Model No. GP-01, Revalidation Review
NRC staff feedback to the applicant's responses to RAI-M-6
as it relates to the structural evaluation (in *Blue and Italics* fonts)

1) Lifting cycles:

The outer receptacle being not a leak tight vessel, the lifting parts of the outer receptacle (stainless steel and rod bolts) are not subject to differential pressure.

For the stainless steel plates:

- thermal expansion: according to the thermal evaluation (see Fig. II-B-9), thermal gradient between the components can be assumed to be null; so, no thermal stress may occur.
- alternative stress due to variation of lifting force: the handling operations are performed with adapted devices which ensure no significant variations of lifting force. No fatigue stresses would be attended for this case.

For the rod bolt, additional variation on stress may depend on:

- thermal expansion of the components between the initial conditions when the torque is applied and the transport conditions,
- lifting load (resulting of the package mass and lifting factor due to the handling operations).

a) Considering an eventual thermal expansion between the components, the increase of load into the rod bolts is evaluated.

The increased of load per bolt due to thermal expansion would be around 5,530 N. The associated increase of stress into the bolt will not exceed 35 MPa.

b) Regarding the variation on stress due to loading

According to §A.4.4.5, taking into account an incertitude of 4% on the tightening torque, the minimal stress into the screw is given by the following formula …

Variation on stress into the screws is then:

For the rod bolt, total additional variation on stress would be around 60 MPa which does not impact the conclusion of the fatigue analysis regarding the current safety margin (alternative stress of 92.3 MPa for a criterion at 206 MPa).

Conclusion of the fatigue analysis of the lifting part will be then unchanged.

NRC staff feedback: *The applicant's response is generally acceptable. The staff noted that the applicant refers to alternating stress values in the fatigue analysis for rod bolts, which ignore the influence of any local stress-raising feature to accurately predict the behavior of the component, for example, at the discontinuity or change in cross section of the "member" (e.g., plate with a hole, bolt threads, etc.). The applicant should consider alternating stresses that account for stress increases at a local discontinuity by considering stress concentration factors in their fatigue calculation or provide rational for not considering it.*

2) Inner receptacle pressurization cycles:

For the stainless steel of the inner receptacle:

- thermal expansion: according to the thermal evaluation (see Fig II-B-9), thermal gradient between the components appears to be low, around 8°C, which is no significant to occur relevant thermal stress into the structure.
- alternative stress due to variation of loading during transport is assumed to be negligible as they are low compared to the stresses occurred by variation of pressure.

For the rod bolts (identical to those of the outer receptable), on the basis of the answer to item No. 1) above, the total additional variation on stress will be less than 60 MPa, which appears not significant regarding the current safety margin (alternative stress of 92.1 MPa for a criterion at 206 MPa).

Conclusion of the fatigue analysis of the inner receptacle will be then unchanged.

NRC staff feedback: *The NRC staff comment is the same as item No. 1) "Lifting cycle" for rod bolts.*

3) Vibration cycles

As exposed in the fatigue analysis of the package, the level of stresses in the structure is then that the allowable number of cycles is closed to infinite which covers largely the need for the package (6,400 cycles of transport).

Cumulative stresses due to variation of loading appears not significant. The effect of fatigue on the vibration analysis is then without consequence.

NRC staff feedback: *The staff does not agree with the applicant's response that 6,400 No. of cycles (cycles) for lifting operations is also applicable to the fatigue analysis for vibration cycles that occur during transport operations. The package components could experience many vibration cycles from numerous vehicle transports by road during the 80-year service life and can significantly exceed 6,400 cycles. As part of aging management program, the applicant should address fatigue analysis for vibrations cycles in more detail to show fatigue failure will not occur.*

If such a fatigue evaluation cannot be performed, or if the fatigue evaluation cannot show adequate protection against fatigue failure considering the combined effects, the applicant should provide proposed inspection methods, inspection equipment, and personnel qualification requirements for detection of fatigue effects like those requested in RAI-M-8.

4) Thermal stress cycles

The applicant did not consider thermal stresses due to cyclical fluctuation given that the regulatory thermal analysis performed in the SAR appears to be very penalizing regarding the expected conditions of transport of the package. Thermal stresses due to cyclical fluctuation appears as not significant regarding the regarding the fatigue analysis.

Model No. GP-01, Revalidation Review
NRC staff feedback to the applicant's responses to RAI-M-6
as it relates to the structural evaluation (in *Blue and Italics* fonts)

NRC staff feedback: The applicant needs to clearly explain why they did not consider the thermal stresses due to cyclical fluctuation and the rationale for stating that these "appear as not significant."