

SUBJECT: NATURAL PHENOMENA HAZARDS MITIGATION

1. PURPOSE. To establish Department of Energy (DOE) policy and requirements for natural phenomena hazard (NPH) mitigation for DOE sites and facilities using a graded approach.
2. BACKGROUND.
 - a. The Department of Energy has been using the requirements of model building codes (e.g., seismic requirements of the Uniform Building Code) and National standards (e.g., ASCE 7 - formerly ANSI A58.1 for wind requirements) to mitigate the effects of natural phenomena hazards. DOE standards, guidance, and practices were developed and promulgated by DOE 6430.1A through the DOE General Design Criteria Manual to provide levels of design for: occupant life safety, reduction in loss of government property, functioning of essential operations and confinement of hazardous material.
 - b. The General Design Criteria implemented the policy of DOE Orders on Environment, Safety, and Health (DOE 5480.1B), Safety Analysis and Review System (DOE 5481.1B), and promulgated the seismic guidance of the National Earthquake Hazards Reduction Program (NEHRP) contained in the Interagency Committee on Seismic Safety in Construction (ICSSC) reports (RP-1 and RP-3). Recent evaluations under the NEHRP studies have found that the standards used by DOE for design and evaluation of buildings to be "substantially equivalent" to the NEHRP provisions required by the Executive Order (E.O.) on Seismic Safety (E.O. 12699 dated 1-5-90) and substantially more conservative for levels of design beyond those judged acceptable for life safety.
3. POLICY.
 - a. It is the policy of the Department of Energy to design, construct, and operate DOE facilities so that workers, the general public, and the environment are protected from the impacts of natural phenomena hazards on DOE facilities. DOE NPH mitigation requirements are consistent with the safety policy and goals of DOE 5480.1B, DOE 5481.1B, the National Earthquake Hazards Reduction Program, and Executive Order 12699, for all its facilities. For nuclear facilities, DOE additionally requires that, the nuclear safety policy of DOE 5480.23 and Secretary of Energy Notice (SEN), SEN-35-91, NUCLEAR SAFETY POLICY, of 9-9-91, be met for NPH mitigation, and that cost effectiveness is considered. The goals of design, evaluation, and construction for NPH mitigation Include:
 - (1) Providing for safe work places;
 - (2) Protecting against property loss or damage;
 - (3) Continued operation of essential facilities; and
 - (4) Protecting public health, property, and the environment against exposure to hazardous materials.
 - b. Presently, General Design Criteria for DOE facilities are included in DOE 6430.1A. This Order (DOE 5480.28) does not supersede DOE 6430.1A. Requirements related to natural phenomena hazards in this Order govern where there are inconsistencies.

4. APPLICATION TO CONTRACTS. The provisions of this Order are to be applied to covered contractors and they will apply to the extent implemented under a contract or other agreement. A covered contractor is a seller of supplies or services involved with the design, operation, or evaluation of a DOE-owned or leased facility and awarded a procurement contract, or a subcontract, containing one or more of the following contract clauses as follows: a. Safety and Health (Government-Owned or Leased Facility) [DEAR 952.223-71 and 970.5204-2]; b. Nuclear Facility Safety [DEAR 970.5204-26]; c. Radiation Protection and Nuclear Criticality [DEAR 952.223-72]; or d. Any other clause whereby DOE elects to enforce health and safety standards.

5. EXCLUSIONS.

- a. This Order does not apply to the parts and portions of DOE-owned or -leased facilities which are licensed by the Nuclear Regulatory Commission.
- b. This Order does not apply to activities of the Naval Nuclear Propulsion Program which are excluded by Executive Order 12344 and Public Law 98-525.
- c. Except as excluded by paragraph 5b, the provisions of this Order apply to all DOE sites and facilities.

6. REFERENCES.

- a. DOE 6430.1A, GENERAL DESIGN CRITERIA (including NPH), of 4-6-89, which contains the criteria for design and construction of DOE facilities.
- b. DOE 5480.1B, ENVIRONMENT, SAFETY AND HEALTH (ES&H) PROGRAM FOR DOE OPERATIONS, of 9-23-86, which contains the requirements and responsibilities for an ES&H program.
- c. DOE 5480.23, NUCLEAR SAFETY ANALYSIS REPORTS, of 4-10-92, which establishes uniform requirements for the preparation and review of safety analyses for nuclear facilities.
- d. DOE 5481.1B, SAFETY ANALYSIS AND REVIEW SYSTEM, of 9-23-86, which establishes uniform requirements for the preparation and review of safety analyses.
- e. Executive Order 12344, paragraph 1634.98, and Public Law 98-525, Stat. 2649, which exempt Naval Nuclear Propulsion applications.
- f. Executive Order 12699, "Seismic Safety of Federal and federally Assisted or Regulated New Building Construction," of 1-5-90.
- g. DOE N 5480.5, IMPOSITION OF PROPOSED NUCLEAR SAFETY REQUIREMENTS, 1-22-92, which describes DOE backfit policy.
- h. DOE 5483.1A, OCCUPATIONAL SAFETY AND HEALTH PROGRAM FOR DOE CONTRACTOR EMPLOYEES AT GOVERNMENT-OWNED CONTRACTOR-OPERATED FACILITIES, of 6-22-83, which establishes requirements and procedures for occupational safety and health standards for Department of Energy (DOE) contractor employees in Government-owned contractor-operated (GOCO) facilities.
- i. DOE 1300.2A, DOE TECHNICAL STANDARDS PROGRAM, of 5-19-92, and associated manuals which provide the procedures for development, coordination, and approval of DOE standards.
- j. DOE Standard (DOE-STD), DOE-STD-1024-92, of 10-92, "Guidelines for Use of Probabilistic Seismic Hazard curves at DOE Sites," (interim).

- k. DOE-STD-101-92, "Compilation of Nuclear Safety Criteria for potential application to DOE Non-Reactor Nuclear Facilities," of 3-92.
- l. Title 10 Code of Federal Regulations (CFR) 600.12, "Financial Assistance Rules," of 1-2-92.
- m. Uniform Building Code, International Conference of Building Officials, Whittier, California, 1991.
- n. Building Officials and Code Administrators International (BOCA), "National Building Code," 1992 Supplement.
- o. Southern Building Code Congress International (SBCCI), "Standard Building Code," of 1992, amendment.
- p. American Society of Civil Engineers (ASCE), ASCE-7, "Minimum Design Loads for Buildings and Other Structures," of 1988.
- q. ICSSC RP-1, "Seismic Design Guidelines for Federal Buildings," of 1987.
- r. ICSSC RP-3, "Guidelines for Identification and Mitigation of Seismically Hazardous Existing Federal Buildings," of 1989.
- s. Federal Emergency Management Administration (FEMA) FEMA-93, "Federal Guidelines for Dam Safety," of 6-79.
- t. "Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards," Lawrence Livermore National Laboratory Report, UCRL-15910, of 6-90, which provides criteria for earthquake, wind, and flood design protection.

7. DEFINITIONS.

- a. Additions and Modifications are changes to a structure, system, and component (SSC) for reasons other than increasing resistance to natural phenomena hazards.
- b. Dams are as defined in FEMA 93/June 1979, "Federal Guidelines for Dam Safety."
- c. Deterministic Method is the technique in which a single estimate of parameters is used to perform each analysis. To account for uncertainty, several analyses may be conducted with different parameters.
- d. Electrical Transmission and Distribution Systems include transmission lines, substation SSCs, and control and communication SSCs.
- e. Facility is one or more building(s) or structure(s), including systems and components, dedicated to a common function (includes operating and non-operating facilities and facilities slated for decontamination and decommissioning).
- f. Function is the capability of structures, systems, and components to perform their intended mission. Maintaining function after NPH occurrence is required by this Order for SSCs important to safety, and to minimize property losses based on cost benefit considerations. Maintaining function such that programmatic objectives are achieved is not required by this Order but is commonly a goal for NPH design and evaluation.

- g. Graded Approach is one in which SSCs are placed into performance categories such that the required level of analysis, documentation, and actions are commensurate with:
 - (1) The relative importance to safety, safeguards, the environment, and security;
 - (2) The expected magnitude of any hazard involved;
 - (3) The programmatic mission of a facility;
 - (4) The particular characteristic of the SSCs; and
 - (5) The cost and replaceability of the SSCs.
- h. Model Building Codes contain design and construction requirements that apply to normal commercial buildings (e.g., 1991 ICBO Uniform Building Code [UBC], the 1992 Supplement to the BOCA National Building Code, and the 1992 Amendments to the SBCCI Standard Building Code).
- i. Natural Phenomena Hazard (NPH) is an act of nature (for example: earthquake, wind, hurricane, tornado, flood, precipitation (rain or snow), volcanic eruption, lightning strike, or extreme cold or heat) which poses a threat or danger to workers, the public, or to the environment by potential damage to structures, systems, and components (SSCs).
- j. NPH Mitigation is an action taken to reduce the impacts of Natural Phenomena Hazards (NPH). This includes natural phenomena hazard resistant design, evaluation, construction requirements, and operational procedures.
- k. Nuclear Safety is the area of safety that encompasses activities and systems that present the potential for uncontrolled releases of fission products or other radioactive materials to the environment or for nuclear criticality.
- l. Performance Category (PC) is a classification using a graded approach in which structures, systems, or components in a category are designed to assure similar levels of protection (i.e., meet the same performance goal) during natural phenomena hazard events (see paragraph 12, Table 1).
- m. Performance Goal is the mean annual probability of exceedance of acceptable behavior limits used as a target to develop natural phenomena hazard mitigation requirements (see paragraph 12, Table 1).
- n. Probabilistic Method is a technique which uses distributions of parameters (including uncertainty and randomness) to perform an analysis. Results are expressed in terms of probabilistic distributions which quantify uncertainty.
- o. Risk is the frequency of possible adverse consequences (loss). In the context of natural phenomena hazard (NPH) evaluation, this is the quantitative or qualitative expression of possible loss that considers the probability that a NPH occurs, the probability that the NPH occurrence will result in consequences, and the nature of the consequences.
- p. Safety Analysis Report (SAR) is a report which documents the adequacy of safety analysis to ensure that a facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and standards.

- q. Site is the area with one or more DOE facilities or activities that can be represented by the same natural phenomena hazard potential with local conditions that can be represented by the same parameters.
- r. Structures, Systems, and Components (SSCs).
 - (1) Structure is an element, or a collection of elements to provide support or enclosure such as a building, free standing tank, basins, dikes, or stacks.
 - (2) System is a collection of components assembled to perform a function such as piping, cable trays, conduits, or HVAC.
 - (3) Component is an item of equipment such as a pump, valve, or relay, or an element of a larger array such as a length of pipe, elbow, or reducer.
- s. Upgrade is a design and construction measure taken to increase the resistance of structures, systems, and components for the effects of natural phenomena hazards. Upgrade, strengthening, and retrofit are equivalent terms.

8. RESPONSIBILITIES AND AUTHORITIES.

- a. The Secretary of Energy (S-1). Many provisions in this Order permit and/or necessitate the exercise of discretion and/or judgment in carrying out the requirements of the Order. In those instances, the determination of whether, in the exercise of such discretion and/or judgment, the requirements of this Order were complied with rests initially with the relevant Department authority and ultimately, with the Secretary. The Secretary retains the sole and final authority to determine what acts are necessary to comply with this Order. Further, the Secretary retains the authority to suspend any and all requirements under this Order whenever the Secretary deems it necessary. This authority may be delegated by the Secretary as appropriate.
- b. Assistant Secretary for Nuclear Energy (NE-1) has overall responsibility for establishing nuclear facility safety policy and implementing guidance. The Assistant Secretary shall:
 - (1) Develop, promulgate, and maintain the policy, requirements, guidance, and technical standards, and provide advice and assistance, as requested, concerning implementation of nuclear safety policy as it relates to natural phenomena hazards at nuclear facilities; and
 - (2) Exercise concurrence authority on requests for permanent exemptions from nuclear safety requirements in this Order related to natural phenomena hazards and NPH evaluations at DOE facilities.
 - (3) Develop and update the Manual of Responsibilities as required.
- c. Assistant Secretary for Environment, Safety and Health (EH-1) acts as the Department's independent element responsible for safety oversight of functional areas encompassing natural phenomena hazards; environmental protection; occupational safety and health; radiological protection directives and standards; and all activities, systems, or processes that present the potential for uncontrolled releases of non-radioactive hazardous material to the environment. As part of this oversight responsibility in these EH

functional areas, EH-1 shall:

- (1) Monitor and review the implementation of all aspects of this Order, including field organization and contractor performance;
 - (2) Review or designate responsibility for the review of documentation such as Technical Safety Appraisals, Safety Analyses, Hazard Evaluations, Safety Analysis Reports, implementation schedules and program office and site office reports and observe on-site activities;
 - (3) Identify circumstances that are indicative of deteriorating or poor performance that may warrant further action;
 - (4) Exercise concurrence authority on requests for permanent exemptions from the requirements of this Order.
- d. Director of Nuclear Safety (NS-1). The Office of Nuclear Safety (NS) reports directly to the Secretary and advises the Secretary on whether line management is adequately achieving nuclear safety. NS has broad responsibilities to monitor and provide oversight of the nuclear safety programs and performance of DOE line and contractor organizations. NS may execute these responsibilities through review of documentation such as Safety Analysis Reports and program office and site reports, as well as through direct observation and assessment of on-site activities. NS is responsible for identifying to the Secretary any circumstances indicative of deteriorating or poor performance that may warrant further in-depth appraisals to identify and fix fundamental problems. NS reviews and exercises concurrence authority on nuclear reactor and non-reactor nuclear facility safety policies and requests for permanent exemptions thereto. It is also responsible for the enforcement policy and programs associated with the civil and criminal authorities of the Price-Anderson Amendments Act. In execution of these broad responsibilities, NS is expected to provide a bridge with DOE operations and commercial industry practices.
- e. Program Secretarial Officers (PSOs) or their designees in the line organization for matters affecting facilities under their programmatic responsibility shall:
- (1) Require that contractors/operators design and evaluate structures, systems, and components, and conduct NPH site characterization and assessment in accordance with the provisions of this Order. For nuclear facilities, the NPH evaluation for a facility does not have to be a stand alone document but may be included in the Safety Analysis Report for the facility, prepared in accordance with DOE 5480.23.
 - (2) Verify that the safety analysis establishes an adequate NPH safety basis and evaluates the adequacy of the NPH mitigation features of the facility in accordance with the provisions of this Order.
 - (3) Approve deviations and temporary (up to one year) exemptions from the requirements of this Order to contractors/operators for all new facilities and those existing facilities evaluated and/or upgraded as determined by the PSO. Notify appropriate Headquarters-level offices of all temporary exemptions granted.
 - (4) Recommend permanent exemptions from requirements of this Order to the Secretary after concurrence by the Assistant Secretary, Nuclear Energy; the Assistant Secretary,

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Environment, Safety, and Health; and the Director of Nuclear
Safety, as appropriate according to their responsibilities
for all new facilities and those existing facilities
evaluated and/or upgraded as determined by the PSO.

- (5) Issue the permanent exemptions approved by the Secretary.
 - (6) Provide guidance and assistance to field organizations in the performance of NPH reviews, prioritization, appraisals, etc., to assure contractor compliance with the provisions of this Order.
 - (7) Conduct appraisals of field and/or contractor organizations to assure contractor compliance with this Order.
 - (8) Transmit the results of the actions taken above to the responsible program managers and field organizations with any necessary or appropriate instructions as to subsequent action to be taken, with copies to the Office of Nuclear Safety and the Assistant Secretary for Environment, Safety, and Health, depending on the nature of the issue being addressed.
 - (9) Review and approve implementation plans for the NPH evaluation and upgrade of existing facilities.
- f. DOE Field Office Managers and Field Program Managers shall:
- (1) Review and make recommendations to the PSO relative to the approval of all NPH evaluations.
 - (2) Oversee contractor/operator planning, preparation, and review of safety analyses and evaluations of NPH mitigation features as directed by the PSO.
 - (3) Conduct appraisals to assure contractor compliance with this Order.
 - (4) Keep appropriate Headquarters program organizations, the Director of Nuclear Safety (NS-1), the Assistant Secretary for Environment, Safety, and Health (EH-1), and the field and area offices advised of NPH issues, deficiencies, needs, and actions taken under this Order.
- g. Heads of Departmental Elements (the senior ranking DOE official at a DOE office location) shall include in a procurement request package, for each procurement requiring the application of this Order, the following: (1) Identification of the Order; (2) Identification of the specific requirements with which a contractor or other awardee is to comply, or, if this is not practicable, identification of the specific paragraphs or other portions of this Order with which a contractor or other awardee is to comply; and (3) Requirements for the flowdown of provisions of this Order to any subcontract or subaward. For application to awarded management and operating contracts, Heads of Department Elements may set forth this information in a written communication to the contracting officer rather than in a procurement request package. See 10 CFR 600.12 where DOE provides financial assistance.
- h. Director, Naval Nuclear Propulsion Program. Presidential Executive Order 12344, statutorily prescribed by Pub. L. 98-525, 42 U.S.C. Subsection 7158 note (1984), establishes the responsibilities and authorities of the Director, Naval Nuclear Propulsion Program (who is also the Deputy Assistant Secretary for Naval Reactors within the Department) over all facilities and

activities which comprise the Program, a joint Navy-DOE organization. These executive and legislative actions establish that the Director is responsible for all matters pertaining to naval nuclear propulsion for all Program facilities and activities. Accordingly, the provisions of this Order do not apply to the Naval Nuclear Propulsion Program.

9. EXEMPTIONS/DEVIATIONS. Nothing in this Order shall preempt the specific requirements contained in other DOE directives relative to their processes and procedures for requesting exemptions and deviations. Exemptions and deviations must be documented in writing and must include an adequate basis justifying the action.
 - a. Exemptions. Review and concurrence by Headquarters-level offices as specified in paragraph 9 are required for exemptions from the requirements of this Order. PSOs may grant temporary exemptions from this Order with notification of appropriate Headquarters-level offices. Temporary exemptions may be granted for durations up to one year, while permanent exemptions apply for the life of a facility. The exemption process is invoked when any of the following apply:
 - (1) Exceptions proposed for structures, systems, and components important to safety; when such exception will or may constitute an adverse impact on environmental protection, safety or health or other DOE design policies or objectives.
 - (2) Exceptions from requirements in Federal laws or regulations or Executive Orders; such exceptions cannot be approved unless such laws, regulations, or Executive Orders provide for deviations or waivers.
 - b. Deviations. Deviations may be granted by the PSO responsible for facility design and/or evaluation when any of the following apply:
 - (1) It has been demonstrated that the deviation is equivalent to, or more conservative than, the requirements such that the risk to the health and safety of the public and workers is not affected by the deviation.
 - (2) A specific portion of the NPH requirements are determined to be inadequate or inappropriate for the facility under consideration.
 - (3) Deviations are necessary or advantageous in the design/evaluation professional's judgment.
 - (4) A NPH requirement affecting environmental protection or health and safety is less stringent than local or State codes or regulations.
 - (5) Deviations will not affect DOE policy and objectives and are determined to be necessary in the acquisition of buildings by lease or purchase (see E.O. 12699).
 - (6) Deviations will not affect DOE policy and objectives, are necessary, and are allowable under existing exemption provisions of another DOE directive.
10. REQUIREMENTS. The requirements provided in this Order shall be used in conjunction with the General Design Criteria in DOE 6430.1A and other Departmental Design Criteria as applicable.
 - a. Design and Evaluation.
 - (1) General Structures, systems, and components (SSCs) shall be

- (1) General. Structures, systems, and components (SSCs) shall be designed and constructed to withstand the effects of natural phenomena hazards. An objective for all SSCs is to prevent loss of structural integrity endangering life safety. An additional objective for selected SSCs or site activities is to prevent loss of capability to perform functions consistent with: (1) importance to safety for workers and the public; (2) impact on the environment; (3) repair/replacement costs; or (4) programmatic mission. NPH design and evaluation criteria for SSCs for earthquake, wind, and flood shall be used for DOE laboratories reservations, and production facilities. UCRL-15910 shall be used until a DOE standard is issued. It is the intent of this Order to conform to and/or use national consensus codes and standards wherever practicable. Thus, where appropriate DOE criteria and standards are not available (e.g., for electrical transmission and distribution systems or dams) or for other DOE facilities, applicable National, Federal, or industry consensus codes, standards, manuals of practice, or model building codes shall be deemed acceptable to meet the intent of this Order.
- (2) Design of New Facilities. SSCs shall be designed to be in compliance with paragraph 10a(1).
- (3) Design of Additions and Modifications. Additions and modifications shall not degrade the safety or function of the existing SSCs to the extent that performance goals cannot be achieved. Additions and modifications to existing SSCs shall be designed and constructed to comply with paragraph 10a(1).
- (4) Evaluation and Upgrade of Existing DOE Facilities.
 - (a) SSCs shall be reevaluated in accordance with the requirements of paragraph 10a(1) under the following circumstances:
 - 1 The SSC was designed and constructed without adequate NPH design and construction standards.
 - 2 The function of the SSC has changed to a performance category with more stringent NPH requirements such as when the SSC is identified as important to safety through upgrades to the facility SAR.
 - 3 There has been a significant change in understanding that results in an increase in the site NPH hazard.
 - 4 When a SSC has been subjected to an unresolved safety question and requires evaluation.
 - 5 A significant physical change in the SSC has been caused by an addition, a modification, deterioration, or a damaging NPH event.
 - (b) The contractor/operator shall establish an implementation plan for evaluating and upgrading existing SSCs. The plan should identify current and future NPH mitigation actions for existing SSCs by facility. The plan should incorporate a prioritized schedule for evaluation of existing SSCs because it is recognized that there are time and funding constraints and programmatic mission considerations.

- (c) The implementation plan for evaluation and upgrade of SSCs shall be consistent with ICSSC RP-3 and meet the provisions thereof, as a minimum. As indicated in E.O. 12699, it is the intent of the Federal Government to ensure that new Federal buildings provide life safety and prevent property loss in the event of a seismic event. A similar effort is underway for lifelines. By extension of E.O. 12699, DOE includes other NPHs in this goal. In the National Earthquake Hazards Reduction Program (NEHRP) Reauthorization Act (Public Law 101-614), the President must adopt, not later than December 1, 1994, standards for assessing and enhancing the seismic safety of existing buildings constructed for or leased by the Federal Government that were designed and constructed without adequate seismic design and construction standards. The intent of the implementing committee, the Interagency Committee on Seismic Safety in Construction (ICSSC), is illustrated in ICSSC RP-3. The detailed requirements for evaluation and upgrade of SSCs for life safety considerations will be consistent with the final consensus standards from this committee.
 - (d) Retrofit of existing DOE facilities for NPH effects shall be conducted in accordance with DOE backfit policy, DOE N 5480.5.
- (5) Interaction. Potential damage and failure of SSCs due to both direct NPH effects and NPH response of adjacent SSCs (interaction) shall be considered. Examples of interaction include: (1) failure of a SSC belonging to a less stringent performance category which falls on an SSC important to safety or mission; (2) impact damage due to displacements of adjacent SSCs; (3) displacements of adjacent SSCs resulting in failure of connecting pipes or cables; (4) SSCs whose failure could hinder necessary operator actions following NPH events such as lighting and communication systems, and access hallways and doors; (5) flooding and exposure to fluids from vessels or piping systems ruptured during a NPH event; (6) offsite NPH effects on the facility such as loss of offsite power and failure of upstream dams and reservoirs; and (7) effects of NPH-induced fires.
- (6) Common Cause Effects. The occurrence of a NPH event, especially earthquake, affects many or all SSCs in a facility. Hence, it is possible to have multiple NPH-induced failures of SSCs. These common cause effects must be considered in design or evaluation. For example, multiple failures in a tank farm can result in loss of contents greater than that held in any single tank. The effects of this large quantity of tank contents on SSCs must be considered.

b. Graded Approach.

- (1) Paragraph 10a(1) shall be satisfied using a graded approach. The graded approach is implemented by the 5 performance categories (paragraph 12, Table 1) established for SSCs on the basis of their safety, mission, and cost significance as per applicable DOE standards.
- (2) Each performance category has been assigned a performance goal with a mean annual probability of exceedance of acceptable behavior limits (paragraph 12, Table 1). The performance goal is a measure of the level of NPH protection and is used as a target for the establishment of NPH mitigation requirements.

mitigation requirements.

- (3) For each performance category, NPH design, evaluation, and construction requirements of varying conservatism and rigor corresponding to the target performance goal have been established.

c. Assessment of Natural Phenomena Hazards. Natural phenomena hazard design and evaluation requirements given in this Order require a probabilistic assessment of the likelihood of future NPH occurrence. The level of probabilistic natural phenomena hazard assessment to be conducted will be appropriate for the performance categories being considered in a manner consistent with the graded approach. For sites containing facilities with SSCs in Performance Categories 3 and 4, a site-specific probabilistic natural phenomena hazard assessment shall be conducted in accordance with the applicable DOE standard. For sites containing facilities with SSCs in only Performance Categories 1 and 2 and which have no site-specific probabilistic NPH assessment, it is sufficient to utilize natural phenomena hazard maps from model building codes or national consensus standards. For sites which have site-specific probabilistic NPH assessments, the SSCs in Categories 1 and 2 shall be evaluated or designed for the greater of the site specific values or the model code values unless site specific values are lower and can be justified.

(1) New Sites.

- (a) Assessment. For a new site, containing SSCs in Performance Categories 3 and 4 which have performance goals more stringent than that provided by model building code provisions, a site-specific probabilistic natural phenomena hazard assessment shall be conducted in accordance with the applicable DOE standard. This NPH assessment shall include adequate site-specific information.
- (b) Siting. Site planning must consider all consequences of natural phenomena hazards. For example, seismicity, geological hazards, and soil failure hazards must all be considered. Siting of structures over active geologic faults, in areas of instability subject to landslides, or where soil liquefaction is likely to occur should be avoided. In addition, structures shall not be sited within flood plains where flood water depth and other flood effects at an annual probability of exceedance equal to or greater than the performance goal can adversely affect structure performance unless structure protection is provided (e.g., levees, or dikes). Special attention shall be given to sites potentially subject to flooding from upstream dams or reservoirs including earthquake caused failures.

- (2) Existing Sites. For an existing site, if there are significant changes in natural phenomena hazard assessment state-of-the-art or site-specific information, the probabilistic natural phenomena hazard assessments shall be updated. If SSCs of Performance Categories 3 and 4 are constructed or installed at an existing site which previously only had Performance Category 1 and 2 SSCs and/or which did not have a site-specific probabilistic NPH assessment, a probabilistic site-specific natural phenomena hazard assessment shall be performed. A review of the state-of-the-art of natural phenomena hazard assessment methodology and of site-specific information shall be conducted at least every 10 years. A recommendation shall be

made to the PSOs on the need for updating the existing NPH assessments based on identification of a significant change.

- (3) Natural phenomena effects. Natural phenomena hazard assessments and NPH design of new facilities and evaluation of existing facilities shall consider all potentially damaging natural phenomena and their effects. For example, all effects of earthquakes including earthquake ground shaking and earthquake-induced fault offset, liquefaction, slope instability, lateral spreading, and subsidence; all effects of tornadoes including wind pressure, tornado-generated missiles, and atmospheric pressure change; or all effects of flooding including water depth, local precipitation, dynamic impact of water, erosion, and impact of floating debris shall be considered. Simultaneous occurrence of most NPH events need not be assumed. However, where events have a cause and effect relationship, their combination must be considered as per paragraph 10a(1).

d. Other Requirements.

- (1) NPH Detection. Facilities or sites which have SSCs in PC 2 (with hazardous material), PC 3 or PC 4 shall have instrumentation or other means to detect and record the occurrence and severity of seismic events.
- (2) Post-NPH Procedures. Facilities or sites which have SSCs in PC 3 or PC 4 shall have procedures to inspect the Facility for damage following an NPH event, to place the facility into a safe configuration when damage occurs, and to document and report such damage.

11. IMPLEMENTATION.

a. Steps Necessary to Implement NPH Mitigation Requirements (given in paragraph 10):

- (1) Perform site-specific studies of site characteristics or evaluate existing data for site characteristics related to NPH and augment with site-specific studies where needed in accordance with the latest applicable DOE standard.
- (2) Establish performance categories for SSCs using a graded approach. Performance categorization of SSCs shall be performed in accordance with the latest applicable DOE standard. Performance categories and associated performance goals are discussed in paragraph 12.
- (3) Perform natural phenomena hazard assessment of the site in accordance with the applicable DOE standard. Guidelines for use of existing probabilistic seismic hazard curves are contained in DOE-STD-1024-92.
- (4) Design and construct or evaluate SSCs. Specified annual probabilities of exceedance for natural phenomena hazards to establish loadings, deterministic design methods for response evaluation, permissible response levels, load combination rules, design detailing requirements, and quality assurance and independent peer review requirements are provided in the latest applicable DOE standards. These standards provide sufficient documentation to: 1) communicate the process, rationale, and results of the NPH evaluation; 2) present information that can be evaluated during peer reviews; and 3) provide traceability and a basis for future assessments. Provisions for seismic design and evaluation of high-level waste storage tanks and related SSCs may be obtained from

waste storage tanks and related SSCs may be obtained from EM-30.

- (5) Establish a prioritized schedule for evaluation and upgrade of existing facilities. A prioritization program will direct initial efforts to facilities which are of greatest importance in terms of safety, mission, and cost in accordance with DOE N 5480.5. A screening program will enable relatively rapid initial evaluations to be conducted such that areas of greatest vulnerability to NPH effects can be identified and addressed. Areas where SSCs might not be vulnerable to NPH effects due to inherent ruggedness or benign site conditions can be identified and eliminated from further consideration.
- b. The intent of this Order is to rely on Federal, National, and industry consensus codes and standards which are adapted, where needed, for DOE use. For example, DOE is currently developing a Natural Phenomena Hazards Design and Evaluation Criteria Standard which adapts provisions from consensus national standards, model building codes, and industry accepted codes and specifications.
- c. The Attachment to this Order provides the list of applicable standards under preparation.
- d. Schedule for implementation of this Order.
 - (1) New Sites. The Order becomes immediately in force at the effective date of the latest applicable standard.
 - (2) Existing Sites. The Order becomes immediately in force at the effective date of the latest applicable standard. Required actions depend on the status of site characterization and NPH assessment for the site and application of the backfit policy.
 - (3) New SSCs. The Order becomes immediately in force at the effective date of the latest applicable standard.
 - (4) Existing SSCs. The Order becomes immediately in force at the effective date of the last applicable standard. The implementation plan for evaluation and upgrade of existing SSCs (see paragraph 11a(5)) shall be completed and submitted to the PSO within 1 year of the effective date of the last applicable standard.

12. PERFORMANCE GOALS AND PERFORMANCE CATEGORIES.

- a. Structures, systems, and components comprising DOE facilities are assigned to one of five performance categories (PCs) in accordance with performance categorization criteria given in the applicable DOE standard. Each performance category has an assigned performance goal as shown in Table 1. Goals and corresponding performance categories should be selected by engineers with knowledge of systems, safety requirements, and facility operations in a manner that DOE safety policies are met. Economic or programmatic considerations may require use of more stringent goals for specific SSCs (i.e., placed in a higher performance category).

Table 1 - Performance Goals for SSCs

Performance Category	0	1	2	3	4
Performance Goal					

(mean annual probability of	N/A	1×10^{-3}	5×10^{-4}	1×10^{-4}	1×10^{-5}
exceedance of acceptable					
behavior limits					
=====	=====	=====	=====	=====	=====

b. The performance goal annual probabilities of unacceptable damage given in Table 1 have been prescribed to be substantially equivalent with (1) the goals of model building code provisions for SSCs in PC 1 and PC 2 and, (2) the goals intended by nuclear power plant seismic criteria for SSCs in PC 4. The relative probabilities and consequences of potential damage or failure of SSCs making up DOE facilities are accounted for by providing several sets of NPH design/evaluation provisions with increasing conservatism (i.e., producing decrease in probability of damage or failure). This graded approach provides a different level of NPH provisions for each performance category, as described below:

- (1) PC 0 has provisions in which no consideration of natural phenomena is necessary, i.e., where natural phenomena hazards are not an issue;
- (2) PC 1 and 2 have NPH provisions consistent with model building codes, where assurance of life safety for on-site personnel or continuity of essential operations is an issue of importance. For PC 1 SSCs, the primary concern is preventing major structural damage or collapse that would endanger personnel. A performance goal annual probability of exceedance of about 10^{-3} of the onset of significant SSC damage is applicable to this category. Repair or replacement of the SSC or the ability of the SSC to continue to function after the occurrence of the hazard is not considered. PC 2 SSCs are of greater importance due to mission-dependent considerations or may pose a greater danger to on-site personnel than PC 1 SSCs because of operations or hazardous materials within the SSC. The performance goal is to maintain capacity to perform essential functions after the occurrence of an NPH event and to provide occupant safety. PC 2 SSCs should be allowed relatively minor structural damage in the event of natural phenomena hazards. This is damage that results in minimal interruption to facility operations and that can be easily and readily repaired following the event. The PC 2 performance goal is consistent with the design criteria for essential facilities (e.g., hospitals, fire and police stations, centers for emergency operations) in accordance with model building codes.
- (3) PC 3 and 4 SSCs pose a potential hazard to worker and public health and safety and to the environment because radioactive or toxic materials are present in significant quantities. Design considerations for these categories are to limit facility damage so that hazardous materials can be controlled and confined, occupants are protected, and functioning of the facility is not interrupted. PC 3 NPH provisions are consistent with those used for reevaluation of commercial plutonium facilities with conservatism in between that of model building code requirements and civilian nuclear power plant requirements. For PC 3 SSCs, an applicable performance goal is an annual probability of exceedance of about 10^{-4} of damage beyond which hazardous material confinement is impaired. PC 4 seismic provisions are consistent with that used for reevaluation or design of civilian nuclear power plants, where off-site release of hazardous material must be prevented. For PC 4 SSCs, a reasonable performance goal is an annual probability of exceedance of about 10^{-5} of damage beyond which hazardous material confinement is impaired.

This performance goal is consistent with, at least for earthquake considerations, the performance goal for seismic-induced core damage associated with design of commercial nuclear power plants. Annual frequencies of seismic core damage from published probabilistic risk assessments (PRA) of recent commercial nuclear plants indicate that mean seismic core damage frequencies ranged from 4×10^{-6} /year to 1×10^{-4} /year based on consideration of 12 plants. For 10 of the 12 plants, the annual seismic core damage frequency was greater than 1×10^{-5} . Hence, the PC 4 performance goal assigned in this Order is consistent with this information. SSCs can also be placed in PC 3 or PC 4 to achieve improved performance required by mission objectives or cost considerations. The Attachment to this Order provides the list of applicable standards under preparation.

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DRAFT STANDARDS

Several Draft Standards are currently being prepared, which cover topics that have previously not been addressed by any DOE Standards. Normally draft standards are not adopted by DOE directives because, they can be modified up until they become final. However, since the topics of the following draft Standards are not covered by suitable alternate standards, this Order will invoke the draft standards as mandatory when they become final. These draft standards are:

- (1) DOE-STD-1020-92, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," (draft) which is a revised version of UCRL-15910.
- (2) DOE-STD-1021-92, "Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems, and Components," (draft).
- (3) DOE-STD-1022-92, "Natural Phenomena Hazards Site Characterization Criteria," (draft).
- (4) DOE-STD-1023-92, "Natural Phenomena Hazards Assessment Criteria," (draft).

The initial implementation requirements of this order are not scheduled to be completed before the draft standards become final. If due to unforeseen events, the finalization of the draft standards are delayed, then the final implementation schedule of this Order may be set back by the PSO. During the interim period, between the time this Order is issued and the draft standards become final, these draft standards should be viewed as guidance for the final implementation of the Order.