71-9234

Eco-Pak Specialty Packaging
Division of CBC

July 9, 1997

Mr. Cass R. Chappell, Chief
Package Certification Section
Spent Fuel Project Office, NMSS
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852

RE: Response to Letter Dated May 27, 1997 - Questions regarding May 15, 1997 Request for Amendment of Certificate of Compliance No. USA/9234/B(U)F Docket No. 71-9234

Dear Mr. Chappell,

This letter is written to respond to the questions posed by your office regarding our May 15, 1997 request for an amendment to the Certificate of Compliance No. USA/9234/B(U)F to authorize shipment of Model No. NCI-21PF-1 packages. Please find enclosed both the response to the questions and the subsequent revised pages in the *Safety Analysis Report for the NCI-21PF-1 Protective Shipping Package* submitted February 26, 1997.

If you have any questions or need any further information, please let us know.

Very truly yours,

William M. Arnold

William M. Arnold
President

WMA/hl

Enclosures

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DRAWINGS: Located in Central Files

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STRUCTURAL

1. **The mechanical properties described in the application for the aluminum valve protection device are significantly different from the values specified in ASTM B26/B26M for Alloy 514. Provide the chemical composition of the aluminum used in the tests and describe how the "modified" Alloy 514 differs from Alloy 514 specified in the ASTM standard. The specification should also include the "ordering information" described in paragraph four of ASTM B26/B26M. Describe how the mechanical properties of the modified alloy were determined. Note that the elongation of the modified alloy does not conform to the ASTM standard.**

The aluminum inserts of the valve protection device were fabricated in accordance with ASTM Standard B26/26M Alloy 514. No special chemical, thermal or mechanical treatments were used to affect the strength and elongation properties of Alloy 514. The pages and drawings within the SAR that reference "modified" Alloy 514 have been changed and are being resubmitted.

Test Articles

A total of fifteen pieces (8 primary inserts, indicated by the VP- prefix, and 7 secondary inserts, indicated by the SC- prefix) were fabricated for compliance testing. Table 1 identifies the valve protection devices and how they were utilized in the test program. This table also relates the valve protection devices to melt-heat combinations.

Table 1
Test Articles

Melt-Heat Combination	Test Article Serial Number	Test Case
1	VP-1	Not Used
	VP-2	10 CFR 71 Hypothetical Accident Testing
2	VP-3	Preliminary Testing
	VP-4	10 CFR 71 Hypothetical Accident Testing
	VP-5	Preliminary Testing
3	VP-6	Not Used
	SC-1	10 CFR 71 Hypothetical Accident Testing & Preliminary Testing
4	SC-2	10 CFR 71 Hypothetical Accident Testing & Preliminary Testing
	SC-3	10 CFR 71 Hypothetical Accident Testing & Preliminary Testing
5	SC-4	10 CFR 71 Hypothetical Accident Testing & Preliminary Testing
6	VP-7	Not used
	VP-8	10 CFR 71 Hypothetical Accident Testing
	SC-5	Not used
7	SC-6	10 CFR 71 Hypothetical Accident Testing
	SC-7	10 CFR 71 Hypothetical Accident Testing

Chemical Composition

The manufacturer of the inserts performed chemical analyses during fabrication. Table 2 provides this information. The table below illustrates that the analyzed chemical composition is in agreement with standard ASTM B26/26M Alloy 514 chemical specification.

Table 2 - Chemical Analyses Provided by the Fabricator
Composition (Values in Weight Percent)

Element	Melt-Heat[1] #1	Melt-Heat #2	Melt-Heat #3	Melt-Heat #6	Melt-Heat #4 & #5	Melt-Heat #7	Specification B26/26M Alloy 514	
							Low	High
Mg	3.8	4.0	4.4	4.2	4.2	4.3	3.50	4.50
Si	0.16	0.11	0.04	0.02	0.10	0.03	0.00	0.35
Ti	0.12	0.11	0.10	0.10	0.11	0.07	0.00	0.25
Mn	0.07	0.07	0.06	0.07	0.06	0.06	0.00	0.35
Fe	0.28	0.27	0.30	0.26	0.25	0.25	0.00	0.50
Cu	0.03	0.03	0.02	0.02	0.03	0.03	0.00	0.15
Zn	0.05	0.05	0.04	0.05	0.03	0.05	0.00	0.15
Cr	0.01	0.01	0.01	0	0	0	0.00	0.05/0.15[2]
Al	Balance	Balance	Balance	Balance	Balance	Balance	Balance	Balance

[1] Melt-Heat numbers correspond to those provided in Table 1.

[2] No value is specified for Cr, it is below the values listed for "other elements."

In addition to the chemical composition information provided by the fabricator, independent chemical analyses have been performed on the following three aluminum inserts:

- VP-2, Primary Insert, test article used for the compliance testing of the DOT-21PF-1B protective shipping package (drop orientation - 13.5° from vertical).

- VP-4, Primary Insert, test article used for the compliance testing of the DOT-21PF-1B protective shipping package (drop orientation - 30° from vertical).

- VP-8, Primary Insert, test article used for the compliance testing of the NCI-21PF-1 protective shipping package (drop orientation - 13.5° from vertical).

These chemical analyses were performed in accordance with ASTM E101-91, "Standard Test Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique." ASTM B26/26 lists ASTM E101 as a suitable method for determining chemical composition. The results of these spectrochemical analyses are presented in Table 3 below:

Table 3 - Chemical Compositions Verified by Independent Laboratory Composition (Values in Weight Percent)

Element	VP-2 Results	VP-4 Results	VP-8 Results	B26/26M Alloy 514 Specification	
				Low	High
Mg	3.74	3.86	3.88	3.50	4.50
Si	0.16	0.14	0.10	0.00	0.35
Ti	0.11	0.09	0.09	0.00	0.25
Mn	0.05	0.05	0.05	0.00	0.35
Fe	0.23	0.28	0.15	0.00	0.50
Cu	0.02	0.02	0.02	0.00	0.15
Zn	0.05	0.05	0.05	0.00	0.15
OE	0.05	0.05	0.05	0.00	0.05
OT	0.15	0.15	0.15	0.00	0.15
Al	Remainder	Remainder	Remainder	Balance	Balance

These chemical analyses demonstrates that the aluminum inserts used during testing meet the chemical composition for Alloy 514.

Mechanical Properties

Mechanical property analyses were performed by the fabricator of the aluminum inserts on four separately cast test bars. These separately cast test bars were taken during the fabrication process but traceability to the melt-heat number could not be confirmed. These test bars were sent to an independent laboratory, where the testing was performed in accordance with ASTM Standard E8, "Tension Testing of Metallic Materials". The results of the testing are in Table 3, below.

Table 3
Mechanical Property Results from Separately Cast Test Bars of Alloy 514

Sample No	Yield Strength, psi	Tensile Strength, psi	% Elongation
1	15,580	29,080	10.0%
2	14,060	28,560	11.0%
3	16,100	24,770	---[1]
4	14,680	25,840	7.0%

[1] Value could not be confirmed

In addition to this data, mechanical property analyses were performed on specimens cut directly from the castings. For each primary insert, two specimens were taken from different locations on the insert. One specimen was taken from each secondary insert. The testing was performed by a different independent laboratory in accordance with ASTM B557, "Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products." The results of this testing is reported below in Table 4.

Table 4
Mechanical Properties from Test Articles

Specimen	Yield Strength, psi	Tensile Strength, psi	Elongation %
ASTM B26/26M, Alloy 514, minimums	9,000	22,000	6%
Typical Values[1]	12,000	25,000	9%
VP-2	13,800	26,000	4.4%
	15,100	27,300	9.4%
	13,000	30,000	11.6%
VP-4			
	15,200	28,400	12.5%
VP-7	13,400	25,000	---[2]
	16,500	27,100	7.8%
SC-1	16,700	25,000	---[3]
SC-2	16,800	25,200	---[2]
SC-4	15,300	21,800	4.4%
SC-6	15,700	24,000	---[3]

1 Typical values are for separately cast test bars published in Metals Handbook - Tenth Edition, Volume 2: Properties and Selection: Nonferrous Alloys and Special Purpose Materials, 1990, ASM International

2 Sample broke within threaded area of specimen

3 Sample broke outside of punch marks.

The mechanical property analysis indicates that the aluminum insert used during testing was Alloy 514.

Ordering Information

"Ordering Information" is provided below and has been included on SAR Drawing VPD-0002.

The requirements of 10 CFR 21 pertain to this order. All material shall be procured, fabricated and tested with the most recent version of the referenced standard at the time of manufacture.

General Requirements:

1. Casting Material: 514.0 Aluminum Alloy per ASTM B26.

2. Indent the following information into the castings:

   Vendor Name,
   Purchase Order Number,
   Drawings Number, and
   Unique Sequential Identification Number.

QA Requirements:

Records shall be maintained in accordance with 10 Code of Federal Regulations, Part 71 "Packaging and Transportation of Radioactive Materials," Subpart H, "Quality Assurance."

Additional Requirements

1. Chemical and Mechanical Testing:

1.1 Spectrochemical analysis shall be performed for each initial melt using a separately cast test bar. The chemical composition shall be determined using any of the suitable spectrographic methods listed in ASTM B26/26M. The chemical composition shall be verified against the chemical composition limits provided in ASTM B26/26M.

1.2 Mechanical testing shall be performed for each melt-heat combination using a single separately cast test bar. Mechanical testing shall be performed in accordance with suitable methods identified in ASTM B26/26M. Mechanical testing, at minimum, shall include tensile strength, yield strength (0.2% offset), and % elongation in 2 in. or 4 in diameter. The mechanical properties shall be verified against the minimum requirements provided in ASTM B26/26M.

2. Repairs:

2.1 Repairs to the bridge of the primary insert are not permissible.

2.2 Repairs to the remainder of the primary insert and the secondary inserts must be reported to the purchaser and a repair method must be agreed upon.

3. Certification

3.1 The vendor shall furnish a certificate stating that each lot has been sampled, tested and inspected in accordance with ASTM B26/26M and has met the requirements.

4. Surface Requirements

4.1 Liquid Penetrant Inspection:

4.1.1 The castings shall be inspected for surface discontinuities by liquid penetrant in accordance with ASTM E165, "Liquid Penetrant Examination" or equivalent.

4.1.2 100% inspection is required on each casting. The casting shall contain no surface cracks, cold shuts, or through wall porosity.

2. **Provide the chemical composition and material specification for the "modified" Alloy 356 T6 that is proposed as a substitute for the alloy used in the tests. Specify the procedures that will be used to determine the minimum properties of the material. This should include the procedures for determining minimum elongation. Note that these procedures may be incorporated as a condition of the approval. Specify the "ordering information" as described in paragraph four of the ASTM B26/26M and compare this with the corresponding "ordering information" that was used for the "modified" Alloy 514 material.**

The request for ASTM B26/26M Alloy 356 T6 as an alternative material is rescinded at this time. All references to Alloy 356 T6 in the SAR and its drawings have been removed and revised pages have been sent.

3. **Show that the minimum elongation of the "modified" Alloy 356 T6, at both 100°F and -20°F, will not be less than the actual elongation of the "modified" Alloy 514 that was used for testing. Describe how the actual elongation was determined for the material used in the tests.**

See response to structural comment #2.

4. **The February 26, 1997, submittal states that the 0.186 inch clearance between the valve protection device is reduced to 0.04 inches following the hypothetical accident condition tests (page 2-34). Justify that the 0.186 inch clearance is sufficient. The justification should account for the maximum height of the valve above the cylinder head, and variations in the valve length and thread engagement specified in ANSI N14.1. Show how the required clearance will be assured for each shipment and following reinstallation of new valves.**

An acceptance test (as described in Section 8.1.3 of the SAR) shall be performed verifying that the 30B cylinder can be used with a valve protection device. A gauge

has been developed for this acceptance test. This gauge incorporates the "worst" case dimensions of the primary insert of the valve protection device. This gauge accounts for the maximum height of the valve above the cylinder head and variations in the valve length and thread engagement as specified in ANSI N14.1.

Figure 1 provides a cut out view at the valve location of the gauge insert. The worst case gauge dimensions are described on this figure. Drawing VPD-0003 provides the gauge dimensions and tolerances. The gauge will be a machined piece and fabricated from either steel or aluminum. (It cannot be fabricated from material that can wear from continuous use).

A valve protection device and 30B cylinder acceptance test has been included in Chapter 8 of the SAR. The acceptance test (similar to placing the valve protection device) will consist of the following steps:

1. The cylinder (horizontal) shall be oriented with the valve in the twelve o-clock position.

2. One secondary aluminum insert shall be placed into the cylinder skirt.

3. The next secondary aluminum insert shall be placed into the cylinder skirt.

4. Once the two pieces have been placed inside of the cylinder skirt, a two to three inch space should exist between the two pieces.

5. The gauge insert shall be placed over the valve. A steel spacer shall be placed between the three pieces.

6. Install the metal spider of the valve protection device among the inserts. Verify that the bridge of the gauge insert covers the cylinder valve and is centered on the centerline of the valve.

7. Clamp the metal spider of the valve protection device in place.

8. Measure g, the minimum clearance between the valve tip and the underside of the gauge insert bridge.

9. Measure Gap, the clearance between the underside of the gauge insert and the cylinder head on the scribe line at the centerline of the 3/4" radius hole.

10. Calculate (g - Gap).

11. If (g - Gap) is greater than 3/16" (5 mm) then the cylinder and its valve are certified for use in the NCI-21PF-1 overpack.

12. If (g - Gap) is less than 3/16" (5 mm) the cylinder with its valve may not be

shipped in an NCI-21PF-1 overpack with a valve protection device.

13. Once complete, unclamp the metal spider of the valve protection device.

14. Remove the metal spider from among the inserts.

15. Remove the metal spacer from among the inserts.

16. Carefully remove the gauge insert from among the cylinder skirt.

17. Remove the secondary location inserts from the cylinder skirt.

This acceptance test shall be performed and recorded prior to first use of the cylinder/valve combination (this includes when valves have been reinstalled) with a valve protection device. It shall be re-performed and recorded with the 5 year cylinder maintenance schedule identified in ANSI N14.1.

THERMAL

The thermal conductivity of the "modified" Alloy 356 T6 is stated to be approximately 10% greater than for the alloy used in the tests. Show that the performance of the package, under the fire test condition, would not be significantly affected by this difference. This evaluation should consider the temperature of the valve (including the valve coupling and solder).

See response to Structural Comment #2.

DRAWINGS

Revise the engineering drawings of the valve protection device to include the following:

1. **The general tolerances that apply to the nominal dimensions.**

2. **The correct material (i.e. "modified" Alloy 356 T6).**

3. **The material specifications that will be used to for the modified alloy.**

4. **The minimum clearance between the valve protection device and the top of the valve.**

5. **The maximum height of the valve above the cylinder head after installation (consider the rise of the valve coupling).**

6. **The dimensions and tolerances of "h" and "i" shown on pages 2-34 of the February 26, 1997 submittal.**

1. General tolerances have been added to the drawings.

2. The correct material standard ASTM B26, Alloy 514 is on the drawings.

3. The "ordering information" for standard Alloy 514 has been provided. No "modified" alloys are included in this submittal.

4. The minimum clearance between the valve protection device and the top of the valve has not been included on the drawings, see response to DRAWING comment #6 below.

5. This dimension has not been included on the drawings. The cylinder head is fabricated in accordance with ASME Section VIII Division 1. The variations in the cylinder head curvature which affects the position of the valve are numerous. (The 30B cylinder has been manufactured internationally by several fabricators for over 25 years. Furthermore, there are variations in the cylinder head within each fabricator.) During testing and fitup of the valve protection devices on the cylinder it was noted that this dimension was not a good indication of proper fit or clearance between the VPD and the valve. To account for these variations, we have proposed that the following measurements be taken prior to use of the valve protection device:

   - a measurement of the fit between the underside of the valve protection device and the cylinder head, "g" value; and
   - a measurement of the clearance between the underside of the valve protection device bridge and the top of the cylinder valve, "gap".

6. These dimensions have not been included on the drawings. The "h" and "i" dimensions included in the SAR were taken at the expected location of the valve protection device. These dimensions were taken as a reference value to measure the valve protection device deflection. A line was scribed on top of the bridge of the primary insert of the valve protection device and then lines were scribed on either side of the "bridge" portion. The lengths of these scribed lines were recorded both pre- and post-testing. The change in height of these measurements was used to calculate the deformation of the primary insert at the location of the bridge. The measurements of "h" and "i" were taken at a location which is not repeatably measured during operation.

FIGURE 1

VPD PRIMARY INSERT
SELECTION OF WORST CASE DIMENSIONS FOR DEVELOPMENT OF GAUGE INSERT