PDR 71-9168

CHEM—NUCLEAR SYSTEMS INC.

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September 30, 1982

RECEIVED OCT 05 1982 U. S. NUCLEAR REGULATORY COMMISSION Mail

Mr. Charles E. MacDonald, Chief
Transportation Certification Branch
Fuel Cycle & Material Safety Division
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Reference: Docket No. ~~71-6601~~
NRC Letter to CNSI dated 10/14/81
CNSI Letter to NRC dated 2/8/82

Dear Mr. MacDonald:

Our letter dated February 8, 1982 indicated that we would respond to your questions regarding the CNS 8-120 radioactive waste shipping cask (see NRC letter to CNSI dated 10/14/81) in the form of a completely revised Safety Analysis Report (SAR). Attached to this letter we have included:

(1) Attachment - Responses to 8-120 NRC Questions; and,

(2) A completely revised Safety Analysis Report.

In performing the extensive, in-depth analyses for the SAR, several improvements were incorporated into the design of the cask.

We have included a check in the amount of $3,500 as per 10 CFR 170.31 (11)(c) for a major amendment.

Please contact this office if you have any questions on this application.

Oct - 1
Applicant..........
Check No. 46542
Amount $3,500
Type of Fee Major Amendment
Date Check Rec'd. 10/4/82
Received By J. Jackson

Sincerely,

CHEM-NUCLEAR SYSTEMS, INC.

L K Poppe

Leslie K. Poppe
Corporate Health Physicist

DOCKETED USNRC OCT 7 1982 MAIL SECTION DOCKET CLERK

LKP:slj

Enclosures: 10 copies Safety Analysis Report
10 copies Drawing C-110-E-0007, Sheets 1 & 2

10/6/82

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RESPONSES TO 8-120 QUESTIONS

Question No. 1

The evaluation of the 30-foot drop test (Sect. 2.7.1) does not adequately demonstrate the integrity of the containment vessel. The analysis should be revised to indicate the stresses that would be present in the containment vessel and to show that these stresses are within acceptable limits to assure the integrity of the vessel. The analysis of impact effects should consider the lateral pressure of the lead against the steel shells as well as the axial stresses that would result from the steel supporting the lead. The analysis should also evaluate the effects of differential thermal expansion (axial and radial) between the lead and the steel shells. Note the statement on page 2-14 that the lead and steel are bonded together and that the steel would support the lead during impact.

Answer No. 1

The new analysis specifically addresses the concerns of this question. Full details are provided in Section 2.7.1 of the revised SAR. Maximum stress intensities throughout the cask, including the containment vessel, are shown in Tables 2.7.1-2, 2.7.1-4 and 2.7.1-6, and are shown to be below allowables, with a minimum safety factor of 1.40. In modeling the lead/steel interface, lead-to-steel bonding was not assumed to take place and, consequently, the steel does not support the lead in the axial direction. This interface was modeled by decoupling the nodes of the lead elements from the nodes of the steel elements of the axial direction, so that the lead was free to move axially with respect to the steel. However, in order to model the radial pressures exerted by the lead on the steel shells, the lead nodes were coupled radially to the steel nodes, thus transferring radial forces between the lead and the steel shells.

Because part of the loading conditions used in determining the stresses in the cask included the temperatures from the thermal analysis (Section 3.0), and the concomitant internal pressures, the stress intensities reported in the revised SAR include the effects of differential thermal expansion (both radial and axial) as well as stresses induced by thermal gradients and internal pressure.

Question No. 2

The evaluation of 30-foot end drop (Sect. 2.7.1.1) only considers slumping of the lead. The analysis should be revised to demonstrate the integrity of the containment vessel and closure under top and bottom end drop conditions.

Answer No. 2

Section 2.2.7.1.1 of the revised SAR discusses results of the 30-foot end drop. Maximum stress intensities throughout the cask, including the containment vessel and closure, are reported in Table 2.7.1-2. The stress intensities are shown to be below allowables, with a minimum factor of safety of 2.81.

Question No. 3

The analysis of the 30-foot top corner drop (Sect. 2.7.1.3) should be revised to provide the following information in connection with demonstrating that an adequate seal will be maintained under accident conditions:

a. Show that the rim which projects above the cover would deform by crushing, as was assumed in the analysis, rather than by local bending, shearing, buckling or some other mechanism which would dissipate less energy. Provide a sketch showing exactly which area of the rim is considered to be the deformed volume. Note that the shape of the deformed volume which was assumed in the analysis (i.e., solid cylindrical wedge, see sketch pg. 2-17) is not consistent with the actual geometry of the package (see Detail C, DRWG. 119-0500-E01). Therefore, it appears that the equations used to evaluate top corner impact (pgs. 2-16 and 2-17) are not valid for this purpose.

Answer No. 3-a

The overpacks in the new design prevent any contact of the cask with the impact surface. Thus no permanent deformation of the corner of the cask occurs. As a consequence of the protection afforded by the overpacks, the protruding rim which projected above the cover has been eliminated in the new design.

Question No. 3-b

b. Show that the closure design is adequate to resist the shear forces that act in the plane of the cover. The analysis (pg. A-9) apparently assumes that a portion of shear force would be reacted solely by the rim that extends above the cover. However, this does not consider that the rim, under impact forces, would deform inward and bear against the cover. Also, the cover is made of laminated plates. The revised analysis should show that the connections between the plates are adequate to transfer shear forces from one plate to another.

Answer No. 3-b

In the new design radial shear forces are reacted by a combination of bearing between the cover and the inner cask wall and by the cover bolts. The clearances around the bolts and between the cover and the inner cask wall have been designed such that radial forces which tend to drive the cask wall and the cover together are reacted by bearing between the two parts and radial forces which tend to radially separate the cask wall from the cover are borne by the cover bolts. While the cask has been designed to perform in this manner, in the actual analysis, shear forces were transmitted by coupling of the cover node to the cask body node at the bolt circle. This allowed bolt stresses to be computed based on the forces at these nodes and the bolt stress area. These analyses are discussed in Section 2.7.1.3 of the revised SAR. The new cask cover design uses two 3½-inch thick plates. The analysis treats these as two separate plates, with shear forces being transmitted only at the welds at the peripheries of the primary and secondary lids. At other locations, only forces normal to the plates are transmitted between the plates. This was accomplished by coupling nodes between the plates in the normal direction only.

Question No. 3-c

c. The revised analysis should show that an adequate seal would be maintained following the test, considering the deformation and distortion that would occur in the area of the cover and the flange.

Answer No. 3-c

The overpacks in the new design protect the cask and prevent permanent deformation in the areas of the seals. Thus, sealing capability after the drop is not altered from pre-drop conditions. Section 2.7.1.3 of the revised SAR discusses pertinent results of the stress analysis.

Question No. 3-d

d. Show that the cylindrical cask walls, and the connection between the walls and the flange, are adequate to resist the load imposed by top corner impact. This should include the lateral pressure (if any) from the lead.

Answer No. 3-d

The overpacks used in the new design reduce the loads imposed by the top corner impact. The stress analysis for this condition, discussed in Section 2.7.1.3 of the revised SAR, shows that stress intensities remain below allowables throughout the cask, with a minimum safety factor of 1.44. This stress analysis included the effects of the lateral pressure of the lead, as discussed in the response to Question No. 1, above.

Question No. 3-e

e. Revise the calculated closure bolt stress (pg. A-8) to consider the additional stresses due to pre-load and horizontal shear (if any). Note that the content weight considered in the analysis (pg. 2-25) should apparently be greater than 10,000 pounds to be consistent with the weights specified on page 2-2.

Answer No. 3-e

The results of the new bolt stress analysis are shown in Section 2.7.1.3 of the revised SAR. The maximum payload weight of 14050 pounds was used in this analysis. Because the applied load greatly exceeds the bolt preload, the preload has negligible effect on maximum bolt stresses. (Refer to Bickford, John H., An Introduction to the Design and Behavior of Bolted Joints, Marcel Dekker, Inc., 1981. See, especially, Chapter 11, Section I. A less comprehensive description of bolted joint behavior is given by Shigley, Joseph E., Mechanical Engineering Design, Third Edition, McGraw-Hill, 1977, Section 6.5, pp 240-244).

Question No. 3-f

f. Justify that it is appropriate to consider the outer edge of the cover plate to be fixed, as was done in the analysis on page A-13. Provide a free-body sketch of the cover and flange which explicitly shows how the necessary moment reaction is developed to provide fixity. Also, the analysis should be revised to consider that the cover is made of laminated plates rather than being a solid 4-inch thick plate (pg. A-14).

Answer No. 3-f

Analysis of the cover is included in the drop stress analysis discussed in Section 2.7.1.3 of the revised SAR. Edge fixity is not assumed in the new analysis. Rather, rotation of the edge is governed by the stiffness of the cask wall, to which the lid is bolted. The analysis considers the cover as laminated plates, allowing only the transmittal of normal forces between laminations, except at the peripheral welds joining the laminated plates, where shear forces, also, are transmitted.

Question No. 4

The analysis of the 30-foot bottom corner drop (Section 2.7.1.3) should be revised to provide the following information:

a. Show that the drain line (see Detail D, DRWG. 119-0500-E01) would remain sealed following a 30-foot bottom corner drop test. Note that this line is located in the region that would apparently be crushed according to the analysis on pg. 2-18.

Answer No. 4-a

The overpacks in the new design cover the drain line and prevent crushing impact, or indeed, any permanent deformation whatsoever in the area of the drain line. Thus, the sealing capability of the drain plug will remain unchanged following the drop.

Question No. 4-b

b. Provide additional narrative and sketches which clearly show the derivation of equations (10) and (11) on pg. 2-17. Also, show the equation used on that page to tabulate the values of coefficient "C".

Answer No. 4-b

Because crushing of the corner of the cask is prevented by the overpacks used in the new design, these equations are not used in the new analysis. A discussion of the corner drop analysis can be found in Section 2.7.1.3 of the revised SAR.

Question No. 4-c

c. Justify that a value of 60,000 in -lb/in^3 is appropriate for the energy absorbing constant used on pg. 2-18. This should consider the specific types of steel used to construct the cask.

Answer No. 4-c

Dynamic flow pressure is not used in the new corner drop analysis in the revised SAR. See Section 2.7.1.3.

Question No. 4-d

d. Clarify the value of kinetic energy that the cask is considered to have under 30-foot drop conditions. Note that the 60,000 pound values used on pgs. 2-18 and 2-19 do not agree with 74,000 pound weight listed on pg. 2-2.

Answer No. 4-d

The corner drop analysis in the revised SAR uses a value of kinetic energy based on the full 74,000 pound cask weight. See Section 2.7.1.3.

Question No. 4-e

e. The analysis of stresses in the plates and welds at the bottom end of the cask (pg. A-17) should be revised to include the additional stresses that would result from the axial component of the inertial force of the contents and bottom closure.

Answer No. 4-e

The inertial force at the contents and bottom closure are included in the new corner drop analysis discussed in Section 2.7.1.3 of the revised SAR.

Question No. 5

Show that the cask closure and bottom end plates are adequately designed to resist the shear forces that would act in the plane of cover under 30-foot side drop conditions. Also, show that the drain line would remain sealed following a 30-foot side drop test.

Answer No. 5

Stresses in the top and bottom closures are included in the results of the side drop analysis in the revised SAR; see Section 2.7.1.2. The overpacks in the new design serve to protect the drain line from suffering any permanent deformation from the side drop impact. Thus, sealing capacity of the drain seal is unchanged following the side drop.

Question No. 6

The revised analysis should evaluate the effects of the 40-inch puncture test considering the cask to be oriented so that the pin would impinge upon the end of the cask. The analysis should consider both the top and bottom ends. The analysis should include the effects in the local vicinity of the pin and the overall effect upon the end plates. The analysis of top end impact should include an evaluation of the pin striking the plugs located in the lid. Note that the puncture analysis (pg. 2-21) should apparently be revised to consider a weight of 74,000 pounds rather than 60,000 pounds.

Answer No. 6

A puncture analysis for end impact is included in the revised SAR in Section 2.7.2. The plugs in the lid have been eliminated from the new design. The new analysis uses the full 74,000 pound cask weight.

Question No. 7

Section 2.6.6 should be revised to explicitly demonstrate that the package meets the requirements of 10 CFR Part 71 under 1-foot drop test conditions.

Answer No. 7

Stresses for the 1-foot drop conditions have been included in Section 2.6.6 of the revised SAR.

Question No. 8

The package drawings should be revised to provide the following information:

a. The torque to which the cover bolts are tightened.

Answer No. 8-a

Cover bolt torque is now included in the package drawings, Appendix 1.3, and in Section 4.0 of the revised SAR.

Question No. 8-b

b. The method or devices used to close and seal the drain plug.

Answer No. 8-b

Drain plug sealing devices and seals are shown on the package drawings of the revised SAR, Appendix 1.3. These devices are discussed in Section 4.0 of the revised SAR.

Question No. 8-c

c. The torque to which the cover plugs are tightened and the method or devices which provide a seal at these plugs.

Answer No. 8-c

The cover plugs have been eliminated from the new design.

Question No. 8-d

d. The clearance of the closure bolts and cover which are discussed on page 2-28.

Answer No. 8-d

Dimensions for the clearances around the cover bolts and for the lid-to-cask body radial clearance are now included in the package drawings, Appendix 1.3 of the revised SAR. The impact of these clearances on bolt loads is discussed in response to question 3-b, above.

"TRANSPORTATION APPROVALS"

Docket No. 71-9168 (ref. 6601) } new certificate will be issued due to major changes in package - waiver needed when issued

William O. Miller
License Fee Management Branch
Office of Administration

MATERIALS TRANSPORTATION APPROVAL CLASSIFICATION

Applicant: Chem-Nuclear Systems, Inc.

Approval No: 9168 Fee Category 11B

Application Dated: 9/30/82 Received: 10/4/82

Applicant's Classification: 11C major

The above application for amendment has been reviewed by the NMSS Transportation Branch, in accordance with Section 170.31, and is classified as follows:

1. Amendments to Approvals in Fee Categories 11A through 11E

   (a) ✓ Major

   (b) ___ Minor

   (c) ___ Administrative

2. Justification for reclassification: Major revisions to original design to up-grade packaging.

3. The application was filed (a) ___ pursuant to written NRC request and the amendment is being issued for the convenience of the Commission, or (b) ___ Other (State reason): ________

Signature: R H Odegaarden
Transportation Branch, NMSS
Date: 10/4/82