Packaging Management Council

Technical Requirements for Procurement of Type A Radioactive Carbon Steel Boxes

January 27, 2020

REVISION HISTORY

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Packaging Management Council (PMC) Approvals

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PMC – Chair, Sylvia McGhee — 1/27/2020 Date

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1.0 INTRODUCTION

The Packaging Management Council (PMC) has prepared these technical requirements for use by DOE contractors. This document is part of the PMC's effort to standardize practices by most, if not all, contractors. This document, along with any contractor's site-specific requirements, can be utilized to meet Department of Transportation regulations and DOE orders. If not specifically used, this document may act as a guidance document for contractors to create their own technical requirements. This document has been produced by the PMC Steel Box Working Group. Any questions, comments, or suggested changes should be directed to the PMC Coordinator.

2.0 GENERAL INFORMATION

2.1 Scope

This document identifies the Technical Requirements for US Department of Transportation (DOT) Type A, carbon steel boxes as described in this document..

2.2 Box Usage

Each standard size box and oversize box is designed and tested so that it can be used for storage incidental to the movement and/or transport of solid radioactive materials and waste, and having the material forms as described in Section 3.5 and the Appendix. Oversize boxes (reference Section 3.2(A) shall also be designed and tested so they can be used to store and/or transport [loaded] standard sized boxes. Boxes designed, fabricated, tested, and procured to this specification are to be utilized only for solid, non-fissile, or fissile-excepted materials. This container is not authorized for liquids.

2.3. Regulatory Requirements

The boxes shall meet the standards for hazardous material packagings in Title 49 Code of Federal Regulations (CFR) Subchapter C and per 49 CFR 178.350, *Specification 7A, general packaging, Type A*.

2.4 References

2.4.1 Industry Standards

The following DOE orders, DOE handbooks, waste acceptance criteria, and industry standards are referenced for use in this specification. The latest available edition/amendment is to be used unless specifically given or otherwise directed by the Buyer. Materials, based on standards other than those specified herein, may be used providing mechanical, chemical, and performance properties are suitable for their design application (e.g., welding, compression, ductility, compatibility, etc.) if approved by the Buyer.

- ANSI/AWS D1.1/D1.1M, Structural Welding Code-Steel
- ANSI/AWS D1.3, Structural Welding Code-Sheet Steel
- ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Code.

- ASME NQA-1-2008/1a-2009, Quality Assurance Requirements for Nuclear Facility Applications.
- ASTM A1011/A 1011 M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- ASTM A 36/A 36M, Standard Specification for Carbon Structural Steel.
- ASTM A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- ASTM A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
- ASTM D 1056, Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
- Documentation and Verification Required for Type A Packaging Use, HNF-SD-TP-TI-006, Revision 1, November 27, 2000
- DOE/NV-325, Nevada National Security Site (NNSS) Waste Acceptance Criteria (WAC)
- DOE Order 414.1D, Contractor Requirements Document (CRD), Attachment 3, Suspect/Counterfeit Items Prevention.
- DOE-HDBK-1221-2016, Change Notice 1, Suspect/Counterfeit Items Resource Handbook
- Mil-HDBK-695E, Rubber Products: Recommended Shelf-Life
- SAE J429, Mechanical and Material Requirements for Externally Threaded Fasteners.
- SAE J995, Mechanical and Material Requirements for Steel Nuts.
- SSPC-SP 1, Surface Preparation Specification No. 1, Solvent Cleaning.
- SSPC-SP 2, Surface Preparation Specification No. 2, Hand Tool Cleaning.

2.5 Definitions/Abbreviations

Box Configuration – This specification provides for multiple box configurations. A box size shall be defined (see Section 3.2 (A) along with all other features that impact box structure or configuration (e.g., type of closure system, venting, and lift attachments). The configuration will be documented by use of a set of drawings. Once the Buyer and Seller concur on the set of drawings, the Buyer will identify that set of drawings in the purchase agreement by, title of drawing, drawing number, and revision. By doing this, the Seller knows which set of drawings has been accepted by the Buyer and will be used in the fabrication of the Buyer's steel box.

Buyer – Individual who represents the organization utilizing this specification to purchase and/or inquire on the purchase of carbon steel boxes.

PMC (Packaging Management Council) – The PMC is an organization that is made up of DOE contractor packaging professionals. The PMC provides a forum for the identification, analysis and resolution of issues to support DOE packaging programmatic needs and to standardize, if possible, common practices. This specification is produced as a part of the PMC's standardization effort through an approved PMC working group.

Seller – Primary fabricator of completed boxes built to this specification.

Shelf life - The maximum period of time, starting from the time of manufacture, that an elastomeric seal element, appropriately packaged, may be stored under specific conditions, after which time it is regarded as unserviceable for the purposes for which it was originally manufactured.

2.6 PMC Responsibility

The PMC is responsible for the origination and revision of these technical requirements. PMC is not responsible for any contractual issues between Buyers and Sellers.

2.7 Attachment

Attachment A, Physical Form of Content

3.0 BOX SPECIFICATIONS

3.1 Design and fabrication of the Specification 7A; general packaging, Type A carbon steel boxes shall comply with packaging requirements in 49 CFR 178.350. Additional design features and technical requirements for fabrication are identified in Section 3.2 below. Listed requirements are applicable to all box designs unless noted otherwise.

3.2 Basic Design and Technical Requirements

ITEM	REQUIREMENT
A. **Dimensions**	**Standard Size Boxes** 1) 6'-0"L x 4'-0"W x 2'-0"H External (~48 ft^3) 2) 7'-0"L x 4'-0"W x 2'-0"HL External (~56 ft^3) 3) 6'-0"L x 4'-0"W x 4'-0"H External (~96 ft^3) 4) 7'-0"L x 4'-0"W x 4'-0"H External (~112 ft^3) 5) 8'-0"L x 4'-0"W x 4'-0"H External (~128 ft^3) Note 1: Tolerances are stated on the fabrication drawings and will not vary unless agreed upon by the Buyer and Seller. The overall height dimension is from the bottom of the box (including riser legs) to the top (including the lid). **Oversize Boxes** Oversize boxes shall have an internal cavity that will allow boxes, 1-5 above, to fit in the box plus allow the use of loading and/or rigging, and/or blocking and bracing equipment while minimizing void spaces. The Buyer will work with the Seller in developing the design of these over sized boxes. The Buyer will provide all the information on the loading and/or rigging, and/or blocking and bracing equipment.
B. **Materials of Construction (Steel Panels & Structure)**	1) Sheet steel shall be a minimum 12-gauge sides/lid and 10-gauge bottom. ASTM A1011 Structural Steel Grade 36 Type 2 is the preferred material. Once a box design is established, tested, and/or analyzed to a classification and type/grade of A1011 steel and accepted by the Buyer, the design shall be fixed. 2) Plate, bar, and shapes shall meet or exceed the requirements of ASTM A36. 3) Structural tubing, (e.g., square, round) shall meet or exceed the requirements of ASTM A500. 4) Bottom and sidewalls panel-to-panel joints shall be welded both external and internal as identified on the fabrication drawings.

ITEM	REQUIREMENT
C. **Fabrication Drawings**	Detailed drawings documenting how the specified box is fabricated.
D. **Gasket Material**	Gasket material shall meet ASTM D 1056. Gasket material, used for lid, filter ports, or vents shall meet the temperature requirements od 49 CFR 173.412(c). There shall be at least 75% of shelf life remaining at the time the Buyer receives the box(es).
E. **Bolting Hardware**	Hardware shall be zinc-plated steel, 3/8" diameter minimum. Bolts shall be SAE J429 Grade 5 Hex Head or better. Hex nuts shall be SAE J995 Grade 5 or better. Bolts and nuts shall meet manufacturer and SAE requirements and the Seller will verify they are not suspect/counterfeit items (DOE –HNBK-1221-2016, Suspect/Counterfeit Items Resource Handbook)
F. **Payload**	All standard size boxes in section 3.2.(A) shall be capable of holding 10,000 lbs. (4,536 Kgs.) minimum.
G. **Strength**	1) A fully loaded (max gross weight) box not going to NNSS shall be capable of supporting a uniformly distributed load (compressive strength) as required by 49 CFR 173.465(d) 2) A Fully loaded (max gross weight) box must meet the requirements in (1) above and those that will be shipped to NNSS must meet their Waste Acceptance Criteria in that the box shall be capable of supporting a uniformly distributed load (compressive strength) of 3,375 lbs./ft^2 (NNSS WAC Section 3.2.5)
H. **Closure System**	The box design shall have bolted closures with gasket unless otherwise specified (e.g., Clips). Gasket compression for any closure shall be no less than 20% and no greater than 80% of gasket thickness when system is fully closed. Closure system shall not interfere with box stacking capabilities.
I. **Lid Locking**	Each box design shall include at a minimum a ½" hole as a means of securing the lid to the lower box on two opposing corners using a standard padlock.
J. **Sidewall Support**	Structural members (channel, tube, angles, etc.) for sidewall support shall be located on the box interior. Note: This does not apply to structural members integral to the box closure system or riser legs located below box.

ITEM	REQUIREMENT
K. **Lifting/ Manipulating**	1) Each box shall include riser legs to allow for manipulation with a forklift. There shall be three 4" high riser legs; installed parallel with the box short side and shall run the full length of the short side of the box. 2) Lifting attachments that are designed to lift the box with contents shall meet the requirements of 49 CFR 173.410(b). 3) Lids shall include lift handles on two opposing sides. When lid forklift channels are specified, there shall be a total of two – 8" minimum wide, 4" maximum high and installed parallel with the box short sides. Channels shall be designed to collapse on impact without penetrating any part of the box structure. 4) Location of lid lift handles or forklift channels shall not interfere with box stacking capabilities.
L. External and **Internal Tie-Downs**	Tie-downs will be specified in the purchase order only when required by the Buyer and shall meet the requirements in 49 CFR 173.412(i).
M. **Liners**	The liner will be specific in the purchase order only when required by the Buyer.
N. **Venting**	1) The boxes will have a provision for the installation of filter vents. When filter vents are to be installed by the Seller, the Buyer will provide the filter vents. 2) Boxes shall have two filter ports located on opposing sides of the box and within 6" from the top of box. Threads shall be a ¾" diameter NPS-14 unless built to accommodate a unique filter, authorized by and provided by the Buyer. When the Seller installs filter vents, they will package in a box the hardware used for plugging ports. 3) Box designs in Section 3.2 (A) of this specification shall meet the reduction of ambient pressure requirements in 49 CFR 173.412(f).

ITEM	REQUIREMENT
O. **Finish**	1) Remove all sharp edges and burrs inside and out of the box 2) Boxes shall be cleaned per SSPC-SP 1 and SSPC-SP 2 or per coating manufacturers specification 3) Interior/Exterior primer/paint manufacturer and color shall be Seller's standard unless otherwise specified. 4) Primer/paint minimum thickness (unless otherwise specified) and application shall be in accordance with coating manufacturer's recommendations 5) Coatings shall be allowed to completely cure prior to full assembly of boxes in preparation for shipment
P. **Markings**	1) Markings shall be per 49 178.350(b) & (c). 2) Each box shall be identified with the Seller's name/address, box size (volume in m^3 (ft^3)), and drawing with revision number. For each box size ordered a unique serial number will be assigned and marked on the box. 3) Each box shall be marked with the **tare weight** in both kg and lbs. 4) Each box shall be marked with the **maximum payload weight** in both kg and lbs. 5) Each box shall be marked with the **maximum gross weight** in both kg and lbs. 6) Adjacent to each lid lifting attachment (handle, fork channel, etc.) stencil the following – "Lid lift only; render unusable prior transport".
Q. DOT Markings	The shipper/offeror who acts as the "Packaging Manufacturer" (49 CFR 178.350 (c)) will certify that the steel box meets all requirements of 49 CFR 178.350, Specification 7A; general packaging, Type A. When the Buyer wants to have the Seller place the DOT marking "USA DOT 7A Type A" on the steel boxes, the Seller shall either tarp the boxes, place the steel boxes in an enclosed conveyance, or the marking shall be covered during transport to the Buyer. When the Buyer requests that the Seller provide a label for the Buyer to apply to the steel boxes, the label material must be able to withstand all types of weather conditions and must be tear resistance.

3.3 Sub-tier Suppliers

Design and technical requirements from this document shall be imposed on sub-tier supplier's work and items they are supplying, as applicable. Primary fabrication functions (i.e., assembly and welding) are the responsibility of the Seller and shall not be outsourced to a sub-tier supplier.

The Seller shall identify and include in subcontracts applicable quality assurance requirements based on the graded approach when issuing procurements to their sub-tier suppliers.

4.0 PERFORMANCE REQUIREMENTS

The following performance requirements apply to the box types and sizes designed and built in accordance with the requirements from Section 3.2 above. The Seller shall ensure the following:

4.1 Each box is to maintain containment of the material/waste under normal conditions of transport and storage as required in 49 CFR 173.24 (b).

4.2 Boxes shall meet the performance specification requirements in 49 CFR 178.350(a) and, when appropriate, meet the compressive strength requirements in Paragraph 3.2(G) only when shipping boxes to NNSS.

4.3 Boxes shall comply with the applicable testing requirements of 49 CFR 173.465. In addition to these requirements, boxes shall also meet the requirements in 49 CFR 173.412(f). Results of testing shall be evaluated against the performance requirements identified in 49 CFR 173.412(j)(1).

4.4 Boxes shall be capable of withstanding the effects of vibration during normal conditions of transport in accordance with 49 CFR 173.410(f). Results of testing shall be evaluated against the performance requirements identified in 49 CFR 173.412(j)(1).

4.5 The package design and analysis is usually dependent upon the characteristics of the contents of the Type A package that will either be stored (incident to transport) or offered for shipment in commerce. The Buyer has the responsibility to inform the Seller of suitable surrogate content with its applicable characteristics that will be shipped in this packaging. The DOE has identified three types/forms (See Appendix A) of surrogate content that the Buyer can use when requiring the testing in 49 CFR 173.465 is done. The goal is to get parity between the actual content and the surrogate content, which can be a combination of the various forms of content. If the Buyer has not identified a surrogate content that is to be used in testing, it is recommend that the Seller use each form of content identified in Appendix A separately for each required test.

As stated previously, the Seller supplying the Type A packaging is not considered the "packaging manufacturer" as defined in 49 CFR 178.350(c) because the Seller does not have knowledge of the radioactive contents and respective characteristics to

determine potential for an increase in radiation or dose rate as a result of any damage that occurred during testing. Thus, for Type A quantities of radioactive materials, the Buyer (shipper/offeror) becomes the packaging manufacturer. It is the Buyer's responsibility to compare the physical characteristics of the planned load with the test load to show compatibility. If the test load and planned load are different, it is the Buyer's responsibility to provide written justification where the planned payload is bounded by testing/analysis done by the Seller or have the Seller provide additional written information that the current testing/analysis bounds the planned payload.

5.0 FABRICATION AND ASSEMBLY REQUIREMENTS

5.1 Work is to be performed to the requirements of this document and the latest revisions of the technical and quality requirement documents reviewed and concurred with by the applicable Buyer.

5.2 All box material and components shall be new and unused, as well as, free from defects or damage (integral to material or occurring during fabrication that would adversely affect a box's performance or maintainability).

5.3 Welding

Welding personnel shall be qualified to AWS D1.1, AWS D1.3, or ASME Section IX as appropriate for the work they are performing. The selected code(s) and use of weld filler material shall be appropriate for the steel used and shall be identified in weld procedures.

5.4 Weld Inspection

Welding Inspection shall be as per AWS D1.1, and AWS D1.3. AWS Certified Welding Inspectors (CWI) will be qualified in accordance with AWS QC1. The CWI's Certificate must be current. Qualification by experience or company certification is not permitted.

6.0 TESTING REQUIREMENTS

6.1 49 CFR Testing

6.1.1 Each box design shall be qualified to requirements identified in Section 4.0 Performance Requirements. When actual testing is required, the water spray, free drop, stacking, and penetrations test requirements shall be performed per 49 CFR 173.465, along with the capability tests identified in 49 CFR 173.410(f) and 49 CFR 173.412(f). The Seller will determine if they are going to perform the actual physical test or use any of the methods authorized by 173.461(a). Whether tests, calculations, and/or analysis are performed on boxes, the Seller will ensure the boxes are closed in the same manner as if prepared for transportation (i.e., fully constructed, loaded to max gross weight, closure system complete and secured). When a box design includes a filter vent, the Seller will replace the vent with a plug when conducting tests required for Type A packaging.

6.1.2 When physical testing is to be performed either on a sample, prototype or scale model, the requirements in 49 CFR 173.461(b) and 173.462 must be met and/or addressed.

6.1.3 The Seller shall develop a test plan along with procedures that document the steps and acceptance criteria for each Type A test performed. The Seller will make the test plan and procedures for each test available upon request from the Buyer.

6.2 Criteria for Passing the Type A Tests

When Type A tests are performed the Seller shall use the criteria in 49 CFR 173.412(j)(1) to ensure the tests have satisfactorily passed.

6.3 Leak Tests

The Seller will determine a leak test method that will evaluate weld integrity for each standard and/or oversize box fabricated to this document. This test shall be performed prior to applying any primer or topcoat. Prior to preforming the leak test, each weld shall be verified by the Seller's CWI (see 5.4). This test is to challenge the weld integrity and ensure there are no leaks. The Seller is to close the box in accordance with their closure instructions. They are to determine the pressurization to be used and will monitor the pressure for indication of leaks not visually identifiable. When leaks are identified, they are to be repaired in accordance with the Seller's Quality Assurance Programs (QAP).

7.0 QUALITY PROGRAM

7.1 Buyers Quality Assurance Program Requirements

The Buyer's QAP is based on ASME NQA-1-2008/1a-2009, Quality Assurance Requirements for nuclear facility applications. Using a graded approach, the Buyer will establish specific NQA-1 requirements that the Seller must implement to ensure the technical requirements identified in this document will be met.

7.2 Buyer's Evaluation of the Seller's Quality Assurance Program

The Buyer has the option to either perform an onsite audit, perform a document review, or use a third party audit to ensure compliance with the QA requirements identified in Section 7.1 above.

7.2.1 Document Review

Working with their welding, DOT, QA. And other SMEs, the Buyer will develop a list of documents that the Seller will provide upon request for the Buyer's review. These documents can be, but not limited to, the following:

- The Seller's current QAP document
- A listing of the Seller's procedures and forms (records) used to implement their QAP. This will allow the Buyer's SMEs to request specific documents and records
- Test plans and procedures for performing tests required in Section 5 in this specification
- Inspection procedures
- Welding qualifications and certificates

- Certificate of Conformance procedure
- Training plans and records for both implement the QA program and DOT regulations
- Fabrication drawings – Complete set, etc.

7.2.2 Onsite Audit

The Buyer, at the request of the SMEs, will request documents similar to this in Section 6.2.1 in this specification. The Buyer, acting as the intermediary between the Seller's QA Manager and the Buyers QA SME, will establish an audit plan. The Buyer's SMEs will perform an onsite assessment to determine if the Seller's QAP will ensure the technical requirements identified in this specification can be met. This onsite audit will be preformed as a pre-assessment to the award of a purchase order.

7.2.3 When the Seller's QA program does not meet the Buyer's QA requirements?

When the Seller cannot meet NQA-1 requirements identified in Section 6.1 above, the Buyer may use the requirements in ASME NQA-1-2008/2009a Part II: Quality Assurance Requirements for Nuclear Facility Applications, Subpart 2.14: *Quality Assurance Requirements for Commercial Grade Items and Services*.

7.2.4 Use of a third party audit

DOE contractors who participate in the Energy Facility Contractors Group (EFCOG) Supply Chain Quality Task Group perform joint audits of various suppliers. They also make these audits available to other DOE contractors. A DOE contractor who chooses to use one of these audits are required to evaluate the audit report prior to acceptance to ensure the audit meets their specified QA requirements.

7.3 Suspect Counterfeit Item Prevention Program

The Buyer will work with the Seller to ensure the Seller has a Suspect Counterfeit Item (S/CI) Prevention program as required by DOE Order 414.1D, CRD, Attachment 3.

As part of Seller's QA and S/CI program, the Seller will have a process in place to ensure that the certification documents, e.g., Certified Materials Test Reports (CMTRs), Calibration Certs, ISO Certs, etc., are verified. This process will ensure the effectiveness of the Supplier's and the Supplier's subcontractor's certification approval system. This process is to establish a method that verifies the validity of the content of the certificates that the Supplier provides to the Buyer. The Buyer can use one of two ways to ensure the content of the certificates are accurate. First, the Buyer can use an independent third party organization to verify the content of the certificates. Second, the Buyer by direct examination of the Supplier's QAP can verify and validate the Supplier's processes that are used to ensure accuracy of the certificates.

7.4 Award of Purchase Order

When the Buyer has completed their evaluation identified in Section 6.2 above, the Buyer may request their representative to be on site to perform specific inspections, witness tests, observe and verify processes (i.e. welding), perform document reviews, etc. The Buyer and Seller will work out a schedule to ensure these activities take place.

8.0 Documentation

Documentation requested shall be submitted to the Buyer shall be legible and may be submitted either by a hard copy or by electronic means. Electronic submittal must be in format readable by Buyer (e.g., Adobe® PDF).

8.1 Fabrication Drawings

Though not required by the regulations, the Buyer is requesting that the Seller shall produce a complete set of fabrication drawings that document the design, materials of construction, methods of construction (e.g. welding), dimensions, weight, closure and closure materials (including gaskets, closing hardware, etc.) of each item of the containment system, shielding, if applicable and packing materials used in normal transportation. For traceability, the fabrication drawings should reference the DOT test report produced by the Seller for the container that meets this specification.

8.2 Test Reports

The requirements in 49 CFR 173.415(a) does not identify a format of a Type A Packaging test report. The UN regulatory requirements in 49 CFR 178.601(l) Record retention, does provide a set of minimum requirements that the Seller could include when developing a Type A test report. The regulations do require that specific requirements be included in this test report. These specific requirements are:

- The test report shall include the date the test took place
- The location or place where the test took place, i.e. physical address
- The signatures of the individuals involved in conducting the tests
- A description of how each test was performed and to whether the test met the requirements in 49 CFR 173.412(j).
- Identify the equipment that was used in the performance of the test, e.g., torque wrench, lifting apparatus, scale used to weight the package. Equipment that is used that requires calibration must show evidence that the equipment is within calibration due date.
- Record of the damage that occurred during the test. The Seller shall document the initial condition of the package prior to the test and the condition of the package after the test including photographs. This shall be documented using dimensions showing the differences. This allows the Buyer's DOT SME to verify if there is an increase in dose rate as required in 49 CFR 173.412(j)(2).

8.3 Demonstration of compliance with tests

When the Seller chooses to use 49 CFR 173.461(a) to qualify packages as meeting the requirements in 49 CFR 178.350(a), they must clearly identify the parameters by which the analysis is performed. The detailed analysis must show that for the contents being used during testing, the package meets the pertinent design and performance requirements for a DOT Specification7A, Type A package.

9.0 STORAGE AND SHIPPING

9.1 Storage

During production and prior to shipping, materials of construction and completed boxes shall be stored in a manner that prevents degradation or damage.

9.2 Shipping

Packaging and shipping methods shall ensure that boxes are delivered to Buyer in an undamaged state. Boxes prepared for shipping shall be clean and free of dirt, oil, or other foreign contaminates. Box interior shall be free of any standing water. Box lids shall be secured to the lower box to prevent vibration induced loosening during transportation. Boxes with a clip design shall be banded and the Seller shall provide protection for paint or the lid secured by some other means. Gaskets shall not be installed, but shall be enclosed inside a waterproof bag along with the vent plugs and closure hardware. These items shall be placed inside the container and secured. Boxes shall be secured to the conveyance in a manner that will prevent damage to box structure or finish during transport. Tiedown straps must not be allowed to come into direct contact with coated surfaces during transport. Containers must be vented to allow barometric breathing. If installed, vent ports shall be protected from ingress of debris prior to and during transport. The containers may be tarped to provide protection from inclement weather and road hazards encountered during transport to the Buyer's facility. If used, tarps shall be secured to prevent damage to the coating from tarp movement during transportation.

10.0 MODIFICATIONS AND NONCONFORMANCES

10.1 The Seller may request modifications for improvement or enhancements to this specification. The request shall identify the paragraph or appendix, the recommended change, and a justification for change.

10.2 Non-conformances to this specification or design that occur during testing or production shall be processed in accordance with the Seller's QAP. Non-conforming conditions that are minor in nature and where reworking or scrapping would not be cost-effective may be submitted to the Buyer for review and approval. Non-conforming conditions that impact compliance with the regulatory requirements will not be accepted under any circumstance. The Buyer shall submit their approval with the resolution to the Seller's Non-Conformance Report under a separate correspondence. No box shall be delivered to the Buyer until all non-conforming conditions have been satisfactorily resolved and accepted.

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Appendix

Physical Form of Content
The physical form of the material has a direct and indirect effect on the applicability of some requirements. For example, the form affects the density of the material, the gross weight, and thus, the requirements invoked for package handling features.

Physical form is very important when determining the containment level required by the load. The ability of the packaging to contain the material being shipped is dependent on particle size and the ability to flow. Usually, containment is simplest for "special form" materials (See definition in CFR 173.403, Definitions.) Special form material must satisfy several defined conditions, but it is typically either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule.

The complexity of containing solids increases, as the particle size gets smaller. DOE's DOT-7A Program, which ended in 2000, classed solid materials into one of three material forms as follows:

- **Form Number 1: Solids--any particle size**
  - A packaging qualified for these contents is expected to contain radioactive contents of any representative particulate size (from the smallest physically possible particle size to the largest particle that will fit within the packaging).

- **Form Number 2: Solids--large particle size only; i.e., sand, concrete, debris, soil**
  - A packaging qualified for these contents is expected to contain contents of a corresponding particulate size, such as soil or construction debris. Materials, such as glass or plastic lab-ware, having fine particulate available for dispersion would not fit this category and would require a packaging qualified for fine particulate, Form Number 1.

- **Form Number 3: Solids--objects with no significant dispersible or removable contamination (for definition of contamination, see 49 CFR 173.443, "Contamination control")**
  A packaging qualified for these contents is expected to contain objects meeting the following or similar conditions:
  - Metals with activation products
  - Forms of metals/alloys/compounds of uranium, thorium
  - Solid materials with the radioactive material firmly fixed in place, possibly by the application of a fixing media; i.e., paint
  - Solidified material.

Form Number 1 material requires a containment boundary that will retain the smallest size possible for the material being shipped, i.e., one molecule. Form Number 2 material requires a containment boundary that will retain the smallest size particle possible for the form of material;

e.g., a grain of sand. Form Number 3 requires a containment boundary that will retain the smallest object that will be shipped in the package. The containment boundary for all three material forms must retain the material not only during shipment but also when subjected to the packaging testing requirements.