The Under Secretary of Energy
Washington, DC 20585

September 2, 1994

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
Suite 700
625 Indiana Avenue, N.W.
Washington, D.C. 20004

Dear Mr. Chairman:

Thank you for your comments on the Department's Order and standards related to natural phenomena hazards. We appreciate the Board's willingness to continue the dialogue with Department staff in addressing this dynamic, difficult, and sometimes contentious subject.

Although the Department has been working on enhancing the natural phenomena hazards safety of its facilities for many years, it is only over the past several years that the Department has begun to impose a discipline on the system to formalize its policy and requirements through a new policy and standards process. This process has identified major policies and assumptions that had not been properly implemented and reviewed by the Department. We believe we have made significant progress in formalizing our natural phenomena hazards program, indicated in part, by the visible linkage of the content and intellectual underpinning of the Orders and standards. The visibility enhances review of the program providing the Department access to diverse views on natural phenomena hazards that will strengthen the overall program and associated standards. While the initial issuance of the natural phenomena hazards standards is underway, we recognize that additional efforts are needed to enhance the overall natural phenomena hazards program including a tighter linkage to the safety bases of Department facilities.

The Department is committed to the utilization of national and international standards in the design, construction, operation, and decommissioning of its facilities and activities. When existing standards do not satisfy our requirements, we will work with national standards developing bodies to address these requirements and, if time does not permit, develop the necessary standards within the guidelines of the Department's Technical Standards Program. For example, in March 1994, the Department requested the American Society of Civil Engineers, Committee on Dynamic Analysis of Nuclear Structures to review one of its natural phenomena hazards standards

(DOE-STD-1020-94). The Society review will provide a check on the degree of consensus outside of the Department of Energy on the standard's methodology and also to determine whether a new national standard is needed. We believe that coordinating departmental standards with nationally recognized independent bodies will help ensure high quality natural phenomena hazards standards. We expect the American Society of Civil Engineers Committee review will be completed by the end of this year, but as you know, timely actions by the consensus organizations cannot be taken for granted.

In the interim, the Department has been developing natural phenomena hazards standards to cover the broad range of departmental facilities. Development of these draft standards has included consideration of the Uniform Building Code experience and the Nuclear Regulatory Commission's regulations and guidance. In addition, the Department's team developing the standards has been following the activities of the Nuclear Regulatory Commission, the U.S. Geological Survey, the National Institute of Standards and Technology, the Electric Power Research Institute, the Federal Emergency Management Agency, and the National Earthquake Hazard Reduction Program to incorporate the latest thinking into these standards. We are committed to continuously improving our Orders and standards. This commitment means that we will make major changes to our standards when such changes are necessary. In this regard, our response to the Board's concerns is intended to go beyond the specific concerns identified. We have initiated a review of the natural phenomena hazards Order and its associated standards to ensure an integrated resolution of the Board's comments, as well as ensuring a complete, coherent, and fully integrated set of natural phenomena hazards Orders and standards that are consistent with other Department Orders and standards, e.g., the safety analysis report upgrade, the standards associated with the safety analysis report Order, and national standards.

A three-phased program has been developed in response to the comments in the letter and in its Attachment A.

Phase 1: <u>Issuance of Interim Technical Standards</u>
Issue interim natural phenomena hazards standards that have been developed by a team of representatives from affected organizations and coordinated in accord with the Department's Technical Standards Program. A number of the Board's concerns will be addressed in these interim standards, e.g., enhanced emphasis on using deterministic analysis.

Phase 2: <u>Natural Phenomena Hazards Systems Engineering Program Review</u>
Conduct a systematic integrated review of the natural phenomena hazards program life cycle requirements and standards and revise as appropriate. Review will be supported by a team with a mix of seismic, risk, and safety experts from Brookhaven National Laboratory, Lawrence Livermore National Laboratory, Science Applications International Corporation, Stone and Webster Engineering Corporation, TENERA, and Future Resources Associates (for linkage to the National Academy of Sciences), and appropriate management and operating personnel.

Phase 3: <u>Conversion and Application of National Consensus Standards</u>
A continuous process to convert Department of Energy developed natural phenomena hazards standards into national consensus standards and incorporation into the natural phenomena hazards program of appropriate new national standards.

A schedule for implementation of the three phases is enclosed. The notes in the enclosure provide added details of the plan to the Board's specific comments as well as the general comments. As noted in the enclosure, the first two phases will be completed within a year. During this time, the Department will keep the Board fully informed regarding implementation of this activity so that it can review and evaluate the content and implementation of these standards in accord with its responsibility. Dr. Neal Goldenberg, Director of the Office of Nuclear Safety Policy and Standards, will be responsible for ensuring that information is exchanged with the Board and that the Board's concerns are addressed.

We appreciate your independent perspective on the natural phenomena hazards program. Future or continuing activity relative to this standard should be coordinated with the Department through the Office of the Department Representative to the Defense Nuclear Facilities Safety Board. Integration of the Board's ideas and comments with the review will result in a world-class natural phenomena hazards program for the Department.

Sincerely,

Charles B. Curtis

Enclosure

Enclosure

PLAN TO STRENGTHEN DOE NATURAL PHENOMENA HAZARDS STANDARDS

Action Item	7/94	1/95	7/95
Phase 1. Issuance of Interim Technical Standards.			
• DOE-STD-1020-94 Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities. - Revised to simplify standard to achieve more uniform implementation and compliance. (see note 1) - Revised to address both new and existing facilities. (see note 2)	7/94		
• DOE-STD-1021-93 Natural Phenomena Hazards Performance Characterization Guidelines for Structures, Systems and Components - Revise to improve integration with DOE 5480.23 and related safety Orders and standards. (see note 3) - Revise to reflect graded approach to mechanical and electrical systems (in conjunction with DOE-STD-1020-94). (see note 4)		12/94 (Revision)	
• DOE-STD-1022-94 Natural Phenomena Hazards Site-Characterization Criteria.	7/94		
• DOE-STD-1023 (draft) Natural Phenomena Hazards Assessment Criteria - Revise to integrate deterministic and probabilistic criteria. (see note 5)		11/94	
• DOE-STD-1024-92, Guidelines for Use of Probabilistic Seismic Hazard Curves at DOE Sites.			
Phase 2. NPH Systems Engineering Program Review			
• Completion of integrated review of NPH program requirements and standards. (see note 6)		12/94	
• Input from consensus committee . Review of DOE-STD-1020-94 by American Society of Civil Engineers Committee on Dynamic Analysis of Nuclear Structures. (see note 7)		12/94	
• Issuance of improved NPH program - DOE Order, as appropriate - Revision of Technical Standards, as appropriate			7/95
Phase 3. Conversion & Application of National Consensus Standards.			
• Conversion of DOE standards into consensus standards			Continuing
• Adoption of new national consensus standards			
Periodic Review with DNFSB		To be determined	

Enclosure Notes:

1) Recent revisions are responsive to the Board's comment, but will be reviewed for completeness in Phase 2. The revisions include: DOE-STD-1020-94 has been revised to both simplify the standard and to clarify its features; NPH training courses have been developed to make Order implementation and compliance more uniform; and provisions have been made to obtain feedback from the field to address any future needed improvements in this regard.

2) DOE-STD-1020-94 is intended to apply to both new and existing facilities. For example, top level criteria and guidance are provided in 1020 for application to existing facilities, but these are applied on a case-by-case basis (e.g., a reduction in loads is permitted for existing facilities). Nevertheless, steps have been taken to strengthen the basis for its consistent application to all facilities. DOE has initiated training on how to apply the standard, along with development of experience-based data for evaluation and upgrading of existing facilities. In addition, DOE is developing risk prioritization tools to aid in making decisions on potential facility improvements relative to NPH requirements. The adequacy of these provisions will be assessed in Phase 2.

3) The interrelationships among various classification schemes with the graded approach will be thoroughly reviewed and better integration achieved. The NPH team will link the requirements of 5480.23 with the guidance under development in draft STDS 3005 and 3009 as they are finalized. Once these standards are completed, we will determine what modifications are needed to DOE-STD-1021-93 to assure that NPH mitigation guidance is consistent with general DOE Guidance.

4) The revised DOE-STD-1020-94 and DOE-STD-1021-93 provide the general framework for applying the graded approach to mechanical and electrical systems and components. Ongoing DOE efforts to adapt the commercial industry Seismic Qualifications Users Group (SQUG) methodology are expected to provide detailed guidance for additional methods for evaluating the seismic capability of mechanical and electrical systems. The NPH team will study this concern and will make recommendations in this regard in Phase 2.

5) DOE is modifying its process for better balance by including a deterministic criteria. To ensure design loads that are appropriately conservative, deterministic criteria for defining design earthquake response spectra will be integrated with the existing probabilistic criteria. The specific approach is to be included in a revision to DOE-STD-1023. During early stages of review a determination will be made whether separate efforts are needed regarding the quantification of ground motion. This revision will be discussed with the DNFSB at the draft stage of development.

6) We have formed a special team to conduct a review of the natural phenomena hazards Order and its associated standards to ensure an integrated resolution of the Board's comments, as well as ensuring a complete, coherent, and fully integrated set of natural phenomena hazards Orders and standards that are consistent with other Department Orders and standards, e.g., the safety analysis report upgrade, the standards associated with the safety analysis report Order, and national standards.

7) In March 1994, the Department requested the American Society of Civil Engineers (ASCE), Committee on Dynamic Analysis of Nuclear Structures to review one of its natural phenomena hazards standards (DOE-STD-1020-94). The ASCE review will provide a check on the degree of consensus outside of the Department of Energy on the standard's methodology and also to determine whether a new national standard is needed.

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FROM: CONWAY, JOHN T CHR DC O
DEFENSE NUCLEAR FACILITIES
SAFETY BOARD

SUBJ: PUBLIC INFORMATION
VIEWS
REQUESTS COMMENTS ON SAFETY
SYSTEM CLASSIFICATION AND
NATURAL PHENOMENA HAZARDS
STANDARDS

REMARKS: THIS IS ESSENTIAL

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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004
(202) 208-6400

April 29, 1994

The Honorable Charles B. Curtis
Under Secretary
Department of Energy
Washington, DC 20585

Dear Mr. Curtis:

Recognizing the safety significance of the development and use of standards in the design, construction, operation and decommissioning of defense nuclear facilities, Congress explicitly set forth in Sec. 312(a)(1) of the legislation establishing the Defense Nuclear Facilities Safety Board (Board) that: "The Board shall review and evaluate the content and implementation of the standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities of the Department of Energy DOE--including all applicable Department of Energy orders, regulations, and requirements--at each Department of Energy defense nuclear facility."

In keeping with the provisions of Sec. 312(a)(1), the Board has followed the development and use of several orders and standards related to facility design and natural and man-made phenomena hazards. Our comments in this letter pertain specifically to DOE Order 5480.28 - "Natural Phenomena Hazards Mitigation," as well as to DOE Standards 1020-92 (Draft) - "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," 1021-93 - "Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems and Components," 1022-92 (Draft) - "Natural Phenomena Hazards Site Characterization Criteria," 1023-92 (Draft) - "Natural Phenomena Hazards Assessment Criteria," 1024-92 - "Guidelines for Use of Probabilistic Seismic Hazard Curves at DOE Sites," and 1027-92 - "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23 Nuclear Safety Analysis Reports." The order and standards are closely linked in content and intellectual underpinning, and form a system related to considerations of natural and man-made hazards. The following comments by the Board are amenable to the systems engineering approach where definition of requirements, integration, and analysis are performed early in the design process, while specifications or standards are in draft form.

We believe that the referenced order and standards have certain generic deficiencies, as follows:

a. The standards overemphasize new and largely probabilistic concepts and do not adequately use long accepted deterministic principles. A better balance should be achieved.

b. Definitive procedures to establish Safety Classes and Performance Categories have not been developed, nor has the relationship among Hazard Category, Safety Class, and Performance Category been clearly defined.

c. The standards are overly complex, lack clarity or completeness, and in many cases are not easily understood even by experts in the subject.

d. The proposed DOE grading of safety classification and performance goals and values have not been accepted by the engineering profession on a consensus basis.

e. Standards, guidance, and procedures for the design or assessment of electrical and mechanical systems that are consistent with the classification methodology to be used have not been developed.

f. No distinction is made between new and existing facilities, nor is there guidance on how the application of the requirements of the order and standards will differ for new or existing facilities.

Further elaboration on the above is contained in Attachment A.

The Board believes that comprehensive reevaluation and streamlining of the referenced order and standards are necessary to resolve these issues. Any changes to the order and standards should reflect: 1) the use of widely-accepted engineering concepts for grading safety systems, 2) the development of technical approaches to and the integration of order and standards that can be more easily understood and implemented, and 3) the issuance of guidance for mechanical and electrical systems that is equivalent to that being provided for structures.

Pursuant to 42 U.S.C. § 2286B(d), the Board requests that DOE provide a report, within 60 days of receipt this letter, that details how these comments and those in Attachment A will be addressed, and provides a schedule for doing so.

The order and standards have been the subject of substantial dialogue among DOE staff, Board staff, and numerous subject matter experts. The Board is prepared to continue such interchange of views if it will assist DOE in further development and integration of the order and standards. In any case, the Board will continue to follow this development effort with intense interest. If you need any further information, please let me know.

Sincerely,

John T. Conway
Chairman

Enclosure (Attachment A)

cc: The Honorable Victor H. Reis, DP-1
The Honorable Tara O'Toole, EH-1
The Honorable Thomas P. Grumbly, EM-1

Attachment A

DNFSB Comments on DOE
Safety System Classification
and
Natural Phenomena Hazards Standards

1. DOE Standards

a. DOE Natural Phenomena Hazards (NPH) Standards generally embody a probabilistic strategy to provide a graded approach to safety and thus to safety system classification. While there is nothing inherently inappropriate in this concept, the approach, as currently implemented, suffers from two fundamental deficiencies:

(1) *The grading of safety classification* for Structures, Systems and Components (SSC) is tied to *specific* performance goals, where performance goals are defined in terms of the annual frequency of failure. Since the risk assessment community has not yet reached agreement on specific standards (preferably based on experience), which would provide a basis for adopting specific numerical values of these failure rates, the numerical grading of performance goals may be premature and require validation.

(2) The probabilistic approach has been more properly used to evaluate relative risks or relative measures of the occurrence of particular hazards, and only occasionally, when sufficient historical evidence exists, to determine an absolute value of risk. In the case of NPH events, there are insufficient historical data upon which to base an absolute value of risk as inherently used in these standards. Therefore, we believe that the probabilistic bases of these orders must be reexamined. They appear to represent a fundamental weakness in the underpinning of the safety system classification for NPH specifically, and system design related orders in general. An appropriate approach or policy statement needs to be defined on the use of the probabilistic methods throughout DOE.

b. DOE's current approach to characterization of seismic ground motion basically uses a probabilistic approach, and ignores the deterministic approach that has been the mainstay of the structural engineering profession up to the present time. While there is increasing use of probabilistic methods in the engineering profession, existing seismic data for low probability, large magnitude events are generally inadequate to provide even a statistical validation of the proposed probabilistic procedures for DOE sites in general and for sites in the eastern United States in particular. Thus, it is not prudent to rely solely on probabilistic principles. This issue is under consideration by Defense Programs. It is requested that any resolution of this issue be an integrated DOE effort with results made applicable to all DOE defense nuclear facilities.

c. Implicit in the development of the concept of the graded approach to safety is the assumption that some facilities pose more of a risk to the public and facility workers than do others, and that the consequences can be characterized as differential risk. However, DOE does not have an approved standard or guide which deals with the issue of quantifying risk. Some DOE contractors have used, as an acceptance standard, the assumed fission product release noted in 10 CFR Part 100.11(a) resulting in a reference dose of 25 rem at the site boundary. However, such use of 10 CFR Part 100.11(a) goes beyond the intent of its provisions. The value in question is intended to be used in establishing site exclusion boundaries for a facility or facilities incorporating specific safety systems on the assumption that these systems would function properly when called on. The development of a standard or guide, applicable to all DOE facilities to quantify the consequences of relative risk associated with natural hazard phenomena, and/or the reassessment of a policy for the protection of the public health and safety are considered essential by the Board. Further, this review should be based on consideration of the contribution of all facilities at a site to the overall hazard since a natural event such as an earthquake will likely affect all facilities within a site.

2. Safety System Classification

a. Safety System Classification, as defined in DOE Order 6430.1A, is in terms of three levels. Classification is assigned to safety systems with specific functions to protect the operator, public, and/or the environment. However, we have not found any evidence that the system of using three safety classes is or will be implemented at any DOE site. Most sites seem to be concentrating on developing a definition of a single safety class that includes only those systems whose failure could cause the radiological dose at the site boundary to exceed specified limits.

Under the current DOE concept, no safety system or hardening of structures would be necessary unless a predetermined site boundary dose would be exceeded following an accident or as a consequence of a severe natural phenomenon. This concept is stated to be based on 10 CFR Part 100. While 10 CFR Part 100 does address a site boundary dose for site selection, it also assumes that safety systems and structures that represent a "defense-in-depth approach" are prudently engineered into a facility from the outset, and not conditionally upon results of dose calculations derived from probabilistic methods. Defense in depth is still required to extend the level of safety beyond that indicated by analysis to provide a robust design that will behave safely for unanticipated events.

In the Board's opinion, the concept of safety system classification needs to follow logical thought processes which have evolved from commercial nuclear practice. 10 CFR Part 100 was used only to estimate the suitability of a site for a nuclear plant having a specified containment and specified safety features used to control pressure and temperature of the atmosphere in the containment following a hypothetical, non-mechanistic accident. In a sense then, it also determined the suitability of the containment and the pertinent safety features to be located at the site. Once the question of the suitability of this containment system was settled, 10 CFR Part 100 reference dose limits were not used further or to decide whether engineered safeguards should or should not be used.

The need for and suitability of safety features and engineered safeguards were then determined according to an assessment logic such as:

1) Is there defense in depth?
2) Would failure of these safeguards lead to unacceptable consequences?
3) Are there adequate measures to render failure suitably unlikely?

Acceptance dose limits are defined in EPA protective action guides, in recommended limits established by the International Commission on Radiation Protection and the National Commission on Radiation Protection, or are derived from ALARA considerations. They are <u>not</u> reference dose limits at the level of those discussed in 10 CFR Part 100.

The limitations in the commercial industry's Technical Specifications for nuclear plants are never derived using 10 CFR Part 100 considerations. They are based on deterministic analysis. Some are simply the result of ensuring adequacy of conduct of operations.

b. An item of interest to the Board is the apparent lack of use of the concept of defense in depth, used in the commercial nuclear industry, as it applies to safety classification of SSC. Specifically, it has been difficult to identify the application of safety classification to SSC's which prevent or mitigate the consequences of a postulated accident. We have not seen explicit evidence that this concept is definitely considered at DOE sites, yet clearly it should be.

c. It is not clear under what circumstances the current classifications will be applied, or if the application will be limited to new facilities or those undergoing major safety modifications. Therefore, we can envision the possibility of high hazard facilities where no safety classification of SSC has been implemented and the ability of SSC to mitigate potential accident conditions has not been evaluated. The Board is interested in determining when implementation of safety classification of all facilities according to current DOE standards will begin and how the application will proceed.

3. Performance Categorization

Performance Categorization is currently related to specific design requirements for NPH, such as earthquake, extreme wind, and flood. Performance Categorization is not considered for other design basis accidents and other external hazards, such as airplane crash, fire, and accidental explosion. Performance Categorization for external events must be considered. Other shortcomings are: 1) Performance Categorization for Design Basis Accidents does not include consideration of single failure criteria or active and passive failure criteria, 2) a clear relationship between Safety Class and Performance Category has not been developed, and 3) a clear relationship between facility hazard categories and Safety Classes and Performance Categories of SSC has not been developed.

4. Graded Approach

The graded approach to design of structures for NPH is treated in DOE Standard 1020-92. However, no standards exists within DOE that apply the graded approach to the design of electrical and mechanical systems and components. Guidance is urgently needed to deal with this issue, since without such definition, assurance that graded safety systems and components will achieve their design objective cannot be assured.

5. Standard 1020-92, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities"

Several fundamental concerns exist regarding this standard. First, the process proposed to achieve specified performance goals is complex and lacking in clarity for ease of application; the process needs to be simplified. Second, it is difficult to determine if the objective of the standard, i.e., the grading of facility design to match the hazard, will in fact, be achieved because of the numerous compensatory factors that are employed to grade the acceptance limit provisions of the standard. Third, it is not certain that all sites

and contractors will be able to understand and thereby correctly apply this standard. The standard addresses structures but does not provide equivalent guidance for the design or assessment of mechanical and electrical systems and components.

The standard is not written to allow the user to readily understand the conservatism and margin that will result with its use. Hence, blind application without a complete understanding of this standard's underpinning could lead to inappropriate and unconservative design bases. The standard needs to be revised to address the issues discussed above.

6. New versus Existing Facilities

The design of new facilities and the assessment of the adequacy of existing facilities are fundamentally different processes. In the design of new structural systems, for example, it is customary to estimate the various combinations of maximum design loadings and to choose resisting systems based on standard or minimum specified material/element properties, employing accepted safety margins. In the assessment of the adequacy of existing structures, it is customary to attempt to establish realistic loadings to which the structural system may be subjected and then to examine the available load and resistance on the basis of actual, potentially degraded, properties of the materials as best as they can be determined. The assessment of the margin of safety and a conclusion as to adequacy of the structure are then determined. However, DOE's current standards do not differentiate between the two processes; although such differentiation is clearly appropriate.