March 18, 2014

Mr. Steven Sisley
Cask Licensing Manager
Energy*Solutions* Products and Technology Group
2105 South Bascom Ave., Suite 230
Campbell, CA 95008

SUBJECT: AUTHORIZATION FOR SHIPMENT OF ACTIVATED METALS USING THE MODEL NO. 8-120B PACKAGE

Dear Mr. Sisley:

As requested by your application dated January 20, 2014, as supplemented February 21 and 25, 2014, pursuant to Title 10 of the *Code of Federal Regulations* Part 71, Certificate of Compliance (CoC) No. 9168, for the Model No. 8-120B package is amended to authorize a maximum of 50 shipments of activated steel from the Zion decommissioning project, as follows:

(1) Authorization is for a maximum of 50 shipments from the Zion decommissioning project with contents as follows: (i) Core Barrel Sections consisting of curved plate sections of Type 304 stainless steel, approximately 2-5/8" thick by 59" high, with a chord length of approximately 36," (ii) Thermal Shield Sections consisting of curved plate sections of Type 304 stainless steel, approximately 2-7/8" thick by 59" high, with a chord length of approximately 36," and (iii) Upper Core Plate Items consisting of Type 304 stainless steel tube stubs, 6" diameter, and approximately 10-12" long.

(2) Only two shipments may contain upper core plate material with the respective liners completely filled to ensure that there is no room for movement of such contents. Contents must all be of similar specific activity.

(3) The liners are approximately 1" thick and shall fit snugly into the cavity of the package. Payloads shall be either "self-nesting" or stabilized using cribbing to minimize shifting of items during shipments.

(4) Prior to shipment, package dose rates shall be measured at all locations necessary to demonstrate compliance with 10 CFR 71.47. The measurement procedure must be comprehensive in nature and follow that outlined in Attachment 1 of Reference 2. When performing steps 2(b)(ii), 2(c)(ii), and 2(d)(ii) of this procedure, the measurements must cover the entire package surface and projected surfaces at 1 and 2 meters as required by 10 CFR 71.47(b)(2), or (b)(3) if the package is transported by a flat-bed, such that all locations along the package circumference are measured for all axial locations of the package, as well as all locations on the top, bottom, driver side, and passenger side. A 20% margin shall be applied to the measured dose rates to account for measurement uncertainties.

(5) Loose contamination or CRUD shall be limited to 0.616 Ci .

(6) All other conditions of CoC No. 9168 shall remain the same.

(7) This authorization shall expire on December 31, 2014.

If you have any questions regarding this authorization, please contact Pierre Saverot of my staff at (301) 287-0759.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

/RA/ B. H. White For

Michele Sampson, Chief
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9168
TAC No. L24876

Enclosure: Safety Evaluation Report

cc w/encl: R. Boyle, Department of Transportation
J. Shuler, Department of Energy c/o L. F. Gelder

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SAFETY EVALUATION REPORT
Docket No. 71-9168
Model No. 8-120B Package
Authorization for Limited Shipments

BACKGROUND

On January 20, 2014 (Reference 1), as supplemented on February 21, and 25, 2014, (Reference 2), Energy*Solutions* (the applicant) submitted a request for authorization to ship activated steel from the Zion plant. The applicant states that the Zion decommissioning project is experiencing schedule delays and additional occupational dose at the plant due to shipping delays because of the overly conservative shielding analyses for Revision No. 20 of the certificate of compliance (CoC) dated November 22, 2013. The applicant states that dose rate measurements for packages shipped under Rev. No. 20 of the CoC exhibit a large margin to normal condition of transport (NCT) dose rate limits in 10 CFR 71.47. The applicant investigated the reason for this large margin and believes that, if contents are made more specific than the generic specification used in Rev. 20 of the CoC, more contents could be shipped while still meeting regulatory dose rate limits.

The applicant intends to submit an amendment request to the current CoC to support an increase in contents for activated steel components. In the meantime, the applicant requested an authorization for a maximum of 50 shipments of activated steel from the Zion plant through December 31, 2014. The request is based on meeting NCT dose rates via comprehensive measurements, and the applicant justified that this was appropriate based on the fact that the contents fit “snugly” within their container and therefore would not experience any re-arrangement during NCT.

EVALUATION

Contents

In Reference 2, the applicant discusses the Model No. 8-120B package payload items as “core barrel sections,” “thermal shield sections,” and “upper core plate items.” These items will be shipped in steel liners as described in Reference 2 that provide additional shielding.

The thermal shield sections and the upper core plate items are large in size and largely fill the cavity space such that re-arrangement under NCT and hypothetical accident conditions (HAC), to the extent that regulatory dose rate limits are exceeded, is not likely. The higher activity core barrel sections are generally sandwiched in between the lower activity thermal shield sections; however, there is not a complete coverage of the higher activity items and, due to the comprehensive pre-shipment measurement being performed, these higher activity items still limit the payload at the position along the package that they are not covered. The upper core plate items are smaller in size and, unlike the other two contents, could rearrange during NCT, if not shored. In Reference 3, the applicant submitted additional information on this content. The applicant states that all of the upper core plate material is contained within two liners. The applicant states that these are filled entirely such that there is no room for the contents to move. In addition, the contents are all of similar specific activity; therefore movement of material from the inside to the outside would not make a difference in external dose rates.

Compliance with NCT Dose Rates

The applicant submitted the measurement procedure in Attachment 1 of Reference 2 that will be used to determine compliance with NCT dose rate limits in 10 CFR 71.47. The staff reviewed this procedure and found it overall comprehensive and acceptable; however, step 2(b)(ii) states: "Perform gamma rate surveys by scanning all external surfaces of the package (front, back, top, bottom, driver side, and passenger side, as shown in Figure 1)." Similar language is used in steps 2(c)(ii) and 2(d)(ii) for the 1 and 2 meter dose rate surveys. Although the text indicates that this measurement will be performed for the entire surface, the staff finds that Figure 1 could be misinterpreted because it is titled "Cask Vehicle – Surface Measurement Survey Points – Radiation and Contamination Conveyance Survey Points" and it points to a single spot on these surfaces. The staff finds that this instruction could cause a user to misinterpret the text and just take survey measurements at these specific points; therefore, the staff finds that it needs to clarify, as part of this authorization, that the dose rate shall be measured at all locations on all surfaces and around the circumference at every location along the vertical axis.

The applicant states that loose contamination will be present but that it will be limited to a specific activity (curie) limit. The applicant states that loose contamination (CRUD) was evaluated for the CoC amendment request, that is planned to be submitted in the coming weeks, and that it was found that it will have a small contribution to external dose rates, approximately 4%. The staff reviewed the applicant's evaluation of loose contamination (CRUD) that was submitted in a proprietary calculation (Energy*Solutions* CALC-12GCL1-001, Rev. 0, "Shielding Calculation for Loading Specification 8-120B-2 (Activated Steel)," January 9, 2014 - ADAMS Accession No. ML14013A078). In this evaluation, the applicant shows that, if the CRUD was limited to 0.616 Ci, this would correspond to a 4% contribution in dose rates of the 8-120B package with a 200 mrem/hr surface dose rate. Attachment 1 of Reference 2 states that all pre-shipment dose rate measurements must show a 20% margin to the regulatory limits. This is to account for minor relocation of contents (including CRUD) and measurement uncertainties.

The NRC staff does not usually accept pre-shipment measurement for determining compliance with NCT dose rate limits because contents could shift or settle during NCT and the measurement accuracy may vary significantly (See Regulatory Issue Summary 2013-04, "Content Specification and Shielding Evaluations for Type B Transportation Packages," April 23, 2013 - ADAMS Accession No. ML13036A135). However, the staff believes that the contents requested for this authorization are not capable of reconfiguration during transport to the extent that NCT dose rates could increase beyond regulatory limits. In addition, measurement uncertainty, loose contamination, and minor shifting of contents are addressed by allowing a 20% margin to the limit when measuring dose rates as described in Attachment 1 of Reference 2. Based on this consideration, the staff determined that there is a reasonable assurance that the package with the authorized contents meets the regulatory requirements of 10 CFR 71.47.

Compliance with HAC Dose Rates

The applicant did not perform any dose rate calculations under HAC for this specific source geometry. The applicant can show that HAC dose rates in 10 CFR 71.51(a)(2) are met by showing that a distributed Co-60 source that would give dose rates right at the limits in 10 CFR 71.47 would also meet HAC dose rates. The applicant performed this proprietary calculation in support of CoC Rev. No. 20 (Energy*Solutions* Calculation Package, "8-120B Shielding Response," Document No. CALC NU-391, Revision 7 - ADAMS Accession No. ML13225A229), and this evaluation has been previously reviewed and approved by the staff.

The applicant is crediting the shielding provided by the liner under NCT. In Reference 2, the applicant states that, although the liner is not qualified to withstand HAC, there are no conditions that could cause the liner to vanish. However, the applicant states that the bolts or welds could fail causing the internal contents to expose for a few inches. Therefore, to demonstrate that the package still meets HAC dose rate limits, the HAC shielding evaluation in Reference 6 must show that there is enough margin to the limit so that, if the liner were to vanish, then HAC dose rates would still meet regulatory limits.

The applicant states that the 1" thick steel liner gives a factor of 2.7 attenuation for a Co-60 source. The package must still meet regulatory dose rate limits for HAC assuming the source increases by this factor. The calculation shows that the distributed Co-60 source would have to increase by a factor of 5 to 7 to exceed the HAC dose rate limits. To verify the applicant's attenuation factor of 2.7, the staff performed a simple hand calculation of attenuation of Co-60 gammas, using mass attenuation and build-up factors for 1" of iron, and the result showed a reduction of Co-60 gammas by a factor of approximately 1.5. This shows that the applicant's factor is conservative with respect to estimating the increase in dose rates due to the failure of the liner under HAC.

Therefore the staff finds the use of the liner acceptable for this authorization. The staff notes that although thicker liners would provide additional NCT shielding, the dose rate increase due to the failure under HAC is not quantified and therefore not shown to meet regulations in 10 CFR 71.51(a)(2).

CONDITIONS

The staff finds that the requested 50 shipments of activated steel in the Model No. 8-120B package as described in References 1, 2, and 3 meet regulatory dose rate limits in 10 CFR 71.47 and 10 CFR 71.51(a)(2) provided the following restrictions are met:

- Contents shall be limited to activated steel and limited to the following items as described in Reference 2:
    - Core Barrel Sections: Curved plate sections of Type 304 stainless steel that largely fill the liner cavity, approximately 2-5/8" thick by 59" high, with a chord length of approximately 36".
    - Thermal Shield Sections: Curved plate section of Type 304 stainless steel that largely fill the liner cavity, approximately 2-7/8" thick by 59" high, with a chord length of approximately 36".
    - Upper Core Plate Items: Type 304 stainless steel tube stubs, 6" diameter, approximately 10-12" long.
- Only two shipments may contain upper core plate material with the respective iners filled completely to ensure that there is no room for movement of such contents. Contents must all be of similar specific activity.
- The liners shall fit snugly within the 8-120B cavity as described in Reference 2 and be approximately 1" in thickness.
- The measurement procedure must be comprehensive in nature and follow that outlined in Attachment 1 of Reference 2. When performing steps 2(b)(ii), 2(c)(ii) and 2(d)(ii) of

this procedure, the measurements must cover the entire package surface and projected surfaces at 1 and 2 meters as required by 10 CFR 71.47(b)(2), or (b)(3) if the package is transported by a flat-bed, such that all locations along the package circumference are measured for all axial locations of the package, as well as all locations on the top, bottom, driver side, and passenger side (not just the specific points in Figure 1 of Attachment 1 of Reference 2).

- A 20% margin to the limit will be applied for all dose rate measurements performed as described in Attachment 1 of Reference 2.

- Loose contamination or CRUD shall be limited to 0.616 Ci.

CONCLUSIONS

Based on the statements and representations in the application dated January 20, 2014, as supplemented February 21, and 25, 2014, the staff agrees that the use by Energy*Solutions* of the Model No. 8-120B package meets the requirements of 10 CFR Part 71, subject to the conditions listed above.

Issued on March 18, 2014.

References

1. Letter from S. E. Sisley (Energy*Solutions*) to US NRC, “Request for authorization to ship activated metal, Reference: 8-120B Package, Certificate No. USA/9168/B(U)-96, Docket No. 71-9168,” January 20, 2014 (ADAMS Accession No. ML14024A032).

2. Letter from S. E. Sisley (Energy*Solutions*) to US NRC, “Response to Request for Additional Information for the Model No. 8-120B Package, Docket No. 71-9168, Reference: Letter from P. Saverot (NRC) to S. E. Sisley (Energy*Solutions*), “Request for Additional Information for the Model No. 8-120B Package, Docket No. 71-9168, February 11, 2014” February 21, 2014 (ADAMS Accession No. ML14055A395).

3. Email from S. Sisley (Energy*Solutions*) to P. Saverot (US NRC), “RAI Response for 8-120B Zion Authorization Request,” February 25, 2014 (ADAMS Accession No. ML14064A304).