Request for Additional Information
Materials Evaluation
Docket No. 71-3090
Model LEUPA
TS-R-1 2009

M-1-1. Provide the following information for the materials related to the fabrication of the package's components:

a. For all licensing drawings, a complete bill of materials detailing all package components, their respective material specifications, drawing views, sections and details of all packaging component fit-up. For example:
   i. components' lengths and thicknesses, tolerances,
   ii. gaps,
   iii. weld locations,
   iv. weld processes,
   v. weld size,
   vi. weld filler material,
   vii. nondestructive testing methods/inspection techniques, and
   viii. sections and/or views showing the location of lids and canister walls.

b. Properties of the materials at temperature ranges from -40^{o}C up to the maximum temperature that will be observed by the package. For example:
   i. yield stress,
   ii. tensile rupture values,
   iii. Young's modulus,
   iv. yield strain,
   v. rupture strain, and
   vi. Poisson's ratio.

c. Translated versions of standards used to describe package materials.

The applicant should revise all the applicable documents in the application to incorporate the response to this question.

For example, Drawing No. 0908-LE01-3AEI004-A does not include a complete description of the materials and corresponding specifications for the components of the Model No. LEUPA package. Licensing drawings should include and provide a bill of materials with details about all package components and their material specifications traceable to a national consensus standard such as the International Standards Organization (ISO),[1] American Society of Testing Materials (ASTM), or American Society of Mechanical Engineers (ASME).

[1] Also known as the International Organization For Standardization.

Note: The drawing mentioned in this question is only an example.

This information is needed to confirm compliance with the requirements in paragraphs 807(b), 807(g), and 807(h) of TS-R-1.

ANSWER:

a. **All licensing drawings include a complete bill of materials detailing all package components, their respective material specifications, drawing views, sections and details of all packaging component fit-up.**
Components' lengths and thicknesses, tolerances, gaps, weld locations, weld sizes and non-destructive testing methods/inspection techniques are detailed in all drawings and where necessary. However, if a drawing includes pieces that have their own drawings, in the drawings of those pieces, the information required is detailed.
Regarding the process of welding and filler material, the details are as follows:

Security-Related Information Figure Withheld Under 10 CFR 2.390.

Security-Related Information Figure Withheld Under 10 CFR 2.390.

Sections and/or views showing the location of covers and canister walls are detailed completely in drawing No. 0908-LE01-3AEIN-010 "Packaging – Main Body".

b. The properties of the materials at temperatures ranges required, are included in document 0908-LE01-3BEIN-026 - ANALYSIS OF THE LEUPA PACKAGE IMPACT TEST.

c. All the standards used to describe package materials are detailed in all drawings. If a drawing includes pieces where a material is mentioned without detailing it (for example "Stainless Steel"), it is because that piece has its own drawing where the required information is detailed (standard).

M-1-2. Provide details about the processes used for "filtering" and pouring cadmium by gravity into the package. Include the following information in your response:

a. precautions when handling cadmium,

b. impact of cadmium on all closure welds, and

c. package maintenance.

In Section 1.2 of Document No. 908-LE00-3BEIN-023-A, the applicant briefly mentions that cadmium is poured by gravity, but does not include details about the technique or processes to ensure the safe handling of cadmium during the fabrication and operation of the package.

This information is needed to confirm compliance with the requirements in paragraphs 613 and 638 of TS-R-1

ANSWER:

a. We are sending a cadmium infiltration procedure (please see document "CADMIUM PROCEDURE"), prepared by the manufacturer, which includes details on the infiltration procedure. In turn, the answer to item Cr-3 of the 1st RAI is also applicable to clarify issues regarding cadmium and its infiltration.

As regards the safety during handling and the procedure, attached is the cadmium safety sheet, which has been fully complied with. It is also worth noting the work was carried out in compliance with the following items:

- **Order and cleaning at work areas: Cooperation in keeping the work area organized and free from dirt, slippery substances or waste. It is known that for melting and refining, ovens are loaded from the upper part with coke, limestone and iron or steel scrap. To reduce the risk of fall of heavy objects due to uneven loading, cleaning and supervising raw material piles are key actions.**
- **Sledgehammers and cranes with large electromagnets are used for reducing scrap to a manageable size to load the oven and hoppers. To reduce the risk of injury due to flying fragments, proper protection in the crane cabin and training of the operators on Occupational Health and Safety are necessary.**
- **Given the hazard of carbon monoxide poisoning, a breathing and resuscitation equipment shall be available, and the operators shall know how to operate it. Likewise, exposure times shall be limited.**
- **Workers shall take rigorous personal protection measures: Use of gloves, helmets, and face shields with normalized filter crystals.**

- **Glares and infrared radiation produced by ovens and metal in the process of melting cause eye injuries. Goggles selected by an occupational health and safety expert shall be used, with tight framing. Facial shields shall also be used.**

b. **The impact on welding is not taken into consideration due to the temperature of the part and the cadmium upon infiltration. This is explained below.**

The structural material of the pressurized container to which the cadmium infiltration is poured (400°C) is austenitic 304L stainless steel. This type of austenitic stainless steel has a much reduced carbon content (<0.03%), which provides high resistance to intergranular corrosion. This resistance makes sensibilization, that is to say, intergranular carbon precipitation affecting stainless steels for temperature ranges from 550°C to 850°C in the area affected by heat (ZAC) near the welding, be practically null based on a good welding procedure.

Based on the foregoing, the heating of austenitic 304L stainless steel when pouring the cadmium infiltration at 400°C should not cause any intergranular corrosion process in the welding or the ZAC. In fact, the temperature of cadmium infiltration is within the temperature range used in the thermal treatment of annealing and stress processing for this type of steel (205°C - 400°C).

Lastly, the infiltration procedure contemplates preheating of the 304L structure up to 300°C, which means the temperature difference with the cadmium infiltration is 100°C. Although the temperature difference is not enough to cause thermal shock on 304L steel, there is a chance that stress concentration points appear during the infiltration process, which should be reduced during the solidification process, since the 304L structure will go through a annealing/stress revealing process.

c. **The package maintenance is specified in the document "0908-LE00-3BEIN-026 - INSPECTION AND MAINTENANCE".**

M-1-3. Explain the effects of the HAC temperature requirements on the cadmium used in the Model No. LEUPA package. Also, discuss how the function of the cadmium remains unchanged during HAC conditions.

The melting point of cadmium is approximately 610ºF (321.1ºC). Paragraph 728 of TS-R-1 specified that the average temperature of the thermal test at

HAC is 800°C (an specimen fully engulfed in a fire for 30 minutes). The staff needs to ensure that the safety function of the cadmium is not affected during HAC.

This information is needed to confirm compliance with the requirements in paragraphs 613 and 638 of TS-R-1

ANSWER:

To ensure cadmium chambers do not reach melting temperatures, the study described in document 0908-LE00-2BEIN-015 - THERMAL ANALYSIS was carried out. This document contains a study on cadmium response when the external cover of the package is subject to a temperature of 800°C.

It was also proved in the REINFORCED THERMAL test documented in section 6.4.7 of 0908-LE02-3BEIN-008-B - Tests final report (Tests Carried Out on Specimens of the Design of Type B(U) Package to Transport Radioactive Material – Final Report), using thermocouples, that cadmium chambers do not reach melting temperatures.

Fragment of document 0908-LE00-2BEIN-015 - THERMAL ANALYSIS, table of temperatures during a 10-hour period at 900°C, we can see that the test has to be carried out for more than 3 hours to reach critical temperatures in the cadmium area, and the validation test requires only 1-hour testing.

Table 5: Thermal simulation results

Area	Cd Container		Cd Cover		Graphite Gasket		Elastomer Gasket	
θ T $[h]$	$\bar{T}$ [°C]	T_{max}[°C]	$\bar{T}$ [°C]	T_{max}[°C]	$\bar{T}$ [°C]	T_{max}[°C]	$\bar{T}$ [°C]	T_{max}[°C]
0	38.0	38.0	38.0	38.0	38.0	38.0	38.0	38.0
1	73.5	80.0	68.3	68.5	71.2	72.4	814.6	820.5
2	159.5	169.8	154.1	154.3	157.8	159.3	855.6	858.9
3	250.0	261.3	246.4	246.6	249.8	251.2	866.9	869.5
4	331.9	342.5	331.0	331.2	334.1	335.1	872.3	874.5
5	404.2	413.6	405.6	405.8	408.2	409.1	876.0	877.9
6	467.6	475.9	470.6	470.8	472.8	473.5	879.1	880.7
7	523.2	530.6	527.1	527.2	529.0	529.5	881.7	883.1
8	571.7	578.3	576.1	576.2	577.7	578.1	884.0	885.3
9	614.0	619.8	618.6	618.7	620.0	620.3	886.0	887.1
10	650.8	655.8	655.3	655.4	656.6	656.9	887.8	888.8

M-1-4. Clarify how the applicant maintains and procures components with a specific safety function in order to ensure these are available to perform its intended safety function, when needed.

As part of verifying the adequacy of the materials used for the fabrication of the package (bill of materials), the staff needs to understand if the applicant has a process or program in place for identifying and classifying the components of the package according to importance to safety during transportation. If the applicant has that type of program, the applicant should describe this program of process in the application.

This information is needed to confirm compliance with the requirements in paragraphs 618 and 637 of TS-R-1.

ANSWER:

The materials procurement method is described in section 5.2.4 Procurement and section 5.2.5.3 Identification and Traceability of document 0908-LE00-EDEIN-019-QUALITY MANAGEMENT PROGRAM.

The LEUPA project, which consists of the design and manufacturing of the LEUPA package, is rated as Level A Quality, and must therefore comply with all protocols, follow-ups and controls imposed for projects at this level. One of the Level A Quality requirements is traceability of ALL manufacturing materials and components of the package, making sure they comply with all safety requirements for the package. This is the procedure to ensure safety in all transportation and operation processes of the package.

Fragment of document 0908-LE00-EDEIN-019-QUALITY MANAGEMENT PROGRAM:

5.2.4 Procurement

5.2.4.1 Procurement Process

1. In the Project, procurement Purchases are carried out through INVAP's Supplies Division, the Head of Quality Management of the Project ensures, through established procedures, that purchased products meet the specified requirements.

2. INVAP's Supplies Division is governed by the Quality and Environmental Manual of the Supplies Division (CDAD-1003-3MEGB-006 – "Manual de Calidad y Ambiental de la Gerencia de Abastecimiento"), and the General Procurement Procedure No. C134-0000-3PEGB-001 ("Procedimiento General de Compras").

3. The Quality Manager, with participation of specific technical sectors of each specific area, carries out the following activities:

a. Evaluates, qualifies and selects suppliers based on their qualifications to meet the requirements of the purchase or subcontract, its quality system

and any other assurance aspect of the product. Using the following procedures: Suppliers Qualification ("Calificación de Proveedores") No. CDAD-2006-3PSGC-001, Suppliers Economic and Financial Assessment ("Evaluación Económica Financiera de Proveedores") No. CDAD-2006-3PSGC-007 and Suppliers Performance Rating ("Calificación de Desempeño de Proveedores") C240-0000-3PEGB-004.
b. They define the type and scope of the control exercised on each supplier. This depends on the type of product, the influence of the product supplied on the quality of the final product and, when applicable, the quality audit and/or background reports proving the capacity of suppliers.
4. The Quality Manager establishes and keeps quality records of accepted suppliers and a file with the performance assessment of those suppliers. Suppliers with an unsatisfactory assessment may be re-evaluated, upon their request, if they consider they have solved the non-conformities stated in the previous evaluation.

5.2.5.3 Identification and Traceability
1. In manufacturing activities, the traceability of outsourced materials or services leads to knowledge of suppliers and procurement management.
2. The personnel or sector involved in the manufacturing and inspection of a product is recorded in the Inspection and Testing Plan.
3. The Inspection and Testing Plan (and related quality protocols) at the manufacturing, assembly and mounting stages provide relevant information which allows to develop a product's background. This knowledge provides the possibility of detecting the causes or activities related to nonconformities and thus taking preventive and corrective actions.
4. The status of the product regarding inspection and testing is identified through the appropriate means to indicate conformity or nonconformity of the product in relation to the inspections and tests. The identification of inspection and test status is maintained throughout the entire construction of the product, in order to ensure that only products which have passed the required inspections and tests are used and integrated.
5. The applicable procedure is the Identification of Parts and Equipment procedure ("Identificación de Piezas y Equipos") No. CDAD-3001-3PSGC-006.

M-1-5. Describe the "Quality Management Program" for the LEUPA Project" for the following:

a. Section 6.1.3, Control of Nonconforming Products, and

b. Section 5.2.5.3, Identification and Traceability, mentions an "Inspection and Testing Plan"

The staff needs detailed information about the actions related to nonconforming products and identification and traceability of package components, including replacing components exhibiting signs of degradation. It is not clear if the applicant is referring to a process in which items commercially available (non nuclear-grade items) are tested and "validated" to meet the specifications of the components needed for fabricating, operating, or maintaining the package. If this is the case, the staff needs a description of the steps that the applicant would follow to ensure that a non nuclear-grade item would meet the regulatory requirements of TS-R-1.

This information is needed to confirm compliance with the requirements in paragraphs 618 and 637of TS-R-1.

ANSWER:
For non-conforming products, the following actions are taken:

IDENTIFICATION OF NON CONFORMING ELEMENTS OR PRODUCTS

1. **When a non-conforming element is detected, it is separated from the others and identified with a "Rejected" tag until the proper action is taken.**
2. **Deviations are always established with reference to a procedure, written requirement, standard or specification of the product, service or process.**
3. **The nonconformance/deviation detected must be eliminated.**
4. **When a non-conforming product is corrected, it shall undergo a new verification to demonstrate its conformance with the requirements.**
5. **When a non-conforming product is detected after delivery or when it has just been used, the organization has to take appropriate actions related to effects or potential effects of the nonconformance / deviation.**
6. **Conditions requiring prompt corrective action shall be immediately reported to the appropriate management of the assessed organization.**

Each material received for the manufacturing of components comes with a traceability sheet. Quality personnel controls that the necessary specifications, standards, size and visual controls required for the quality level are met.
Below is a fragment of document PROCEDURE TO IDENTIFY PARTS AND EQUIPMENT CDAD-3001-3PEGC-036-A.

5.2. Identification of the Material to be manufactured (Subdivided or not from the materials originally received from suppliers or from own stock). The material shall be identified indicating the following digits:

- *WP No.*
- *WO No. (if applicable)*
- *System / Sub-System*
- *Position No.*

The tagging mode shall be that indicated in item 5.1.

5.3. Identification of finished parts controlled by the Quality Division. The identification shall be carried out by means of an Identification Card, which shall remain with the part until the related assembly is carried out. Said Card shall state the control protocol number, part denomination, WP number, data and Inspector's signature and the result obtained. Green cards shall be used for Approved parts, while red ones shall be used for parts with Non-Conformities.

Parts may be identified with the approval of the person in charge of engineering or the technical representative, by means of engraving using an electric pencil where the component's functionality may not be affected. The parts shall be engraved with four digits for the system / sub-system, 3 digits for the drawing number and two digits for its position (if applicable).

M-1-6. Define dimensional units of each component of the Model No. LEUPA package.

In the "Safety Report," Document No. 0908-LE00-3BEIN-023-A, page 11 of 29, Table 2, the applicant provides the diameter and height dimensions of each component (subset) listed as (mil). The staff needs clarification about the definitions of the units used in Table 2.

This information is needed to confirm compliance with the requirements in paragraphs 618 and 637 of TS-R-1.

ANSWER:
A new version of document 0908-LE00-3BEIN-023 – Safety Report, is submitted with this amendment.

M-1-7. Describe the following for Kaolite:

a. precautions, handling, installation, and drying in order to ensure that the material meets its intended function;

ANSWER:
Attached is a document detailing the Kaolite infiltration procedure, explaining this item. The document title is KAOLITE PROCEDURE.

b. for “Package General Assembly” drawing, the relationship between the purpose of gaps/holes in steel plates and Kaolite;

ANSWER:
The purpose of the holes in the steel plates in item 11 of drawing 0908-LE01-3AEIN-010 is to make the Kaolite infiltration easier, enabling connection between empty spaces.

c. how the appropriate mechanical properties are maintained during the drying process; and

ANSWER:
Attached is a document detailing the Kaolite infiltration procedure, explaining this item. The document title is KAOLITE PROCEDURE.

d. susceptibility to galvanic corrosion with structural components of the transport package due to expected heat and moisture conditions.

ANSWER:
Corrosion of stainless steels in most environments, including alkaline and cementitious and concrete (pH 10-13), is usually dependent on the passivating layer, which limits the rate of corrosion taking it to very low values. It should also be noted that stainless steels usually are not affected negatively by effects of galvanic coupling with other materials.
The magnitude of the effect of galvanic couple depends on several factors, such as the potential difference between the metals or alloys involved in the pair, the relative areas of the coupled metal and the electrolyte conductivity.
Most cement and concrete have a high resistance to ion beam current, so it is likely that the distances over which can operate galvanic effects are well localized areas of the container. This causes the potential galvanic couples that may arise in waste containers may be temporary, since the galvanic coupling can occur through a contact point concrete which is lost once the material from which stainless steel form the parse has corroded.

In the “Safety Report,” Document No. 0908-LE00-3BEIN-023-A, Section 2, item No. 12, the applicant mentions the process for adding Kaolite in the package. The applicant uses Kaolite as a thermal insulator. The application does not include a description of the process or testing to ensure that the properties of Kaolite are consistent, homogenous distribution after pouring into the package, proper precautions when handling Kaolite, and details about possible reactions between Kaolite and the package’s materials.

This information is needed to confirm compliance with the requirements in paragraphs 618, 637, and 651(c) of TS-R-1.

ANSWER:
Attached is a document detailing the Kaolite infiltration procedure, explaining this item. The document is entitled KAOLITE PROCEDURE.
Kaolite infiltration is carried out observing the precautions stated in the product's safety sheet, provided by the Kaolite supplier.
In the document KAOLITE PROCEDURE, you will find the safety sheet INFORMATION SHEET KAOLITE.

M-1-8. Provide the materials’ specifications for all gaskets, bolts, and washers used in the Model No. LEUPA package as well as precautions to ensure these components do not adversely react with other materials in the package.

Safety Report Section or Number	Page No.	Reference from the Application
Numbers 8 and 9,	7 of 29	Use of the term “elastomeric gasket.”
Section 3.1, Number 2.e.	10 of 29	“Several elastomeric and metallic gaskets…” (without mentioning material specifications in the documents in licensing drawings).
Table 2	11 of 29	“Several gasket” material listed with the general term “Nitrile.” (Rubber)

The response should include reference or information from a reliable source such as the manufacturer’s specifications sheet, a technical handbook, etc. If not available in English, the applicant should submit a translated version (English) of the document(s) supporting the response to this question.

This information is needed to confirm compliance with the requirements in paragraphs 618 and 637 of TS-R-1.

ANSWER:

The components such as rings, nuts and bolts are detailed in items 35, 34, 33, 16, 15, 14, 13 of drawing 0908-LE01-3AEIN-010-PACKAGING MAIN BODY, where the type of standard is specified.

These components are made of stainless steel and therefore do not react with the package.

Regarding separation joints of the intermediate and exterior covers, drawing 0908-LE01-3AEIN-020 - SET OF JOINTS RUBBER SUPPLEMENT, which contains the settings and materials, is being sent. Also, the materials reception sheet for these joints is attached, which contains a description of the number of pieces and type of standard.

As regards its reaction to the rest of the materials, it was proved in document 0908-LE02-3BEIN-008- TEST FINAL REPORT, that, despite all tests carried out, specially the reinforced thermal test, the joints do not react to stainless steel, and cause no inconvenient.

M-1-9. Provide the specific ASME Code and material requirements applicable to the components important to safety of the Model No. LEUPA package.

In Section 1.2 of Document No. 908-LE00-3BEIN-023-A, the applicant mentions the following:

> "Fissile substances are placed in steel non airtight vessels called –in the project context–inner cans. Each of them has an inner volume of 1.56 dm^3. LEUPA can load as much as four of these cans, which are in turn, housed in the hereby named container. This is designed in accordance with code ASME Section III, Division 1, Sub-section NB, with a useable inner volume of around 8.25 dm^3."

The applicant should provide specific information related to the ASME Codes used for all the components important to safety for the Model No. LEUPA package.

This information is needed to confirm compliance with the requirements in paragraph 638 of TS-R-1.

ANSWER:

The applicable ASME code for drawing 0908-LE01-3AEIN-005 is:

- **ASME Section III, Division 1, Sub-section NB 3100**
- **ASME Section III, Division 1, Sub-section NB 3300**

The materials shall comply with the requirements set forth in document 0908-LE00-EDEIN-019-QUALITY MANAGEMENT PROGRAM and the requirements set forth in drawing 0908-LE01-3AEIN-005.

M-1-10. Demonstrate that the package will meet the solar insolation conditions as specified in TS-R-1, 2009 Edition, Table 13, "Insolation Data."

In the "Safety Report," Document No. 0908-LE00-3BEIN-023-A, Section 5.1.4,. item No. 6, the applicant states the following:

> "The values of solar radiation of charter 13 of the Standard in Doc. 0908-LE00-3DEIN-018 attached, shall be taken into account."

The staff is not able to find the insolation data in the document referenced by the applicant.

This information is needed to confirm compliance with the requirements in paragraph 655 of TS-R-1.

ANSWER:
This document does not contain solar radiation data. Document 0908-LE00-3BEIN-023-A - SAFETY REPORT contains an explanation stating that document 0908-LE00-3DEIN-018 - TRANSPORT MANUAL took into consideration this solar radiation information.
In this case, it is as follows.

TABLE 13. INSOLATION DATA

Case	Form and location of surface	Insolation for 12 hours per day (W/m^2)
1	Flat surfaces transported horizontally — downward facing	0
2	Flat surfaces transported horizontally — upward facing	800
3	Surfaces transported vertically	200[a]
4	Other downward facing (not horizontal) surfaces	200[a]
5	All other surfaces	400[a]