ROBATEL technologies

# U.S. NRC Request for Supplemental Information
# Docket No. 71-9365
# Model No. RT-100 Package

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For:
U.S. Nuclear Regulatory Commission
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Subject: Robatel Technologies Responses to the US NRC Request for Supplemental Information for Model No. RT-100 Package, Docket No. 71-9365

References: Supplemental Information Needed Letter, dated November 21, 2022

The NRC request for supplemental information (RSI) letter identifies information needed by the staff in connection with its review of Robatel's Safety Analysis Report, Revision No. 8, dated August 29, 2022. NUREG-2216, "Standard Review Plan for Transportation Packages for Spent Fuel and Radioactive Material," was used by the NRC staff in its review of the application.

Each individual RSI describes information needed by the U.S. Nuclear Regulatory Commission (NRC) staff to complete its review of the application to determine whether the applicant has demonstrated compliance with the regulatory requirements.

The RSI comments are grouped by chapter number and title from the Safety Analysis Report, along with the Robatel response. The response addresses the comment and where applicable, references the locations in the SAR and/or supporting documents where revised information can be located.

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## Chapter 1: General Information

### Question 1.1

Provide updated drawings that have legible title blocks.

The title blocks of all drawings are either very difficult or impossible to read even after significantly increasing the magnification. Staff needs legible copies of all drawings.

This information is necessary for the staff to evaluate compliance Title 10 of the Code of Federal Regulations (10 CFR) 71.33(a).

### Response 1.1 (Proprietary Response)

Attached to this response are the following PDF drawings,

1. RT100 PE 1001-1 Rev. H — Robatel Transport Package RT-100 General Assembly Sheet 1/2 (Proprietary)
2. RT100 PE 1001-2 Rev. H — Robatel Transport Package RT-100 General Assembly Sheet 2/2 (Proprietary)
3. RT100 PRS 1011 Rev. E — Robatel Transport Package RT-100 Cask Sub Assembly Weld Map Cask Body (Proprietary)
4. RT100 PRS 1013 Rev. C — Robatel Transport Package RT-100 Cask Sub Assembly Weld Map Secondary Lid (Proprietary)
5. RT100 PRS 1031 Rev. D — Robatel Transport Package RT-100 Cask Sub Assembly Weld Map Lower Impact Limiter (Proprietary)
6. RT100 PRS 1032 Rev. D — Robatel Transport Package RT-100 Cask Sub Assembly Weld Map Upper Impact Limiter (Proprietary)
7. 102885 MD 1031-06 Rev. F — Robatel Transport Package RT-100 Sub Assembly Fabrication Drawing Impact Limiter Foam (Proprietary)

## Chapter 2: Structural Chapter

### Question 2.1

Explain whether prying action effects were considered for vibration-induced loads in the lid closure bolts, and the total vibration loads were included in the calculation of Normal Conditions of Transport (NCT) Load Combinations.

It appears that Safety Analysis Report (SAR) Rev. 8, Section 2.6.5, which presents vibration effects on closure bolts, does not determine the portion of tensile loads induced by prying action. It also appears that the total vibration-induced bolt tensile loads are omitted from NCT load combinations determined in SAR Section 2.13.2.4.2. Section 8 of NUREG/CR-6007 provides guidance that the total vertical vibration-induced bolt loading includes the effects of prying action. NUREG/CR-6007, Tables 6.1 and 6.2, and NUREG-2216, Section 2.4.5.5, provide guidance that the total vibration-induced bolt loads also be combined with others generated by NCT loads.

This information is necessary to evaluate compliance with 10 CFR 71.71(c)(5).

### Response 2.1

Robatel considered the prying effect due to vibration-induced loads as shown in the following supplemental calculations. The calculations and the stress ratio comparison tables (Table 1 and Table 2) show that the effect of adding vibration-induced loads to the primary and secondary lid bolts is not significant. The calculations below were done in accordance with the equations listed in Tables 4.7 and 4.8 in NUREG 6007,

VTR = Vibration transmissibility
= 1 (NUREG 6007, Section 4.8)
ava = Maximum transverse acceleration (g)
= 2g (10 CFR 71.45b(1))
Wlp = Weight of the primary closure lid
= 3650 kg (RT-100 SAR, Revision 8)
Wls = Weight of the secondary closure lid
= 860 kg (RT-100 SAR, Revision 8)
xi = Impact angle, RT-100 is shipped vertically
= 90° (RT-100 SAR, Revision 8)
Dlb = Lid diameter at bolt circle
= 1.92 m for primary lid (RT-100 SAR, Revision 8)
= 0.926 m for secondary lid (RT-100 SAR, Revision 8)

The tensile bolt force per bolt for the primary lid ($F_a$):

$$F_a = VTR\ x\ ava\ x\ (Wlp + Wls)$$

$$= (1)\ x\ \left(19.62\ \frac{m}{s^2}\right) x\ (3650\ kg + 860\ kg)\ x \left(\frac{N}{1000\ kN}\right) = 2.765\ kN$$

The fixed edge primary closure-lid force ($F_f$):

$$F_f = \frac{sin(xi)\ x\ \ ava\ x\ (Wlp + Wls)}{\pi\ x\ Dlb}$$

$$= \frac{sin(90)\ x\ (19.62\ m/s^2)\ x\ (3650\ kg + 860\ kg)}{\pi\ x\ 1.92\ m}\ x \left(\frac{N}{1000\ kN}\right) = 14.67\ kN/m$$

The fixed edge primary closure-lid moment ($M_f$):

$$M_f = \frac{sin(xi)\ x\ \ ava\ x\ (Wlp + Wls)}{8\ x\ \pi}$$

$$= \frac{sin(90)\ x\ (19.62\ m/s^2)\ x\ (3650\ kg + 860\ kg)}{\pi\ x\ 8}\ x \left(\frac{N}{1000\ kN}\right) = 3.521\ kN - m/m$$

The NCT stress ratios of the primary lid bolts were calculated following the procedure outlined in the RT-100 SAR, Revision 8. As shown in Table 1 below, the impact of including vibration-induced loads is not significant in comparison with the stress ratios without vibration loads. Additionally, there is a significant safety margin on the primary lid bolts for NCT loads.

**Table 1. Primary Lid Bolts (NCT) Stress Ratio Comparison**

| Stress Ratio | With Vibration Loads | Without Vibration Loads |
|---|---|---|
| Axial stress ratio (Rt) | 0.63 | 0.62 |
| Combined stress ratio ($Rt^2 + Rs^2$) | 0.39 | 0.39 |
| Stress intensity ratio (Ri) | 0.65 | 0.64 |

The tensile bolt force per bolt for the secondary lid ($F_a$):

$$F_a = VTR\ x\ ava\ x\ Wls$$

$$= (1)\ x\ \left(19.62\ \frac{m}{s^2}\right) x\ (860\ kg)\ x \left(\frac{N}{1000\ kN}\right) = 0.937\ kN$$

The fixed edge secondary closure-lid force ($F_f$):

$$F_f = \frac{sin(xi)\ x\ ava\ x\ Wls}{\pi\ x\ Dlb}$$

$$= \frac{sin(90)\ x\ (19.62\ m/s^2)\ x\ (860\ kg)}{\pi\ x\ 1.92\ m}\ x\left(\frac{N}{1000\ kN}\right) = 5.80\ kN/m$$

The fixed edge secondary closure-lid moment ($M_f$):

$$M_f = \frac{sin(xi)\ x\ ava\ x\ Wls}{8\ x\ \pi}$$

$$= \frac{sin(90)\ x\ (19.62\ m/s^2)\ x\ (860\ kg)}{\pi\ x\ 8}\ x\left(\frac{N}{1000\ kN}\right) = 0.671\ kN - m/m$$

The NCT stress ratios of the secondary lid bolts were calculated following the procedure outlined in the RT-100 SAR, Revision 8. As shown in Table 2 below, the impact of including vibration-induced loads is not significant in comparison with the stress ratios without vibration loads. Additionally, there is a significant safety margin on the secondary lid bolts for NCT loads.

**Table 2. Secondary Lid Bolts (NCT) Stress Ratio Comparison**

| Stress Ratio | With Vibration Loads | Without Vibration Loads |
|---|---|---|
| Axial stress ratio (Rt) | 0.53 | 0.52 |
| Combined stress ratio ($Rt^2 + Rs^2$) | 0.28 | 0.27 |
| Stress intensity ratio (Ri) | 0.56 | 0.56 |

In summary, Robatel didn't combine the vibration-induced load with NCT loads from other sources since it does not cause a significant reduction in the safety margins of the primary and secondary lid bolts.