November 15, 2012

Mr. Teo Grochowski, Chief Executive Officer
Robatel Technologies, LLC
5115 Bernard Drive
Suite 304
Roanoke, VA 24018

SUBJECT: REQUEST FOR SUPPLEMENTAL INFORMATION FOR THE REVIEW OF THE MODEL NO. RT-100 PACKAGE

Dear Mr. Grochowski:

On October 9, 2012, Robatel Technologies, LLC, submitted an application for approval of the Model No. RT-100 package as a Type B(U)-96 package. The staff performed an acceptance review of your application to determine if it contained sufficient technical information in scope and depth to allow the staff to complete a detailed technical review.

This letter is to advise you that, based on our acceptance review, the application does not contain sufficient technical information. The information needed to continue our review is described as Request for Supplemental Information (RSI) in the enclosure to this letter. Please note that addressing these RSIs does not preclude the staff from issuing further Requests for Additional Information (RAIs) during the course of the detailed technical review of this application.

In order to schedule our technical review, the RSI responses should be provided by November 28, 2012. If the RSI responses are not received by this date, the application may not be accepted for review and the staff may discontinue any further review.

Please reference Docket No. 71-9365 and TAC No. L24686 in future correspondence related to this request. If you have any questions regarding this matter, I may be contacted at (301) 492-3408.

Sincerely,

/RA/

Pierre Saverot, Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety
and Safeguards

Docket No. 71-9365
TAC No. L24686

Enclosure: Request for Supplemental Information

Mr. Teo Grochowski, Chief Executive Officer
Robatel Technologies, LLC
5115 Bernard Drive
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Roanoke, VA 24018

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Enclosure: Request for Supplemental Information
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ADAMS Accession No. : ML12324A057

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NAME:	PSaverot		ZLi		JChang		SDePaula		JBorowski		NDay	
DATE:	11/06/12		11/6/12		11/8/12		11/7/12		11/9/12		11/06/12	
OFC:	SFST	E	SFST	C	SFST	C	SFST	C	SFST	E	SFST	C
NAME:	DPstrak		MRahimi		MSampson		MDeBose		BWhite			
DATE:	11/8/12		11/6/12		11/13/2012		11/15/12		11/14/12			

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Request for Supplemental Information
and Observations
for the
Model No. RT-100 Package
Docket No. 71-9365

This Request for Supplemental Information (RSI) identifies information needed by the staff in connection with its acceptance review of the Robatel Safety Analysis Report, Revision No. 0, dated October 9, 2012. The requested information is listed by chapter number and title in the applicant's Safety Analysis Report.

Chapter 1 – General Information

1.1 Describe the types of metals housing the content's media, and the potential reactions of the metal(s) with both the contents and water.

The applicant noted in Section 1.2.2.3 of the application that contents may also include metal(s) housing the media. The applicant should describe the types of metals and their potential reactions with contents and water.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.33(a)(5)(v) and 71.33(b)(3).

1.2 Clarify the maximum allowable shipping time for the package.

The applicant explained in Section 1.2.2.6 that "the shipper will ensure that the total amount of hydrogen gas……and during twice the expected shipping time will be limited to a molar quantity that would be no more than 5% by volume of the secondary container void at STP conditions." The applicant should clarify the maximum allowable shipping time, i.e., number of days, within which transportation will be completed and for which the amount of hydrogen generation will be evaluated.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.43(d).

Licensing Drawings and Bill of Materials

1.3 Provide legible versions of the Bill of Materials and licensing drawings in Appendix 1 of the application.

The Bill of Materials and licensing drawings are critical elements of an application that describes the package's design. The detailed drawings that were provided were not clearly legible. A detailed review cannot be completed without legible licensing drawings.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.31(a).

Chapter 2 – Structural Evaluation

2.1 Clearly indicate which material properties were used for the impact limiter analysis in Section 2.13 of the application. Tabulate the static and/or dynamic stress-strain curves, as applicable, that were used to analyze the impact limiters. Identify the level of variability that is considered in the analysis and justify any deviations from the manufacturer's recommendations of ±15% for densities greater than 8 pcf and ±20% for densities less than or equal to 8 pcf. Justify the use of temperature-independent thermal conductivity values for the polyurethane foams: FR-3705, FR-3720, and FR-3740, as indicated in Table 3.2-1 of the application.

The package evaluation is largely dependent on the material properties used as inputs to the analytical models. However, the properties used for the impact limiter foam were either not clearly identified nor justified in some cases.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.35(a).

2.2 Revise, as appropriate, Attachment 2.13-B, Volume II, "Verification of Selected Crush Strength Strain Equation Form," by clarifying the following:

a. Justify the use of foam crush strength data in the "densification region," particularly for strains beyond 60%. Explain how lock-up is considered and evaluated in the analysis.

   Earlier versions of the *General Plastics LAST-A-FOAM FR-3700 for Crash and Fire Protection of Nuclear Material Shipping Containers* (NRC ADAMS ML050410066) indicate that the polyurethane foams begin to lock up and shouldn't be pushed beyond strains of 60%. Use of foam property data in the densification region may have a significant effect on calculated deceleration values.

b. With respect to the BAM results presented in the 2012 paper by Eva M. Kasparek, et al., (Reference 1), explain whether the **true** (boldface added) stress-logarithmic strain relations are used for arriving at Equation 2 of page 2-64, Volume II, for extrapolating the General Plastics foam testing data for foam strains greater than 70%.

   The stress-strain plots of the BAM paper appear to be associated with true strains. However, it is unclear, from Figures 1 and 2 of Attachment 2.13-B, Volume II of the application, whether Equations 1 and 2 are formulated with true strains. If, indeed, true strains were considered in Equations 1 and 2 for comparing the BAM test results with the equation-extrapolated stress-strain curves, also explain how true strains were used in the numerical integration solution, in Section 2.13.3.1, for calculating dissipated energy, deceleration, velocity, and crush depth of the RT-100 package impact limiter.

c. Provide an appropriate reference for Table 2.13.4.1-1, "Crush Strength for Cask 125B – Excerpt from Reference 37."

   Section 2.12, "References," of the application, cites, as Reference 37, the 2012 BAM paper by Eva M. Kasparek, et al. However, in a cursory staff review of Sandia National Laboratory (SNL) Report, SAND85-2129/UC-71, as cited in Section 2.14.4.1, "Verification with Published Data," Volume II, of the application, the staff could not find the tabulated crush strength curves as presented in Table 2.13.4.1-1 for the NuPac 125B ¼-scale cask drop tests.

d. Provide a summary, in the application, of the foam crush strains, including locations where they developed in the impact limiter, corresponding to the maximum decelerations reported in Table 2.13.4.1-3, "Maximum Decelerations Summary," to facilitate staff's review of the impact limiter performance.

   The calculated maximum decelerations can be very much dependent on the foam crush strain beyond 60%. The peak strains reached at key impact limiter locations are, therefore, needed to help assess the impact limiter performance during a 30-ft free-drop accident.

e. Provide the General Plastics/Robatel benchmarking drop testing report for the FR 3700 series foam used in the impact limiters.

   Staff notes that the impact limiter is constructed of multiple foam components. Each component has a different geometric configuration and density. Provide the report, with a schematic of an impact limiter assembly that documents the impact limiter response in a physical drop test. Include test article fabrication information that links the test article to the proposed design.

The information cited in Items a through e above is needed by the staff to determine compliance with the requirements of 10 CFR 71.73(c)(1).

2.3 Justify that the numerical integration can terminate before reaching "apparent" peak decelerations for the deceleration vs. time plot displayed on page 2-29 and 2-30, Volume II. In addition, discuss the differences between the NuPac Cask 125B and the RT-100 impact limiter designs that may influence the correlation between the analytical results and the package behavior, considering differences in foam formulation, inclusion of more than one foam formulation, and complexity of the geometry, at a minimum.

The calculation is incomplete to demonstrate verification or benchmarking of the Enercon impact limiter analysis methodology. The calculated deceleration time histories do not appear to have reached plateaus, which indicate that higher calculated decelerations could result. The calculated deceleration is not conservative in all cases for the NuPac Cask 125B case and it is not clear that trending that is observed would translate to the Model No. RT-100 package design.

The information is needed by the staff to determine compliance with the requirements of 10 CFR 71.73(c)(1).

2.4 Provide a summary description of the rigid body decelerations under a 30-ft free drop hypothetical accident condition in Section 2.7.1 “Free Drop,” Volume I, of the application, to demonstrate that consistent loading conditions are considered for structural integrity analysis of the packaging components.

Page 2-69, Volume I, of the application states, “The inertia loads imposed upon the cask by the impact limiter…being acted upon by a design deceleration value of **60 g** (boldface added) for the 30-ft end-drop case.” It is unclear why the design deceleration is far less than all of the values reported in Table 2-13.4.2.1.1-1, “Maximum Decelerations Summary for 9.0 m End-Drop Case.” Please note that this request applies to all other drop orientations.

The information is needed by the staff to determine compliance with the requirements of 10 CFR 71.73(c)(1).

2.5 Provide a report consistent with ISG-21 to ensure that computational modeling for finite element analysis is properly and sufficiently done.

Staff noted that reports ST-402 and ST-403 document normal conditions and hypothetical accident condition tests. However, the reports do not adequately address the criteria listed in ISG-21 “Use of Computational Modeling Software.”

Of particular interest, but not limited to, staff is interested in the applicant’s selection of elements and the meshing scheme. Sensitivity analyses should also be incorporated in the element selection/meshing methodology. Also, the applicant needs to benchmark the “ability of the code” and their “use of the code” against a physical drop or other established test. Note that these studies may be applicable to some drop/load cases, and not others (e.g., side drop vs. lid down end drop).

ISG-21 is a comprehensive review protocol that provides a complete discussion on modeling techniques and practices, discussion of computer model development, computer model validation, justification of bounding conditions/scenarios, description of boundary conditions and assumptions, documentation of material properties, description of model assembly, discussion and justification of selected loads and time steps, and sensitivity studies. In order for the applicant to use computational modeling software for finite element analysis, a report that addresses all of these issues is deemed to be necessary.

This information is needed by the staff to determine compliance with the requirements of 10 CFR 71.31(a)(2), 71.31(b), and 71.35(a).

<u>Observations</u>

2.1 Revise descriptions of the package containment boundary acceptance criteria, including those of Section 2.1.2.1, “Cask Body Criteria,” and Section 2.1.4, “Identification of Codes and Standards for Package Design,” to ensure consistent alignment of stress acceptance criteria defined in the codes and those implemented in the application. Also, revise, as appropriate, page 2-11, Items 3 and 5 descriptions on using the ASME, Section III, Division 3, WB-3200 criteria for evaluating the package containment boundary shell.

Section 2.1.2.1 states, "The criteria for the cask shells and lids are developed per Regulatory Guide (R.G.) 7.6." In addition to noting R.G. 7.6 as the codes and standards used for the package, Section 2.1.4 also cites NUREG/CR-3854 for the package containment system design per the ASME Code, Section III, Subsection ND. As noted below, citation of multiple codes/standards is confusing in that it mandates use of different types of reported stress for acceptance criteria consideration.

a. The R.G. 7.6 design-by-analysis stress evaluation is based on ASME Code, Section III, Subsection NB, for Class 1 nuclear containment vessel, which considers stress intensity limits acceptance criteria. R.G. 7.6 does not allow Subsection ND design stress evaluation, which is based on allowable stress limits associated with maximum normal stresses instead for the Class 3 nuclear containment vessels.

b. R.G. 7.6 Positions 4 and 7, as cited above for Items 3 and 5 of page 2-11, Volume II, are not explicitly related to the Division 3, Subsection WB-3200, provisions. They should not be used as guidance for the RT-100 containment evaluation without proper justification for code use exceptions.

c. NUREG/CR-3854 accepts ASME Code, Section III, Subsection ND, stress acceptance criteria for Category II shipping package, which applies to the Model No. RT-100 package. However, as described in pages 2-5 and 2-6, if the containment shell stress evaluation is performed with R.G. 7.6 consistent, Subsection NB criteria, it should properly be presented throughout the application, including those described in Sections 2.1.2 and 2.1.4 of the application.

This information cited in Items a through c above is required by the staff to determine compliance with the requirements of 10 CFR 71.31(c).

2.2 Revise Section 2.7.1 of the application to clarify the 9-m free-drop HAC package rigid body decelerations considered for stress evaluation of the package containment boundary components for individual drop orientations. The applicable rigid body decelerations and bases for their determination should clearly be presented in Section 2.7, which addresses the free-drop HAC.

The second sentence, third paragraph, page 2-69, Volume II, of the application states, "[T]he inertia loads imposed upon the cask…by a design value of 60 g for the 30-ft end-drop case." Although, as noted in the last sentence of the preceding paragraph, "…the discussions in the following sections refer to Section **2.6.7** (boldface added)…" the inertia load accelerations called out in Section 2.6.7 are 44 g and 52 g for the end and side drop conditions, respectively, are different from the 60 g cited in Section 2.7.1. This observation is also applicable to Sections 2.7.1.2, "Side Drop," and 2.7.1.3, "Oblique Drop," for which no deceleration g-loads are presented.

This information is required by the staff to determine compliance with the requirement of 10 CFR 71.73(c)(1).

2.3 Editorial and Typographical Errors – Staff noted that the application contains numerous typographical errors along with incorrect references, e.g., pages 2-6, 2-11, 2-22, 2-86, etc. Please perform an holistic review of the application to ensure its readiness for staff's detailed technical review.

Also, regarding the impact limiter analysis, revise the application to ensure proper representation of the safety analyses performed for the impact limiter, including:

a. Insert section, "2.13.2 Methodology," to page 2-7, Volume II.
b. Realign "2.13.3.4 Side-Drop Case" to follow "Section 2.14.4.3 Pin Puncture," as appropriate, on page 1-3, Volume II.
c. Relocate "2.13.3.3 Crush Force," in page 2.14, Volume II, to follow completion of the Section 2.13.3.2 crush strength presentation, as appropriate.
d. Correct the underlined typo, "Section X.2.3," on pages 2-18 and 2-21, Volume II.
e. Correct the underlined typo, "Figure 2.13.4.1-4…(Side-Drop Case)."
f. Correct the underlined typo, "Figure 2.13.4.1-5…(Corner-Drop Case)."
g. Add caption to the plot on page 2-30, Volume II.
h. Correct the underlined typo, "Table 2.13.4.2.1.1-2 Maximum Decelerations …"

This information cited in Items a through h above is required by the staff to determine compliance with the requirement of 10 CFR 71.1(b) and 71.31(a)(1).

Chapter 3 – Thermal Evaluation

3.1 Clarify the maximum average temperatures of the gas in the package cavity under NCT and HAC.

Staff noted that the maximum average temperatures of the gas in the package cavity were not listed in Tables 3.1.3-1 and 3.1.3-2 of the application for NCT and HAC, respectively.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.33(a)(5)(v), 71.71 and 71.73.

3.2 Provide detailed information of the seal (EPDM) used in the package.

Besides providing the melting temperature (150°C) of the EPDM seal, the applicant should also provide information regarding the resistance of the EPDM seal to very low temperature (-40°C), permeation of helium, damage by radiation, and change in hardness.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.33.

3.3 Provide the derivation of the uniform heat flux of 13.04 W/m^2.

The applicant simulated the internal heat load of 200 watts as a uniform heat flux of 13.04 W/m^2 in the thermal model but did not explain how the heat flux of 13.04 W/m^2 is derived. Such derivation should be described in the application.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.35.

3.4 Provide calculations of the pressure, due to water vapor, in the package.

The applicant assumed a condensing surface temperature at 80°C, and stated that the water pressure at 80°C is 6.87 psia without showing any calculation. The applicant should provide calculations or attach pertinent references to show how the water pressure of 6.87 psia is derived in Section 3.3.2.3 of the application.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.35.

3.5 Explain or demonstrate how the quantity of hydrogen is limited to less than 5% by volume in the Model No. RT-100 package.

The applicant assumed the quantity of hydrogen is limited to less than 5% by volume and then calculated the pressure due to gas generation. Before using a 5% limit for gas generation in calculations, the applicant should explain how the hydrogen generated in the package will be limited to less than 5% by volume.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.35 and 71.43(d).

3.6 Improve the legends and add the temperature unit in the figures of the application and Report RTL-001-CALC-TH-0201.

The applicant should revise the legends and add the temperature unit (°C or °F) in Figure Nos. 3.3.1.3-1, 3.4.2.2-3, and 3.4.2.2-6 of the application as well as Figure Nos. 9, 29, 30, 32, 34, 44, 45, 47, 48, and 50 of Report RTL-001-CALC-TH-0201 to clarify the temperature curves in which the components are represented. For example, instead of using the name (e.g., 43-TDpocketT-01) defined in the computer model, the applicant should revise the name to the real name of each component described in the application.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.35 and 71.95.

3.7 Revise the time frame in the x coordinate and round the numbers to the 0 decimal place for Figures displayed in the application and Report RTL-001-CALC-TH-0201.

For the HAC fire analysis, the applicant should re-plot the temperature history with the time frame (x coordinate) starting from 0 second of the 30-minute fire period and covering the entire period of 30-minute fire and the subsequent post-fire cooldown. The applicant should begin the x coordinate with 0 second, instead of 899.79 seconds or 8997.9 seconds, in Figure Nos. 3.4.2.2-3 and 3.4.2.2-6 of the SAR and Figure Nos. 29, 30, 32, 34, 44, 45, 47, 48, and 50 of Report RTL-001-CALC-TH-0201.

It is also suggested to round the time values in x coordinate to the 0 decimal place.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.95.

Chapter 4 – Containment Evaluation

4.1 Confirm the basis for the O-ring selection and groove dimensions.

The basis of the O-ring selection and groove dimensions should be clarified. For example, provide the vendor’s datasheet if the specifications are based on an O-ring supplier’s technical handbook.

This information is required by the staff to determine compliance with the requirements of 10 CFR 71.51.

4.2 Correlate the containment leakage rates, in Section 4 of the application, with the associated post NCT and HAC (total sequence) containment boundary closure seal system configuration.

Satisfying the ASME ND stress allowables does not demonstrate regulatory compliance with 10 CFR 71.51. Provide a detailed analysis that concludes that there will be no inelastic deformation, in reference to NUREG-1609, Section 2.5.7, for the package containment boundary closure and seal system, or that the deformation correlates to a release less than the regulatory limits (using ANSI N14.5).

This information is required by the staff to demonstrate compliance with the requirements of 10 CFR 71.51.

Observations

4.1 There appears to be missing text on page 4-6 and 4-7. For example, staff could not find Equation 4.1.

4.2 Page 4-8 states a standard leakage rate of 5.952E-6 cm3/sec whereas Table 4.3-1, the second to last sentence on page 4-10, and the second to last sentence on page 4-11, lists 6.154E-6 cm3/sec.

4.3 Section 7.1.2.2 states that seal leakage rate tests of primary seals should follow Section 7.8. However, Section 7.8 is not relevant to a seal leakage rate test.

Chapter 5 – Shielding Evaluation

5.1 Demonstrate that there is only about a 1.62 mm lead slump in the lead shield layer of the Model No. RT-100 package.

Section 5.3.1 of the SAR indicates that lead slump was considered in the HAC shielding analysis. On page 2-70, the application states that the total displacement of the lead is 1.62 mm. It was not clear how this number was determined and how it was used in the shielding analysis. Given the fact that lead will shrink during the solidification process, there may be some gaps along both the axial and radial directions in the lead layer, even without a drop impact.

The staff requests the applicant to provide justification for the assumed lead gaps under both NCT and HAC. A demonstration by testing is preferred, but not required, to provide a full and complete justification of the data. Correct the data if necessary, and recalculate the dose rates for the package under both NCT and HAC.

This information is necessary for the staff to determine if the package meets the regulatory requirements of 10 CFR 71.47 and 71.51.

5.2 Provide justification for the use of a material density of 0.65 g/cm^3 in the free gas model used for carbon and hydrogen mixture for all contents and redo the shielding analyses, if necessary.

The applicant provided, in Tables 5.6.2-1 and 5.6.2-2 (Tables 5.7.2-1 and 5.7.2-2 in the proprietary part) of the application, the gamma dose rate equivalent factors for each isotope in the package under NCT and HAC, respectively. The applicant provided, in Tables 5.6.3-1 and 5.6.3-2 of the application, the neutron dose rate equivalent factors for each isotope in the package under NCT and HAC, respectively. However, it was not clear what material density assumptions were used in those calculations. If the same material property was used in determining these data, as stated on page 5-8 of the application, i.e., a density of 0.65 g/cm^3 in the free gas model for carbon and hydrogen mixture, the results may be unreliable and, consequently, the final shielding analyses may also be not accurate.

Although acceptable for gamma emitter contents, this assumption may be incorrect for neutron dose rate calculations with heavy isotope contents because the free gas model of carbon and hydrogen mixture will provide significantly larger neutron slow-down capability and, hence, the calculations will give a lower neutron dose rate. The staff requests the applicant to examine the appropriateness of this approach for all intended contents, and recalculate the dose rates for the package if necessary, particularly for the packages with neutron emitter contents.

This information is necessary for the staff to determine if the package meets the regulatory requirements of 10 CFR 71.47 and 71.51.

5.3 Provide a justification for the use of a material density of 1.13 g/cm^3 for dose rate calculations for package under HAC and redo the analysis with the correct material density, if necessary.

From Figure 5.3.1-4 of the application, it seems that a material density of 1.13 g/cm3 was used in the model under HAC. However, it was not clear why such a content material density was used. It is particularly important to note that compaction of media for neutron shielding may significantly underestimate the dose rate outside the package because of the arbitrary increase in material density and, hence, the moderation of the neutrons traversing the media. The staff requests the applicant to examine this approach and recalculate the dose rates for the package, particularly for the packages with neutron emitter contents.

This information is necessary for the staff to determine if the package meets the regulatory requirements of 10 CFR 71.47 and 71.51.

Observation

5.1 Review and correct, if necessary, the dimensions provided in Table 5.3-1. Perform the shielding analyses with the correct dimensions.

The application provides, in Table 5.3-1, the dimensions of the package and those that were used in the models. However, the data appear to be incorrect: (i) no unit was given for any of these data, (ii) the data do not appear to be meaningful for any of the commonly used units. For example, the name of the second row of the data table is "lead" and the nominal dimension given for lead is 90. It is not clear whether here 90 means 90 cm or 90 inches. By cross checking with the MCNP input file, it looks like the dimension unit should be millimeter. The staff requests the applicant to examine the data provided in Table 5.3-1.

This information is necessary for the staff to determine if the package meets the regulatory requirements of 10 CFR 71.47.

Chapter 8 – Acceptance Tests and Maintenance Program

8.1 Describe the acceptance tests required for non-standard materials and components.

Section 8.1.5 discusses component and material tests that are required for those components and materials that meet ASME code specifications. For materials and components that are not fabricated to consensus standards, such as the impact limiter foam, describe the required acceptance tests.

This information is needed by the staff to determine compliance with the requirements of 10 CFR 71.31(c).

8.2 Revise Section 8.1.3 of the application to add the containment boundary structural tests to meet the ASME Code, Subsection NB, Article NB-6000 or ND, Article ND-6000, provisions, which require hydrostatic tests of containment boundary components at not less than 1.25 times the lowest design pressure.

The hydrostatic tests are done to meet 10 CFR 71.31(c) codes/standards compliance requirements for the packaging components and the quality assurance program provisions per NUREG -1609, Sections 8.3.1 and 8.5.1.3, respectively. The application needs to make a case to demonstrate either that the 150% maximum normal operating pressure testing is bounding or to perform the hydrostatic tests, which are based on 125% of the containment boundary design pressure.

This information is required by the staff to determine compliance with the requirement of 10 CFR 71.31(c), 71.37(b).