criticality Control of Special Actinide Elements*

6.21 DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*

6.22 10 CFR 40.13. *Unimportant quantities of source material*

Attachment 1
DOE Standard 1027 Working Group Members

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Attachment 2
Reproduction of Exhibit A-1 of
EPA Technical Background Document

EXHIBIT A-1

Element	Symbol	Release Fraction (R)
Actinium	Ac	0.001
Aluminum	Al	0.01*
Americium	Am	0.001
Antimony	Sb	0.01
Argon	Ar	1.0
Arsenic	As	0.01*
Astatine	At	0.001**
Barium	Ba	0.01
Berkelium Bk-249 & Bk-250	Bk	0.001** 0.01*
Beryllium	Be	0.01*
Bismuth	Bi	0.01
Boron	B	0.01
Bromine	Br	0.01
Cadmium	Cd	0.01
Calcium	Ca	0.01
Californium	Cf	0.001
Carbon	C	0.5
Cerium	Ce	0.01
Cesium	Cs	0.01
Chlorine	Cl	0.01
Chromium	Cr	0.01
Cobalt	Co	0.001

Copper	Cu	0.01
Curium	Cm	0.001
Dysprosium	Dy	0.01*
Einsteinium Es-254m	Es	0.001** 0.01*
Erbium	Er	0.01*
Europium	Eu	0.01
Fermium	Fm	0.001**
Fluorine	F	0.01*
Francium	Fr	0.01*
Gadolinium	Gd	0.01
Gallium	Ga	0.01*
Germanium	Ge	0.01
Gold	Au	0.01
Hafnium	Hf	0.01
Holmium	Ho	0.01
Hydrogen	H	0.5
Indium	In	0.01
Iodine	I	0.05
Iridium	Ir	0.001
Iron	Fe	0.01
Krypton	Kr	1.0
Lanthanum	La	0.01*
Lead	Pb	0.01
Lutetium	Lu	0.01*
Magnesium	Mg	0.01*
Manganese	Mn	0.01
Meitnerium	Mt	0.01

Mendelevium	Md	0.001**
Mercury	Hg	0.01
Molybdenum	Mo	0.01
Neodymium	Nd	0.01*
Neptunium	Np	0.001
Nickel	Ni	0.01
Niobium	Nb	0.01
Osmium	Os	0.01*
Palladium	Pd	0.01*
Phosphorous	P	0.5
Platinum	Pt	0.01*
Plutonium	Pu	0.001
Polonium	Po	0.01
Potassium	K	0.01
Praseodymium	Pr	0.01*
Promethium	Pm	0.01
Protactinium	Pa	0.001
Radium	Ra	0.001
Radon	Rn	1.0
Rhenium	Re	0.01*
Rhodium	Rh	0.01*
Rubidium	Rb	0.01
Ruthenium	Ru	0.01
Samarium	Sm	0.01
Scandium	Sc	0.01
Selenium	Se	0.01
Silicon	Si	0.01*
Silver	Ag	0.01

Sodium	Na	0.01
Strontium	Sr	0.01
Sulfur	S	0.5
Tantalum	Ta	0.001
Technetium	Tc	0.01
Tellurium	Te	0.01
Terbium	Tb	0.01
Thallium	Tl	0.01
Thorium	Th	0.001
Thulium	Tm	0.01
Tin	Sn	0.01
Titanium	Ti	0.01
Tungsten	W	0.01
Uranium	U	0.001
Vanadium	V	0.01
Xenon	Xe	1.0
Ytterbium	Yb	0.01
Yttrium	Y	0.01
Zinc	Zn	0.01
Zirconium	Zr	0.01

* Indicates that the release fraction is based on the NUREG-1140 release fraction for "any other beta-gamma emitter."

** Indicates that the release fraction is based on the NUREG-1140 release fraction for "any other alpha emitter."

Source: McGuire, S.A., "A Regulatory Analysis on Emergency Preparedness for Fuel Cycle and Other Radioactive Material Licensees," NUREG-1140

Enclosure 3
Areas of DOE-STD-1027 which may have been Misinterpreted and Resulted in Inappropriate Facility Categorization

Three specific areas of DOE-STD-1027 (Sealed Sources, Type B Containers, and adjustment of Hazard Category 3 threshold quantities) lack clarity or detail and may have resulted in inappropriate facility categorization decisions.

1. Sealed sources, which did not meet the following criteria, may have been inappropriately excluded from the inventory used to categorize the facility.

   - DOT Special Form criteria per 49CFR173.469
   - NRC Special Form criteria 10CFR71.75
   - ANSI N43.6/ISO 2919 Annex E Special Form criteria
   - ANSI N43.6/ISO 2919 Class 4, Class 5, or Class 6 (or Class X equivalent) performance criteria for temperature, impact, and puncture.

2. Radioactive material in non certified Type B containers may have been excluded from the inventory used to categorize the facility.

3. Hazard Category 3 threshold quantities may have been inappropriately adjusted upwards in the final hazard categorization because the basis for the threshold quantities (and their adjustment) is not clear. This may have resulted in some facilities being inappropriately categorized as less than Hazard Category 3 in the final hazard categorization.