DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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December 15, 2000

The Honorable Madelyn R. Creedon
Deputy Administrator for Defense Programs
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0104

Dear Ms. Creedon:

The Defense Nuclear Facilities Safety Board (Board) has been following the Department of Energy's (DOE) efforts to start up certain dynamic experiments at Los Alamos National Laboratory (LANL). The Board is pleased to note that significant progress was made during recent meetings between the blue ribbon panel convened to provide mentoring and advice on this program and the staffs of DOE, LANL, and the Board. Consensus was reached between the two staffs on an acceptable methodology for applying a standards-based approach, based on the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, to design and construction requirements for confinement and safety vessels. The use of such a standards-based approach has been of paramount concern to the Board. The Board would especially like to commend Messrs. G. Raffi Papazian, Edward A. Rodriguez, Christopher Romero, and George Antaki for their efforts in this regard. The enclosed methodology as proposed by LANL was reviewed and found acceptable by the Board.

The Board notes that Defense Programs has delegated approval of the authorization basis documentation for this program to the Albuquerque Operations Office. However, the details of how this will be executed throughout the life of the program still need to be defined and appropriate resources need to be provided to execute this function. The Board would like to be informed on the actions taken to resolve these issues once you have clarified the path forward for the project.

Sincerely,

John T. Conway
Chairman

c: Dr. David H. Crandall
Mr. Richard E. Glass
Mr. David Gurule
Mr. G. Raffi Papazian
Mr. Duane C. Sewell
Mr. Mark B. Whitaker, Jr.

Enclosure

ENCLOSURE

1. DOCUMENTATION

a. Design Specification

Los Alamos National Laboratory (LANL) shall prepare a design specification using the format of Appendix B of the American Society of Mechanical Engineers (ASME) Boiler & Pressure Vessel Code (B&PVC) Section III or equivalent with commentary to parallel prescriptive requirements.

b. Design Report

LANL shall prepare a design report using the format of Appendix C of ASME B&PVC Section III (or equivalent) including checked calculations and software qualifications.

c. Procurement Specifications

LANL shall prepare a procurement specification, for an outside organization to bid, on vessel manufacture excluding the "design" and "material selection" activities, which will be provided by LANL. Selected manufacturer shall have an ASME authorization to affix applicable code stamps.

d. All other documentation as if these were (or are) Code stamped vessels to ASME B&PVC Section VIII, Division 1, Lethal Service or ASME B&PVC Section III, Division 1, Class 1.

Vessel manufacturer selected by LANL to prepare documentation that would be required if these were (or are) code stamped vessels. LANL shall structure vessel certification package (VCP) to address ASME Code requirements for documentation, materials, fabrication, examination, inspection, and testing.

2. MATERIAL

a. Plate and Forgings

HSLA-100 material may be used having Certified Mill Test Reports (CMTR) with values greater than 100 ksi yield and 115 ksi ultimate strength meeting the requirements of ASME BPVC Section VIII, Division 1 for Lethal Service or Section III, Division 1, Class 1. Fracture toughness tests shall be performed meeting the requirements of ASTM E-604 supplemented by Section VIII, Division 1 requirements. Use Military Specification MIL-S-24645A modified accordingly. Minimum yield and ultimate strength to be met, otherwise design allowables to be modified based on actual material properties. Traceable CMTR required for all plate and forging material.

b. Weld

Weld material specification is to be compatible with HSLA-100. Weld material strength to be equal to or greater than plate/forging material strength otherwise design allowables will be modified accordingly.

3. DESIGN

The design of both the confinement and safety vessels shall consider all loads (other than impulse loads resulting from the detonation blast and reflected waves) as "Design" loads, which are required to meet the normal code allowables of current ASME B&PVC Section VIII, Division 1 for Lethal Service, or ASME BPVC, Section III, Division 1, Class 1.

For the detonation impulse loading, use a specific methodology of ASME B&PVC Section III, Division 1, Appendix F modified accordingly. Specifically,

a. Maximum equivalent membrane strain, ε_m shall be limited to the total equivalent strain at yield, which is the sum of the elastic strain and the 0.2 percent plastic strain offset (e.g., for 100 ksi yield HSLA-100 material, the total equivalent strain is $(\varepsilon_y)_m = 0.0055$ in./in.)

b. The maximum $\varepsilon_m+\varepsilon_b+\varepsilon_Q+\varepsilon_F$ individual principal plastic strains shall be less than the uni-axial tensile instability plastic strain divided by 3. Such uni-axial strain limit is determined from a uni-axial strain specimen and is the lesser of strains in the rolling and transverse directions.

c. Local primary membrane strains shall be limited to $3(\varepsilon_y)_m$.

4. FABRICATION

Fabrication shall meet the requirements of ASME B&PVC Section VIII, Division 1 for Lethal Service or alternatively ASME Section III, Division 1, Subsection NB. Exception to post weld heat treatment shall be based on Code Case 1932-2 requirements.

5. EXAMINATION

Vessel welds shall be 100 percent visual inspected (VT), 100 percent radiograph inspected (RT), 100 percent magnetic particle inspected (MT), and 100 percent ultrasonic inspected—both straight and angle beam (UT). Examination in accordance with Section VIII, Division 1, Lethal Service requirements and supplemented with American Welding Society (AWS) D1.1-92.

6. TESTING (HYDROSTATIC/PNEUMATIC)

Testing shall meet ASME B&PVC Section VIII, Division 1 Lethal Service or ASME B&PVC Section III, Division 1, Subsection NB requirements.

7. INSPECTION

Inspection shall be performed by ASME Code Authorized Inspectors for ASME B&PVC Section VIII, Division 1 Lethal Service or ASME B&PVC Section III, Division 1, Subsection NB and supplemented with requirements of AWS D1.1-92 .

8. PENETRATIONS & WINDOWS

All non-integrally attached components (i.e., welded electrical and mechanical penetrations, windows, etc.) shall be qualified by prototype testing to 1.5 times the maximum design basis impulse. It is not necessary to demonstrate leak tightness for these components under this loading case. However, structural failure shall be precluded. In addition, all bolting and joining ferrous materials shall be designed and fabricated to the same requirements as the body of the vessel and do not have to be fabricated from HSLA-100 material.

9. SAFETY VESSEL

The Safety Vessel shall be designed and constructed per ASME B&PVC Section VIII, Division 1 or Division 2 to contain the maximum calculated static design basis pressure using normal ASME B&PVC allowable stresses.