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BWXT Y12
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U. S. Nuclear Regulatory Commission
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Minor Number Adjustment in the ES-3100 Safety Analysis Report

In the process of preparing documentation for our production order of ES-3100 shipping containers, it came to our attention that a value in the Catalog 277-4 material specification needed to be adjusted. The specification for this material is JS-YMN3-801580-A005, "Casting Catalog 277-4 Neutron Absorber for the ES-3100 Shipping Package," which is found on pages 1-109 through 1-142 of the SAR. The value in question is the minimum Loss on Drying (LOD) percentage of 25.3%.

The adjustment of this LOD percentage value from 25.3% to 30.1% was necessitated for the following reason. The LOD percentage is based on the mass loss that occurs when the 277-4 material dries after casting. The value is calculated by dividing the mass lost by the original mass. The original mass of 277-4 used to calculate the 25.3% value was taken when the material was wet (wet density of 119.03 lb/ft^3). After the 277-4 material is cast and cured for four weeks, the moisture level is less, and thus the material density is 100 lb/ft^3. When the LOD percentage is calculated using the "drier" density, the LOD representing the same hydrogen atom density of 3.2238×10^{22} atom/cc becomes 30.1%.

This hydrogen atom density (which represents the minimum available hydrogen) was used in the criticality analysis of Chapter 6. Since the hydrogen atom density of 277-4 remains unchanged, there is no impact on the criticality analysis.

In the SAR, the LOD percentage is found on pages 1-124 and 1-134. On page 1-124, the value appears in Section 4.7.3 and on page 1-134 the value is in the Loss on Drying column. This LOD percentage value does not appear in any other discussions in the SAR. Please find attached change pages 1-124 and 1-134.

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If you have any questions, please contact me at (865) 576-8254 or George Singleton at (865) 241-3854.

Very truly yours,

Jeffrey G. Arbital
Containers Program Manager

JGA:acj

Attachments: As stated

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4.6.2 Body Weldment and Neutron Absorber Form Companion Test Samples

Both the Body Weldment (drawing M2E801580A002) and the Neutron Absorber Form (drawing M2E801580A034) will have two companion sample cans cast mid way through the casting process.

a. The cast density of all companion sample cans shall be verifying the requirements in Section 4.7.1 by passing the tests found in Section 4.8.3.

b. The active neutron absorber material densities requirements in Section 4.7.2 for hydrogen and natural boron are verified as the results of the testing in Section 4.8.

c. The odd serial number companion sample cans for the Body Weldment or Neutron Absorber Form shall verify the requirements in Section 4.7.3 by passing the tests found in Section 4.8.3.

d. The even serial number companion sample cans for the Body Weldment or Neutron Absorber Form shall verify the requirements in Section 4.7.4 by passing the tests found in Section 4.8.5.

4.6.3 Heavy Can Spacer Assembly Companion Test Samples

A batch of cast Heavy Can Spacer Assembly is defined on Form D, "ES-3100 Heavy Can Spacer and Companion Sample Casting Control and Tests," as a group of 12. Take two cans from the middle of the Form D list and declare them to be companion sample cans.

a. The cast density of all companion sample cans shall be verifying the requirements in Section 4.7.1 by passing the tests found in Section 4.8.3.

b. The active neutron absorber material densities requirements in Section 4.7.2 for hydrogen and natural boron are verified as the results of the testing in Section 4.8.

c. The odd serial number companion sample cans for the Body Weldment or Neutron Absorber Form shall verify the requirements in Section 4.7.3 by passing the tests found in Section 4.8.3.

d. The even serial number companion sample cans for the Body Weldment or Neutron Absorber Form shall verify the requirements in Section 4.7.4 by passing the tests found in Section 4.8.5.

4.7 Solid Cured Neutron Absorber

Both the Body Weldment (drawing M2E801580A002) and the Neutron Absorber Form (drawing M2E801580A034) have a solid neutron absorber cast into the shape of a tube with an average volume of approximately 0.466 ft^3 and weight of 48.89 lb @ 105 lb/ft^3 (1.68 g/cc). Without accounting for any lost material, one needs 48.89×100/127 = 38.5 lb of dry mix to make this casting plus companion samples weight and waste material weight.

The ES-3100 Heavy Can Spacer Assembly (drawing M2E801580A026) solid neutron absorber shall be cast into the shape of a hockey puck inside an 8-oz. slip fit metal can with an average volume of approximately 0.008 ft^3 that weighs 0.845 lb at 105 lb/ft^3. The same type of can (8-oz. slip fit metal can) shall be used to create two verification companion casting samples per drum assembly. The verification companion casting sample cans shall be cast during the drum liner filling process with the same wet mix and a serial number that is recorded and traceable to the final part serial number. Furthermore, 12 neutron acceptance standards using the same type of can (8-oz. slip fit metal can) shall be cast following this specification but using a mix of 75% Catalog No. 277-4 with 25% catalog 277-0 (no boron).

4.7.1 Cured Neutron Absorber Density Requirements

Each batch shall result in a cured product that has a solid material density of 105±5 lb/ft^3 as verified with measurements in Section 4.8.1.

4.7.2 Neutron Absorber Boron Density Requirements

Each batch cast shall result in a cured product as a solid material that contains no less than 3.8220×10^{21} atoms/cc of natural boron in the chemical form of B_4C. Thermo Electron Corporation controls the chemical purity and quality of the proprietary mixture Catalog No. 277-4 dry mix. It is required that the Certification of Conformance Catalog No. 277-4 dry mix contains more than 5.38 weight percent of natural boron. When cast to 105 lb/ft^3 with a water content of 31.5%, Catalog No. 277-4 castings have more than 4.69 weight percent, generating 4.40×10^{21} atoms/cc of natural boron.

4.7.3 Neutron Absorber Hydrogen Density Requirements

At the minimum density of 100 lb/ft^3 and the minimum LOD of 30.1% the hydrogen is at the rejection level of 3.2238×10^{22} atoms/cc. At least one companion sample for the Body Weldment, Neutron Absorber Form, and for each ten spacer cans shall be tested by a Loss On Drying (LOD) test. The hydrogen density requirement shall be measured and described as LOD percent. The acceptable LOD percent range is from 40% to 30.1%, which can be expressed as a water density between 40 and 30.1 lb/ft^3 at the minimum density of 100 lb/ft^3 tested in Section 4.8.4.

4.7.4 Neutron Acceptance Standard Requirements

The Prompt Gamma-ray Neutron Activation Analysis (PGNAA) shall test at least one companion sample for the Body Weldment, Neutron Absorber Form, and for each ten spacer cans. The neutron acceptance standards require a specialized skill set. This neutron acceptance was developed with the help of Canberra Industries who is recommended to perform the PGNAA testing. Since the casting Subcontractor may subcontract this service, the PGNAA testing requirements shall be stated in Appendix A.

4.8 VERIFICATION TESTING

All verification testing shall be completed after the curing time is completed. This requires the Catalog No. 277-4 casting to be covered with plastic or a metal lid for 1 week and uncovered in a dry room for 3 weeks for a total cure time of 28 days.

4.8.1 As-Cast Density Measurements Tests

The solid density of the cast part shall be determined by weighing the casting container before casting, filling the casting void with water, weighing after the curing is completed (28 days after casting). After the water weight measurements are completed, the casting form shall be dried. Before casting Catalog No. 277-4, use a shop vacuum to remove all standing water from inside the casting form.

Since the density of water is known, a simple relationship between the weight differences shall determine the final as-cast density. If the cast density is beyond the acceptable range defined in Section 4.7.1, contact the Company.

$$Density = \left(\frac{28 days After - Empty}{With Water - Empty}\right) \times 62.3\ \text{lb/ft}^3 \quad @\ 70°F$$

FORM C ES-3100 Neutron Absorber Form Casting Control

Caster's Company Name			Seller's Company Name		
Part Serial Number			Drawing Number M2E801580A034		
Measured Weights ±0.5 lb	Casting Information		Comments	Operator	Witness
	Weight	Date			
Clean and Empty					
Filled with Water[a]					
After Casting					
After Casting and Clean 28 days after Casting					
Water Information	Water Weight ±0.5 lb	Water Temp.	Comments	Operator	Witness
Water Conditions[a]	lb	°F			
Casting Start Date	Air Temp. °F	Vibration Settings[b] lbf / VPM			
Operation	MCN[c]	Time	Comments	Operator	Witness
Pour Start					
Vibration Start	NA				
Vibration Stop	NA				
	Serial Number	Date	Density[d]	Operator	Witness
Neutron Absorber Form					
1 Companion Sample[e]					
2 Companion Sample[e]					

[a] Record the water weight and water temperature within 10 minutes from completion of the weighing process.

[b] Recommended vibration settings are at 450 VPM and three times the total vibrated weight. The total vibrated weight is the finish cast part and fixtures weight, for a setting of approximately 250 pound-force.

[c] A 10-digit Mixing Control Number (MCN) shall be used to define the date and the time of mixing the casting batch using the format with a 24-hour clock (i.e., 1021041515 is used for October 21, 2004 at 3:15 pm).

[d] Use the above weights to calculate the Density as shown below. If the density is greater than 110 lb/ft^3 or less than 100 lb/ft^3, then contact the Company for disposition.

[e] Use Form D, ES-3100 Heavy Can Spacer and Companion Sample Casting Control to control the Companion Sample castings.

$$Density = \left(\frac{28 Days After - Empty}{With Water - Empty} \right) \times 62.3 \text{ lb/ft}^3 \quad @ \ 70°F$$

EXEMPT FROM IO-155 (8-02)

FORM D ES-3100 Heavy Can Spacer and Companion Sample Casting Control and Tests

Caster's Company Name		MCN[a]					Casting Date[a]			Drawing Number M2E801580A026			
Serial Numbers		Can Measurement Weights ±0.01 lb						28 Day Cure Density lb/ft³		Loss On Drying		PGNAA Net Count Rate Counts/sec	
Drum (If any)	Can[b]	Empty Body Weight[c]	Filled with Water Weight	Water Temp. °F	After Casting Weight	28 Day Cure Weight	LOD Weight	28 Day Cure Density	Range 100 - 110	LOD%	LOD% Range 40 – 30.1	277-4 Can	277-3 5 can Average
Casting Operator		Casting Witness					PGNAA Technician			PGNAA Setup Number			

a A 10-digit Mixing Control Number (MCN) shall be used to define the date and the time of mixing the casting batch using the format with a 24-hour clock (i.e., 1021041515 is used for October 21, 2004 at 3:15 pm).

b Recommended vibration settings are at 450 VPM and three times the total vibrated weight. The total vibrated weight is the finish cast part and fixtures weight, for a setting of approximately 3 pound-force.

c For the same lot of sample cans, it is acceptable to use an average weight of ten can bodies and ten can lids.

$$Density = \left(\frac{28DaysAfter - Empty}{WithWater - Empty}\right) \times 62.3 \text{ lb/ft}^3 \text{ @ } 70°F \qquad LOD\% = \left[1 - \frac{(LODWeight - Empty)}{(28DayAfterCastClean - Empty)}\right] = 100\%$$

EXEMPT FROM IO-155 (8-02)