72-1004

TRANSNUCLEAR WEST

March 21, 2001
NUH61B-TNW0103-01
RMG-01-014

Mr. Timothy Kobetz
Project Manager, Spent Fuel Project Office
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Subject: Clarification of Acceptance Testing criteria of NUHOMS® 61BT DSC Poison Plates

References:
1. Revision 2 of Amendment No. 3 Application for NUHOMS® Certificate of Compliance No. 1004 (TAC No. L23137), February 16, 2001 (NUH61B-TNW0102-03).
2. Steven Baggett to Rob Grenier letter dated September 29, 2000; Revised Schedule for Review of the NUHOMS Standardized Storage System (TAC No. L23137).

Dear Mr. Kobetz:

Transnuclear West Inc. (TN West) herewith submits an updated version of Chapter K.9 included in Reference 1. This updated Chapter K.9 provides modified acceptance criteria for testing of the poison plates which are acceptable to the staff as discussed in a telelcon on 3/16/01.

TN West understands that this update was not provided for in the application review schedule (Reference 2). Hence, the issuance of the preliminary CoC and SER for the application is being delayed to April 16, 2001. This slippage is acceptable to TN West with the understanding that the staff plans to approve the final CoC/SER for the application as a direct final rule change. This expedited process for the final rule change for the 61BT amendment ensures that TN West meets its commitment to support Oyster Creek loading campaign scheduled for February 2002.

TN West believes that a couple of the sampling acceptance criteria proposed by the NRC staff in the phone call of 3/16/01 are unnecessarily onerous. Hence, TN West also submits for your review an alternate version of the two affected paragraphs.

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NMSS01 Public

Please contact Mr. U. B. Chopra (510-744-6053) or me (510-744-6020) if you require any additional information in support of this submittal.

Sincerely,

Robert M. Grenier
President and Chief Operating Officer

Docket 72-1004

Attachments: 1. Revision 3 of Section K.9 of Appendix K to the FSAR (Entire Section).

2. Alternate Version of Selected Paragraphs of Chapter K.9, Revision 3.

cc: File NUH61B.0003.01

Alternate Version of Selected Paragraphs of SAR Chapter K.9

The are two cases in which Transnuclear West believes that the wording supplied by the NRC in the phone call of 3/16/01 is unnecessarily onerous. The alternate words for these two cases, along with a supporting justification for the suggested changes are provided in the following paragraphs:

1. SAR Page K.9-4, second paragraph, "Acceptance Testing, Neutronic", for Borated Aluminum

"Macroscopic uniformity of B10 distribution is verified by neutron radioscopy or radiography of the coupons. The acceptance criterion is that there be uniform luminance across the coupon. This inspection shall cover the entire coupon. In addition, a statistical analysis of the neutron transmission results for all accepted plates in a lot shall be used to demonstrate that applying the one-sided tolerance factors for a 95% probability / 95% confidence level results in a minimum areal density greater than specified minimum value given in Table K.9-1. A lot may be defined either as all the plates rolled from a single cast ingot, or all the plates rolled from a single piece of the cast ingot. The analysis shall be based on full data set for the lot. *"For any lot which fails the test, the plate shall not be used for that level of required B10 content but may be used for alternative level of B10 for which the lot passes this test".*

The last sentence, if we are interpreting it correctly, means that if the lot fails the statistical criterion, then all plates in the lot are rejected. In practice, the alternative level of B10 loading is not useful, since a given order for canisters will all have a single specified minimum. Furthermore, the final rejection of the entire lot is not consistent with the standard practices of inspection by sampling, which provide for alternate means, usually tightened or 100% inspection, for accepting the pieces in the lot. (See, for example, ANSI/ASQC Z1.4.) Therefore, we propose the following alternate to the last sentence:

"If any lot fails this test, all plates in the lot shall be rejected. The plates may be re-examined by neutron transmission testing at four points on each plate as described below. Acceptance may be based on one of the following three criteria:

a) Individual plates may be accepted by verifying that none of the four points falls below the acceptance criterion, or

b) Selected plates may be re-examined, and the average of the four plate data plus the coupon datum used in a revised statistical analysis in place of the original coupon datum. The lot may then be accepted if the revised statistical analysis meets the acceptance criterion stated above, or

c) *If reduced sampling was used after the first 25% of the coupons, 100% of the coupons may be examined, and the statistical analysis revised with this larger sample. The lot may then be accepted if the revised statistical analysis meets the acceptance criterion stated above."*

2. SAR Page K.9-9, second paragraph, "Acceptance Testing, Neutronic", for Metamic®

"The areal density of B10 in Metamic® will be verified by coupon removal, sampling, and neutron transmission testing as described above for Boralyn® in Section K.9.1.7.B. The acceptance criteria of Table K.9-3 shall apply to Metamic® as well."

The testing for uniformity by neutron radioscopy and statistical analysis is well beyond the requirements of regulatory guidance for 75% credit. If this material is inspected by the neutron transmission testing only, it will still produce the data required to perform the statistical analysis for information. This can then be used to determine if an amendment application to obtain 90% credit is appropriate for this material, at which time, more stringent testing could also be imposed. There, we propose the following wording for this paragraph:

"The areal density of B10 in Metamic® will be verified by coupon removal, sampling, and neutron transmission testing as described above for Boralyn®, *except that radiography/radioscopy and statistical analysis of neutron transmission results are not required.* The acceptance criteria of Table K.9-3 shall apply to Metamic® as well."

K.9 Acceptance Tests and Maintenance Program

K.9.1 Acceptance Tests

The acceptance requirements for the NUHOMS®-61BT System are given in the existing FSAR with the exceptions described in the following sections. The NUHOMS®-61BT DSC has been enhanced to provide leaktight confinement and the basket includes an updated poison plate design. Additional acceptance testing of the NUHOMS®-61BT DSC welds and of the poison plates are described.

K.9.1.1 Visual Inspection

There are no changes associated with this amendment.

K.9.1.2 Structural

The NUHOMS®-61BT DSC confinement welds are designed, fabricated, tested and inspected in accordance with ASME B&PV Code Subsection NB [9.1] with exceptions as listed in Section K.3.1. The following requirements are unique to the NUHOMS®-61BT DSC:

- The inner bottom cover weld is inspected in accordance with Article NB-5231.
- The outer bottom cover weld root and cover are penetrant tested.
- The canister shell longitudinal and circumferential welds are 100% radiographically inspected.
- The outer top cover plate weld root, middle and cover are penetrant tested.

The NUHOMS®-61BT DSC basket is designed, fabricated, and inspected in accordance with ASME B&PV Code Subsection NG [9.1] with exceptions as listed in Section K.3.1. The following requirements are unique to the NUHOMS®-61BT DSC:

- The fuel compartment wrapper welds are inspected in accordance with Article NG-5231.
- The fuel compartment welds are inspected in accordance with Article NG-5231.

K.9.1.3 Leak Tests

The NUHOMS®-61BT DSC confinement is leak tested to verify it is leaktight in accordance with ANSI N14.5 [9.2].

The leak tests are typically performed using the helium mass spectrometer method. Alternative methods are acceptable, provided that the required sensitivity is achieved.

K.9.1.4 Components

No changes associated with this amendment.

K.9.1.5 Shielding Integrity

No changes associated with this amendment.

K.9.1.6 Thermal Acceptance

The analyses to ensure that the NUHOMS®-61BT DSCs are capable of performing their heat transfer function are presented in Section K.4.

K.9.1.7 Poison Acceptance

Functional Requirements of Poison Plates

The poison plates only serve as a neutron absorber for criticality control and as a heat conduction path; the NUHOMS®-61BT DSC safety analyses do not rely upon their mechanical strength. The basket structural components surround the plates on all sides. The radiation and temperature environment in the cask is not sufficiently severe to damage the aluminum matrix that retains the boron-containing particles. To assure performance of the plates' Important-to-Safety function, the only critical variables that need to be verified are thermal conductivity and B10 areal density as discussed in the following paragraphs.

Thermal Conductivity Testing

The poison plate material will be qualification tested to verify that the thermal conductivity equals or exceeds the values listed in Section K.4.3. Acceptance testing of the material in production may be done at only one temperature in that range to verify that the conductivity equals or exceeds the corresponding value in Section K.4.3.

Testing may be by ASTM E1225 [9.3], ASTM E1461 [9.4] , or equivalent method, performed on a sample of specimens removed from coupons adjacent to the final plates (see Section K.9.1.7 for more detail on coupons).

B10 *Areal* Density Testing

There are three types of NUHOMS®-61BT DSC baskets (Type A, B, and C), each identical with the exception of the minimum B10 content in the poison plates, as described in Table K.6-1. Only one type of poison plate is used in a specific NUHOMS®-61BT DSC, based on the maximum enrichment of the fuel that will be placed in the NUHOMS®-61BT DSC. There are three acceptable poison materials, Boral®, Borated Aluminum and Boron Carbide/Aluminum Metal Matrix Composite (MMC). There are two variations on the MMC, one with billets produced by vacuum hot pressing, and the second produced by cold isostatic pressing followed by vacuum sintering. All materials shall be subject to thermal conductivity, dimensional, and visual acceptance testing. The B10 areal density and uniformity of the poison plates shall be verified, based on type, using approved procedures, as follows.

A. Borated Aluminum Using Enriched Boron, 90% B10 Credit

Material Description

The poison consists of borated aluminum containing a specified weight percent (wt. %) boron, depending on the NUHOMS®-61BT DSC Type, which is isotopically enriched to 95 wt. % B10. Because of the negligibly low solubility of boron in solid aluminum, the boron appears entirely as discrete second phase particles of AlB_2 in the aluminum matrix. The matrix is limited to any 1000 series aluminum, aluminum alloy 6063, or aluminum alloy 6351 so that no boron-containing phases other than AlB_2 are formed. Titanium may also be added to form TiB_2 particles, which are finer. The effect on the properties of the matrix aluminum alloy are those typically associated with a uniform fine (1-10 micron) dispersion of an inert equiaxed second phase.

The cast ingot may be rolled, extruded, or both to the final plate dimensions.

The specified wt. % boron for full thickness (0.305 inch) plates, by NUHOMS®-61BT DSC Type is given in Table K.9-1. For example, the 2.1 wt. % converts to a nominal areal density of B10 as follows: (2.69 g BAl/cm^3)(2.1 wt. % B)(95 wt. % B10)(0.305 inch)(2.54 cm/inch) = 0.0416 g B10/cm^2, which is intentionally 4% above the design minimum of 0.040 g B10/cm^2. If thinner poison sheets are paired with aluminum sheets (see drawing NUH-61B-1065), the boron content shall be proportionately higher, up to that needed to maintain the minimum required B10 areal density.

Test Coupons

The poison plates are manufactured in a variety of sizes. Coupons will be removed between every other plate or at the end of the plate so that there is at least one coupon contiguous with each plate. Coupons will generally be the full width of the plate. Thermal conductivity coupons may be removed from the full width coupon. The minimum dimension of the coupon shall be as required for acceptance test specimens; 1 to 2 inches is generally adequate. *Neutron absorption samples are taken from roughly one centimeter diameter samples through the thickness of the plate.*

Acceptance Testing, Neutronic

Effective B10 content is verified by neutron transmission testing of these coupons. The transmission through the coupons is compared with transmission through calibrated standards composed of a homogeneous boron compound without other significant poisons, for example zirconium diboride or titanium diboride. These standards are paired with aluminum shims sized to match the scattering by aluminum in the poison plates. Uniform but non-homogeneous materials such as metal matrix composites may be used for standards, provided that testing shows them to be equivalent to a homogeneous standard. The effective B10 content of each coupon, minus 3*s* based on the number of neutrons counted for that coupon, must be greater than or equal to the minimum value given in Table K.9-1.

Macroscopic uniformity of B10 distribution is verified by neutron radioscopy or radiography of the coupons. The acceptance criterion is that there be uniform luminance across the coupon. This inspection shall cover the entire coupon. *In addition*, a statistical analysis of the neutron transmission results for all accepted plates in a lot *shall* be used to demonstrate that applying the one-sided tolerance factors for a 95% probability / 95% confidence level results in a minimum areal density greater than *specified minimum value given in Table K.9-1. A lot may be defined either as all the plates rolled from a single cast ingot, or all the plates rolled from a single piece of the cast ingot. The analysis shall be based on full data set for the lot. For any lot which fails the test, the plate shall not be used for that level of required B10 content but may be used for alternative level of B10 for which the lot passes this test.*

Initial sampling of coupons for neutron transmission measurements and radiography/radioscopy shall be 100%. Rejection of a given coupon shall result in rejection of its associated plate. *Reduced sampling (50%) may be introduced based upon acceptance of all coupons in the first 25% of the lot. A rejection during reduced inspection will require a return to 100% inspection of the lot.*

In the event that a coupon fails the single neutron measurement, four additional measurements shall be made at separate locations on the plate itself. For each of the additional measurements, the value of areal density less than 3s based on the number of neutrons counted must be greater than or equal to the specified minimum value given in Table K.9-1 in order to accept the plate.

If any of those four fails, the plate associated with the measurements shall be rejected. However, the average of the five measurements made is to be used as a datum in subsequent analysis conduced on the lot. The use of the datum allows for the possibility that the rejected plate is really identical to the plate that was not rejected.

Neutron absorption samples are taken from roughly one centimeter sample through the thickness of the plate. Any data from materials which are rejected based on physical examination of the materials are not to be used in the statistical analysis. For example, rejection based on thickness or malformation detected by examination of the plate are grounds for excluding the data associated with these materials.

Justification for Acceptance Test Requirements, Borated Aluminum

According to NUREG/CR-5661 [9.5]

> "Limiting added poison material credit to 75% without comprehensive tests is based on concerns for potential 'streaming' of neutrons due to nonuniformities. It has been shown that boron carbide granules embedded in aluminum permit channeling of a beam of neutrons between the grains and reduce the effectiveness for neutron absorption."

Furthermore

> "A percentage of poison material greater than 75% may be considered in the analysis only if comprehensive tests, capable of verifying the presence *and uniformity* of the poison, are implemented." [emphasis added]

The calculations in Section K.6 use boron areal densities that are 90% of the minimum values given in Table K.9-1. This is justified by the following considerations.

a) The coupons for neutronic inspection are removed between every other finished plate. As such, they are taken from locations that are representative of the finished product. Coupons are also removed at the ends of the "stock plate", where under thickness of the plates or defects propagated from the pre-roll ingot would be most likely. The use of representative coupons for inspection is analogous to the removal of specimens from structural materials for mechanical testing.

b) Neutron radiography/radioscopy of coupons across the full width of the plate will detect macroscopic non-uniformities in the B10 distribution such as could be introduced by the fabrication process.

c) Neutron transmission measures effective B10 content directly. The term "effective" is used here because if there are any of the effects noted in NUREG/CR-5661, the neutron transmission technique will measure not the physical B10 areal density, but a lower value. Thus, this technique by its nature screens out the microscopic non-uniformities which have been the source of the recommended 75% credit for B10 in criticality evaluations.

d) The use of neutron transmission and radiography/radioscopy satisfies the "and uniformity" requirement emphasized in NUREG/CR-5661 on both the microscopic and macroscopic scales.

e) The recommendations of NUREG/CR-5661 are based upon testing of a poison with boron carbide particles averaging 85 microns. The boride particles in the borated aluminum are much finer (5-10 microns). Both the manufacturing process and the neutron radioscopy assure that they are uniformly distributed. For a given degree of uniformity, fine particles will be less subject to neutron streaming than coarse particles. Furthermore, because the material reviewed in the NUREG was a sandwich panel, the thickness of the boron carbide containing center could not be directly verified by thickness measurement. The alloy specified here is uniform throughout its thickness.

B. *Boralyn*®, 90% B10 credit

Material Description

The poison plates consist of a composite of aluminum with a specified volume % boron carbide particulate reinforcement, depending on the NUHOMS®-61BT DSC Type. The material is formed into a billet by powder metallurgical processes and either extruded, rolled, or both to final dimensions. The finished product has near-theoretical density and metallurgical bonding of the aluminum matrix particles. It is "uniform" blend of powder particles from face to face, i.e.; it is not a "sandwich" panel.

The specified volume % boron carbide, by NUHOMS®-61BT DSC Type, is given in Table K.9-2. For example, 15 volume % boron carbide corresponds to a B10 areal density of 0.15(2.52 g/cm^3 B_4C)(0.782 gB/gB_4C)(0.185 g B10/gB)(0.305 in)(2.54 cm/in) = 0.0424 g B10/cm^2, which is intentionally 6% above the design minimum of 0.040 g B10/cm^2.

The process specifications for the material shall be subject to qualification testing to demonstrate that the process results in a material that:

- has a uniform distribution of boron carbide particles in an aluminum alloy with few or none of the following: voids, oxide-coated aluminum particles, B_4C fracturing, or B_4C/aluminum reaction products,
- meets the requirements for B10 areal density and thermal conductivity, and
- will be capable of performing its Important-to-Safety functions under the thermal and radiological environment of the NUHOMS®-61BT DSC over its 40-year lifetime.

The production of plates for use in the NUHOMS®-61BT DSC is consistent with the process used to produce the qualification test material. Processing changes may be incorporated into the production process, only if they are reviewed and approved by the holder of an NRC-approved QA plan who is supervising fabrication. The basis for acceptance shall be that the changes do not have an adverse effect on either the microstructure or the uniformity of the boron carbide distribution, because these are the characteristics that determine the durability and neutron absorption effectiveness of the material. The evaluation may consist of an engineering review, or it may consist of additional testing. In general, changes in key billet forming variables such as the temperature or pressure would require testing, while changes in mechanical processing variables, such as extrusion speed, would not have to be evaluated. Increasing the boron carbide content would require testing, while decreasing it would not.

Typical processing consists of:

- blending of boron carbide powder with aluminum alloy powder,
- billet formed by vacuum hot pressing,
- billet extruded to intermediate or to final size,
- hot roll, cold roll and flatten as required, and
- anneal.

<u>Test Coupons</u>

The poison plates are manufactured in a variety of sizes. Coupons will be removed between every other plate or at the end of the plate so that there is at least one coupon contiguous with each plate. Coupons will generally be the full width of the plate. Thermal conductivity coupons may be removed from the full width coupon. The minimum dimension of the coupon shall be as required for acceptance test specimens; 1 to 2 inches is generally adequate. *Neutron absorption* *samples are taken from roughly one centimeter diameter samples through the thickness of the plate.*

Acceptance Testing, B10 Density

Effective B10 content is verified by neutron transmission testing of these coupons. *Acceptance testing is as described for borated aluminum in Section K.9.1.7.A, except that the acceptance criterion is taken from Table K.9-2.*

In *this* method, the transmission through the coupons is compared with transmission through calibrated standards containing a uniform distribution of boron without other significant poisons, for example zirconium diboride, titanium diboride, or boron carbide metal matrix composites. These standards are paired with aluminum shims sized to match the scattering by aluminum in the poison plates. Uniform but non-homogeneous materials such as metal matrix composites may be used for standards, provided that testing shows them to be equivalent to a homogeneous standard. The effective B10 content of each coupon, minus 3*s* based on the number of neutrons counted for that coupon, must be greater than or equal to the minimum value given in Table K.9-2.

Sampling of B10 density measurement shall be *in accordance with Section K.9.1.7.A for borated aluminum.*

Justification for Acceptance Test Requirements, *Boralyn*®

Macroscopic uniformity of B10 distribution is verified by the qualification testing.

According to NUREG/CR-5661

> "...Limiting added poison material credit to 75% without comprehensive tests is based on concerns for potential 'streaming' of neutrons due to nonuniformities. It has been shown that boron carbide granules embedded in aluminum permit channeling of a beam of neutrons between the grains and reduce the effectiveness for neutron absorption."

Furthermore

> "A percentage of poison material greater than 75% may be considered in the analysis only if comprehensive tests, capable of verifying the presence *and uniformity* of the poison, are implemented." [emphasis added]

The calculations in Section K.6 use boron areal densities that are 90% of the minimum values given in Table K.9-2. This is justified by the following considerations.

a) The coupons for neutronic inspection are removed between every other finished plate. As such, they are taken from locations that are truly representative of the finished product, and every plate is represented by a contiguous coupon. Coupons are also removed at the ends of the "stock plate", where under thickness of the plates or defects propagated from the pre-roll ingot would be most likely. The use of representative coupons for inspection is analogous to the removal of specimens from structural materials for mechanical testing.

b) Macroscopic uniformity of B10 distribution is verified as part of qualification testing. Thereafter it is assured by controls over the powder metallurgical process *and is verified by subsequent measurement of B10 content on coupon samples of production material.*

c) Neutron transmission measures effective B10 content directly. The term "effective" is used here because if there are any of the effects noted in NUREG/CR-5661, the neutron transmission technique will measure not the physical B10 areal density, but a lower value. Thus, this technique by its nature screens out the microscopic non-uniformities which have been the source of the recommended 75% credit for B10 in criticality evaluations.

d) The use of neutron transmission and powder metallurgical processing satisfies the "and uniformity" requirement emphasized in NUREG/CR-5661 on both the microscopic and macroscopic scales.

e) The recommendations of NUREG/CR-5661 are based upon testing of a poison with boron carbide particles on the order of 80-100 microns. The boron carbide particles in a typical metal matrix composite are much finer (1-25 microns). The powder metal manufacturing process controls and the qualification testing assure that they are uniformly distributed. For a given degree of uniformity, fine particles will be less subject to neutron streaming than coarse particles. Furthermore, because the material reviewed in the NUREG was a sandwich panel, the thickness of the boron carbide containing center could not be directly verified by thickness measurement. The metal matrix composite specified here is uniform throughout its thickness.

C. Boral® *and Metamic®*, 75% B10 Credit

Material Description, *Boral®*

Boral® consists of a core of mechanically bonded aluminum and boron carbide powders sandwiched between two outer layers of aluminum 1100, which is mechanically bonded to the core. The boron carbide particles average approximately 85 microns in diameter. The sheet is formed by filling an aluminum 1100 box with the boron carbide/aluminum powder mixture, and then hot-rolling the box. The walls of the box form the cladding, while the powder mixture forms the core of the Boral®. Additional information on the fabrication, specification, and performance of Boral® may be found in References [9.8] and [9.9].

Material Description, Metamic®

The poison plates consist of a composite of aluminum with boron carbide particulate reinforcement. The material is formed into a billet by powder metallurgical processes and either extruded, rolled, or both to final dimensions. The finished product has near-theoretical density *and metallurgical bonding of the aluminum matrix particles. It is a "uniform" blend of powder particles from face to face, i.e.; it is not a "sandwich" panel.*

Typical processing consists of:

- *blending of boron carbide powder with aluminum alloy powder,*
- *billet formed by cold isostatic pressing followed by vacuum sintering*
- *billet extruded to intermediate or to final size,*
- *hot roll, cold roll and flatten as required, and*
- *anneal (optional).*

<u>Acceptance Testing, Neutronic</u>

Boral® will be procured using AAR Advance Structures' standard specification for guidance [9.8]. In accordance with Section 7.3 of that specification, B 10 areal density will be verified by chemical analysis or by neutron attenuation testing, using a sampling plan that will verify *that the coupon meets the specified minimum values* of Table K.9-3 with 95% probability at the 95% confidence level *The procedure for data analysis shall be the same as that described for borated aluminum in Section 9.1.7.A. Both neutron absorption and chemical samples are taken from roughly one centimeter diameter sample through the thickness of the plate.*

The areal density of B10 in Metamic® will be verified by coupon removal, sampling, and neutron transmission testing as described above for Boralyn® in Section K.9.1.7.B. The acceptance criteria of Table K.9-3 shall apply to Metamic® as well.

K.9.2 Maintenance Program

NUHOMS®-61B system is a totally passive system and therefore will require little, if any, maintenance over the lifetime of the ISFSI. Typical NUHOMS®-61BT System maintenance tasks will be performed in accordance with the existing FSAR.

K.9.3 References

9.1 ASME Boiler and Pressure Vessel Code, Section III, 1998 Edition including 1999 addenda.

9.2 ANSI N14.5-1997, "American National Standard for Leakage Tests on Packages for Shipment of Radioactive Materials", February 1998.

9.3 ASTM E1225, "Thermal Conductivity of Solids by Means of the Guarded-Comparative-Longitudinal Heat Flow Technique."

9.4 ASTM E1461, "Thermal Diffusivity of Solids by the Flash Method."

9.5 NUREG/CR-5661, "Recommendations for Preparing the Criticality Safety Evaluation of Transportation Packages," 1997.

9.6 ASTM C 791, "Standard Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of Nuclear-Grade Boron Carbide."

9.7 ASTM D 3553, "Fiber Content by Digestion of Reinforced Metal Matrix Composites."

9.8 AAR Advanced Structures, "Boral®, The Proven Neutron Absorber".

9.9 AAR Advanced Structures, Boral® Product Performance Report 624.

Table K.9-1
Specified Boron Content
Borated Aluminum (90% B10 Credit)

Reference Boron Content (wt. % Boron)	**Section K.6 Analysis** B10 Content (g/cm^2)	**Specified Minimum** B10 Content (g/cm^2)
1.1	0.019	0.021
1.6	0.029	0.032
2.1	0.036	0.040
For Damaged Fuel		
2.1	0.036	0.040

Table K.9-2
Specified Boron Carbide Content
***Boralyn®* (90% B10 Credit)**

Reference Boron Carbide Content (volume %)	**Section K.6 Anaysis** B10 Content (g/cm^2)	**Specified Minimum** B10 Content (g/cm^2)
8	0.019	0.021
12	0.029	0.032
15	0.036	0.040
For Damaged Fuel		
15	0.036	0.040

Table K.9-3
Specified B10 Areal Density
Boral® *and Metamic*® (75% B10 credit)

Section K.6 Analysis B10 Content (g/cm^2)	**Specified Minimum** B10 Content (g/cm^2)
0.019	0.025
0.029	0.039
0.036	0.048
For Failed Fuel	
0.036	0.048