

Guidance Document For Selecting Applicable Quality Assurance Requirements For Department of Transportation Packaging

By the

Packaging Management Council (PMC)

And

**Energy Facilities Contractors Group
Supply Chain Quality Task Team**



**E-SG-QA-QA-2016-01
Revision 0
November 1, 2016**

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1.0 Introduction

Members from the Energy Facility Contractors Group (EFCOG) Supply Chain Quality Task Team (SCQTT) and the Packaging Management Council (PMC) met in September 2012 to discuss the impact of the American Society of Mechanical Engineers (ASME) Committee on Nuclear Quality Assurance (NQA) Technical Interpretation 10-1365, issued March 22, 2012. This letter of interpretation impacted the way DOE contractors have been flowing down Quality Assurance (QA) requirements to suppliers of Department of Transportation (DOT) packagings. Based on a 2014 PMC Container Survey (see [Appendix A](#)), sixty-five percent of DOE contractors use ASME NQA-1, “*Quality Assurance Requirements for Nuclear Facility Applications* (hereafter referred to as NQA-1) as their QA standard.” When flowing down requirements to a DOT packaging supplier, the contractors used the basic 100 or general requirements of NQA-1.

The published Technical Interpretation, 10-1365, reads in part:

“The application of only section 100 by an implementing organization is insufficient to claim credit for implementing Part I or Part II of an NQA-1 based Quality Assurance Program. It is also insufficient for an invoking organization to invoke only section 100 of Part I or Part II and expect results equivalent to specifying all of Parts I or II.”

DOE contractors interpreted this to mean they needed to flow down all 18 requirements in NQA-1, Part I, and the applicable requirements in Part II.

What used to be a straightforward selection and flow down of NQA-1 requirements to DOT packaging suppliers, now has become a more complicated process. The complexity of this selection process was demonstrated in August 2012 when an audit was performed at a DOT packaging supplier’s facility. The scope of the audit was to assess the packaging supplier to all 18 requirements of Part I of NQA-1-2008. From this audit it brought to the forefront three issues:

- DOE contractors need to tailor NQA-1 requirements to the specific packaging being procured by determining which requirements apply and which ones don’t apply,
- NQA-1 requirements selected need to be applied in a graded approach by the packaging supplier
- If a packaging supplier cannot meet the selected NQA-1 requirements the DOE contractor has the option to procure the packaging where appropriate by implementing a Commercial Grade Dedication process as described in ASME NQA-1a-2009, Part II Subpart 2.14.

The DOT identifies minimal QA requirements for packagings and packages in the regulations. Packaging manufacturers are not required to implement a QA program based on a specific standard, but the DOE contractor should explore the end use of the packaging to make the appropriate selection of QA requirements. Nuclear facilities, as defined by 10 CFR 830 and the Facility Classification (e.g. Safety Class) determination of the packaging within nuclear facilities are required under DOE Order 414.1D to have

a QA program based on the ASME NQA-1 standard. This document uses the NQA-1 standard as the standard of choice, but as stated in DOE Order 414.1D other national or international QA standards are acceptable.

A discussion at the September 2012 meeting yielded the outcome of creating two working groups:

- First, to develop a guidance document to assist DOE contractors in applying a tailored and graded approach when selecting QA requirements for DOT packagings.
- Second, to develop a guidance document to assist DOE contractors in establishing a commercial grade dedication program based on NQA-1a-2009, Part II, Subpart 2.14, when the DOT packaging supplier cannot meet the applicable QA requirements flowed down from a DOE contractor.

This working group covers the development of a guidance document that will assist DOE contractors in applying a tailored approach when selecting QA requirements for DOT packagings. This working group understands that each discipline mentioned in this document, e.g., DOT, QA and Nuclear Safety Specialists (NSS), are trained and qualified in each of their respective disciplines. Also as stated in DOE Order 414.1D, DOE contractors are responsible for flowing down the applicable requirements of the Contractors Requirements Document (CRD) to the extent necessary to subcontractors at any tier. The DOE contractors should only flow down requirements to packaging suppliers applicable to the work being performed.

2.0 Purpose

The purpose of this guidance document is to establish a process to show how a DOE contractor tailors the applicable quality assurance requirements that are flowed down to the DOT packaging supplier for a specific DOT packaging procured.

3.0 Scope

The scope of this document is limited to the procurement of UN Performance-Oriented Packaging used to ship solids and liquid hazardous waste, substances, and materials. This packaging may also meet the requirements of DOT Specification 7A, Type A used to ship solid radioactive materials. The packaging that meets DOT Specification 7A Type A requirements may also be used for transporting onsite radioactive materials from nuclear facilities or activities that meet 10 CFR 830 Subpart B, Safety Basis Requirements. The safety basis requirements are based on the intended use of the packaging with loaded radioactive contents.

The Packaging Management Council Results Survey 2014 ([Appendix A](#)) shows three commonly used metal drums procured by DOE contractors:

- Metal drums meeting UN-Performance Packaging requirements
- Metal drums meeting DOT Specification 7A, Type A Packaging requirements
- Metal drums meeting UN-Performance and DOT Specification 7A, Type A Specification Packaging requirements

The specific packaging that will be used as an example throughout this document for establishing the applicable NQA-1 requirements is a 55-gallon, open-head, carbon steel drum (hereafter referred to as a 55-gallon drum). The technical requirements as required by NQA-1, Requirement 4, Procurement Document Control, for packaging will be derived from the “PMC Technical Description for a 208-Liter (55-Gallon) Removable Head, Performance-oriented Package (POP) and Type A Specification, Carbon Steel Drum with Closure Ring specification, ([Appendix B](#)).”

4.0 Responsible Group of Subject-Matter-Expert (SME)

The process for identifying quality assurance requirements for a DOT packaging begins with the organization where employees are trained and qualified under the DOT regulations, i.e. 49 CFR Parts 171-180. DOT SMEs are responsible for the packaging selection process, The DOT trained SMEs work with the material owner to ensure the packaging is compatible with the contents ([Appendix C](#)). DOT SMEs define the technical requirements, which include the regulatory requirements the packaging supplier must meet. They will also review the packaging supplier’s documentation validating the selected packaging meets the regulatory and specified technical requirements.

The next group of SMEs is the quality assurance specialists. Under the DOE contractor’s Quality Assurance Program (QAP) the QA specialist ensures the packaging supplier communicates the technical requirements within the supplier’s organization. This ensures the approved packaging configuration is not modified outside the approved scope, and is manufactured according to the designated requirements. This means the ordered packaging will meet the approved packaging design configuration set forth by the DOE contractor.

The last group of SMEs is the Nuclear Safety Specialist (NSS), which get involved only when the DOT packaging is used in a nuclear facility or activity. DOT packaging may be excluded from 10 CFR 830, Nuclear Safety Management, based on its use. This exclusion from 10 CFR 830 is only allowed when transportation activities are regulated by DOT. For example, if a 55-gallon drum is used in a nuclear facility or activity, and it meets all the regulatory requirements of 49 CFR 171-180, the drum is excluded from the 10 CFR 830 requirements. But, when the DOT packaging is not regulated by DOT, it is subject to the requirements in 10 CFR 830, Subpart B, Safety Basis Requirements when used in a nuclear facility. For example, if a 55-gallon drum is used in a nuclear facility or activity, and a Type B quantity (greater than Type A quantity) of radioactive material is placed in the drum, the drum no longer meets the regulatory requirements of 49 CFR Parts 171-180 and is subject to the regulatory requirements in 10 CFR 830 Subpart B, Safety Basis Requirements, when handled and transferred onsite.

This document identifies the responsibilities of the SMEs when selecting the DOT packaging, tailoring while using the graded approach in the selection of QA

requirements for DOT Packaging when applicable, and interfacing with Nuclear Safety Specialists.

4.1 Department of Transportation SMEs

DOT SMEs are trained in accordance with 49 CFR 172 Subpart H, Training. Once trained these DOT SMEs work with the material owner in determining the material classification, proper shipping name and making the packaging selection ([Appendix C](#)). Along with determining the packaging selection the DOT SMEs, with the material owner, ensure the contents and the packaging is compatible. After the packaging selection is made DOT SMEs develop the technical requirements for the selected packaging. These requirements become part of the procurement package when purchasing the DOT packaging.

Using NQA-1-2008/2009a as the standard, the selection of technical requirements for the procurement of a 55-gallon drum begins with NQA-1, Requirement 4, Procurement Document Control , Section 202, Technical Requirements, which states:

Technical requirements shall be specified in the procurement documents. These requirements shall be specified, as appropriate by reference to specific drawings, specifications, codes, standards, regulations, procedures, or instructions, including revisions thereto that describe the items or services to be furnished. The procurement documents shall identify appropriate test, inspection, and acceptance criteria for determining acceptability of the item or service.

For the purpose of this document, the technical requirements are derived based on the “PMC Technical Description for the Procurement of a 208-Liter (55-Gallon) Removable Head, Performance Oriented Package (POP) and 7A Type A Carbon Steel Drum with Closure Ring, ([Appendix B](#)).” As defined in the scope of this document there will be developed technical requirements for three different configurations of a 55-gallon drum. These are:

- UN Performance packaging, [Appendix D](#)
- DOT Specification 7A, Type A Packaging, [Appendix E](#)
- Drum meeting both UN Performance and DOT Specification 7A, Type A Packaging, [Appendix F](#)

4.2 Nuclear Safety Specialist (NSS)

The DOE contractor’s Nuclear Safety Specialist (NSS) SMEs are trained and qualified in accordance to Paragraph G.2 of [Appendix G](#). Based on the hazard class of the material in the facility, or the material to be transported onsite as determined by the NSS in accordance with DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports ([Appendix G](#)) NSS SMEs develop Safety

Basis Document and/or Transportation Safety Document, based on 10 CFR 830 Subpart B, Safety Basis Requirements.

The functional classification of the packaging (i.e. Safety Class, Safety Significant) is identified as a result of the hazard and accident analysis. Based on the identified functional classification the packaging may be classified as either safety class (SC) or safety significant (SS). Based on the functional classification of the packaging a set of critical characteristics are derived that when met ensure that the packaging will perform its intended safety function.

Using the example in Paragraph G.3 in [Appendix G](#), a safety function has been identified as well as a set of critical characteristics that, when met, will ensure the safety function will perform properly. The DOT SMEs working with the NSS SMEs reviewed the technical requirements in [Appendix E](#) for Type A Specification Packaging and the combined technical requirements in [Appendix F](#) for both UN Performance and Type A Specification Packaging Requirements. Based upon the review of the DOT and NSS SMEs, it was determined that the only additional requirement is the drop test requirement in 49 CFR 173.465 (c)(2) for fissile material. When the 55-gallon drum is required to meet the safety function, the requirement in Table 4-1 is to be inserted into the tables in [Appendix E](#) and [Appendix F](#). By adding this critical characteristic, it will ensure that the safety function is met.

Table 4-1, Additional Critical Characteristic to ensure The Safety Function is Met	
Type A Test for packages containing Fissile Material.	49 CFR 173.465 (c)(2), For packages containing fissile material, the free drop test specified in paragraph (c)(1) of this section must be preceded by a free drop from a height of 0.3 m (1 foot) on each corner, or in the case of cylindrical packages, onto each of the quarters of each rim.

4.3 Quality Assurance

Both DOE Order 414.1D, Quality Assurance (the Order) and 10 CFR 830 Subpart A, Quality Assurance (the Rule) ([Appendix H](#)) require DOE contractors to implement the 10-criteria (DOE QA requirements) using a national or international consensus standard. As previously stated the results of the PMC 2014 Container Survey ([Appendix A](#)) shows sixty-five percent of DOE contractors use the NQA-1 as the selected consensus standard to implement both the Order and Rule; however, other national or international consensus standards may be used.

For purposes of this document the selection of QA requirements will use the ASME NQA-1 2008/2009a standard. What allows the QA SMEs to select the applicable QA requirements is Requirement 4, *Procurement Document Control*, Section 203 *Quality Assurance Program Requirements*, which states the following:

Quality assurance program requirements shall be specified in the procurement documents. These requirements shall be consistent with importance and/or complexity of the item or service being

procured. The procurement documents shall require the Supplier to incorporate appropriate quality assurance program requirements in sub-tier procurement documents.

This allows the DOE contractors to select the applicable NQA-1 requirements that will become part of the procurement documents that packaging suppliers will need to meet. As noted in the introduction, when the ASME letter 10-1365 came out in March of 2012, a number of DOE contractors interpreted this to mean packaging suppliers need to meet all of the applicable requirements in NQA-1, and began to audit all of their packaging suppliers to the full NQA-1 Part I requirements. This resulted in a large number of suppliers failing these audits. NQA-1, Requirement 4, Section 203 states: “these requirements (NQA-1) shall be consistent with importance and/or complexity of the item or service being procured.” This infers the DOE contractors will tailor the QA requirements, based on their importance to safety and/or complexity of the packaging. Then packaging suppliers using the graded approach will determine the level of rigor, or effort (e.g., Risk, Safety) that needs to be applied when implementing the selected QA and contractual requirements.

The DOE contractors need to take into consideration that the application of QA requirements may increase the cost of the packaging in question. The more complicated the packaging, the more rigorous the application of the selected QA requirements.

For example, a 55-gallon drum is manufactured from a flat piece of steel that is rolled and then seam welded with a lap seam weld. The bottom flange and top curl is formed with rolling hoops then being formed. At this point the drum body is pressure tested to ensure the integrity of the seam weld. If it passes, the drum body is cleaned and a rust inhibitor is applied to the interior of the drum and oven dried. Now the drum bottom is mechanically (e.g. round chime) applied to the drum body. If the drum is to contain liquids, the DOT pressure test is performed (49 CFR 178.604, Leakproofness Test). If the drum passes the DOT pressure test, the drum is then painted and oven dried. The drum is then marked (49 CFR 178.502 and 503) and the drum top is placed on the drum. The closure ring is then applied and torqued to secure the lid and ring in place for transport. If the drum has bungs in the lid, they are torqued to secure them in place for transport to the customer ([Appendix J](#)).

The manufacturing process of a 55-gallon drum is not overly complicated.

In the example above the 55-gallon drum, DOT SMEs working with the material owner, and when applicable, the NSS SMEs, developed specific technical requirements (NQA-1 Requirement 4, Section 202) that will be used in the procurement of the 55-gallon drums. These technical requirements are found in:

- Performance Oriented Packaging, [Appendix D](#)
- DOT Specification 7A, Type A Packaging [Appendix E](#), and

- Combined technical requirements meeting both UN-Performance and DOT Specification 7A, Type A Packaging, [Appendix F](#)

From the three technical requirements listed above for the 55-gallon drum, [Appendix F](#) contains the technical requirements that will be used in the example in the selection of QA requirements.

5.0 Tailoring QA Requirements

As noted above, the QA and DOT SMEs need to understand how the 55-gallon drum is manufactured so the complexity of the process is understood. [Appendix J](#) shows the generic process of how a drum is manufactured. With this understanding the QA and DOT SMEs in conjunction with the technical requirements in [Appendix F](#) can tailor the applicable NQA-1 requirements.

Before tailoring specific NQA-1 requirements the QA SMEs recognizes there are common elements within the NQA-1 Standard. Table 5-1 NQA-1 Part I, Requirements Common to all NQA-1 Programs, lists these common requirements.

Table 5-1, NQA-1 Part 1 Requirements Common to all QA Programs		
NQA-1 Requirement	Sections	Discussion
Requirement 1, <i>Organization</i>	100, 200, and 300	This requirement establishes the packaging suppliers organization and identifies how the QA organization functions
Requirement 2, <i>Quality Assurance Program</i>	100, 200, 300, 400, and 500	This establishes the QA program, which includes QA training, DOT training, qualification requirements for individuals performing inspections, auditors and lead auditors, and technical specialist and the required documentation. Note: Requirements 301 and 302 will be applied only as required.
Requirement 5, <i>Instructions, Procedures, and Drawings</i>	100	The packaging supplier will have procedures in place that document how they produce instructions and procedures. They also have a program in place as to how drawings are generated (drawn by), reviewed, and approved and how all revisions are controlled. This will control the packaging design configuration.
Requirement 6, <i>Document Control</i>	100, 200, and 300	The document control program covers all document and records generated. It also should include current standards and regulations within this program.
Requirement 15, <i>Control of Nonconforming Items</i>	100, 200, 300, and 400	This requirement is used to identify all non-conforming items that are received, identified during production, final inspection, and includes all testing performed.
Requirement 16, <i>Corrective Action</i>	100	Corrective actions are documented for significant conditions adverse to quality. A Corrective Action Request (CAR) can be sent to suppliers when trending of NCRs

		indicates poor performance. The CAR process should include root cause analysis and extent of condition.
Requirement 17, <i>Quality Assurance Records</i>	100, 200, 300, 400, 500, 600, 700, and 800	The requirement works hand-in-hand with Document Control: a document tells you what to do; a record tells what you did.
Requirement 18, <i>Audits</i>	100, 200, 300, 400, 500, 600, 700, and 800.	This requirement is used when assessing the internal organization and these requirements should be passed down when using an outside organization to perform an independent audit of the Packaging Supplier.

With the common NQA-1 requirements identified, the QA SMEs begin to tailor the NQA-1 requirements by breaking down the technical requirements into various parts and assigning NQA-1 requirements (Appendix K). In tailoring the NQA-1 requirements for each technical requirement, the QA SME recognizes they could be selecting the same requirement multiple times. Even though multiple NQA-1 requirements might be selected they will all be compiled into a single table (See [Appendix L](#)) that will become part of the procurement document.

The QA SME first takes the technical requirements in [Appendix F](#) and creates tables K-1 to K-6 (Appendix K).

1. Table K-1 is a compilation of the technical requirements for a UN-Performance and DOT Specification 7A, Type A packaging, the applicable regulatory requirements, and the specific NQA-1 requirements that would ensure those requirements in Table K-1 would be met.
2. Table K-2 was created to identify the components of a drum that a packaging supplier would purchase. The QA SMEs identified the items the packaging supplier will purchase, identified their applicable regulatory requirements, and reviewed the specific NQA-1 requirements the Packaging supplier will pass down to their supplier when purchasing the appropriate components.
3. Table K-3, NQA-1 Requirements for General Design Requirements in 49 CFR 173.410. Table K-3 was created to ensure regulatory requirements are met.
4. Table K-4, NQA-1 Requirements for Additional Design Requirements in 49 CFR 173.412. Identifies the applicable NQA-1 requirements that ensure the regulatory design requirements are met for Type A Packaging.
5. Table K-5, UN Performance Packaging Testing identifies the tests and the selected NQA-1 requirements that ensure these tests are performed as documented in the regulations
6. Table K-6, Type A Specification Packaging Testing, identifies the tests and the selected NQA-1 requirements that ensure these tests are performed as documented in the regulations
7. Table K-7, Requested Documentation showing compliance to DOT Regulations and additional Documentation, lists the documentation a packaging supplier must provide to show compliance in order to comply with the regulations and the DOE contractor purchase order. The applicable documents in Table K-7 will need to be in the packaging supplier's document control program.

5.1 Drum classified for use in a Nuclear Facility

As stated in [Appendix G](#), Drums Qualified for use in Nuclear Facilities or Activities, the 55-gallon drum specified has a safety function and a set of critical characteristics that the Nuclear Safety SMEs have established through their hazard and accident analysis. In Section 4.2 of this document the Nuclear Safety, DOT and QA SMEs have evaluated the technical requirements in [Appendix E](#) and [Appendix F](#). Based on their review they have determined that the following requirement needs to be added to the technical requirements to guarantee the critical characteristics identified will ensure the safety function will perform properly when implemented.

By adding the requirement in Table 4-1, Additional Critical Characteristics to Ensure The Safety Function is Met, into [Appendix E](#) and [Appendix F](#) the 55-gallon drum will meet the safety function for use in a nuclear facility. By adding this requirement the QA SME will increase the rigor of QA applied to the procurement of the 55-Gallon drum. Also an onsite audit will be required to ensure NQA-1 requirements and the critical characteristics are met.

5.2 Additional Requirements by DOE

DOE Order 414.1D, Contractors Requirement Document Attachment-3, requires the packaging suppliers to establish a Suspect/Counterfeit Items Prevention Program, and in Attachment-4, contractors are to have a Safety Software Quality Assurance Requirements for Nuclear Facilities Program. The Table 5-3, Additional DOE Order 414.1D, QA Requirements, below identifies the NQA-1 Requirements recommended for each of these programs.

Table 5-3, Additional DOE Order 414.1D QA Requirements		
DOE Requirement	NQA-1 Requirement	Discussion
Suspect/Counterfeit Items Prevention	Requirement 5 Requirement 7, 505	Requirement 5 is to establish procedures that implement this requirement, and requirement 7, 505 are receiving inspection requirements.
Safety Software Quality Assurance Requirements or Nuclear Facilities	NQA-1, Part II, Subpart 2.7 Section 301, Procured Software and Software services	The software that a Packaging Supplier may use is drafting programs, e.g. AutoCAD, and Microsoft Word and Excel spreadsheets. These are commonly purchased software.

5.3 Grading the Tailored QA Requirements

[Appendix L](#) documents the compilation of the tailoring process done in Section 5.0 of this document and identifies the applicable requirements with an “X” and those that do not apply by “N/A”. The purpose in doing this is to allow the packaging suppliers to use the graded approach in how each requirement is to be implemented. The application of each requirement is determined by the complexities of the packaging being manufactured, which are a function of the

design, the DOE contractor's technical requirements and the size of the Packaging Supplier's organization.

When the DOE contractor includes NQA-1 Requirements in the procurement documents submitted to the packaging supplier, the QA SME will then be required to select the appropriate method or methods to determine if the packaging supplier can meet the tailored QA requirements.

Referring to NQA-1, Requirement 7, Control of Purchased Items and Services, Section 200, Supplier Evaluation and Selection, the QA SME can select one or any combination of three options when selecting a packaging supplier. These are:

- a) Supplier's history of providing an identical or similar product that performs satisfactorily in actual use. The Supplier's history shall reflect current capability.
- b) Supplier's current quality records supported by documented qualitative and quantitative information that can be objectively evaluated.
- c) Supplier's technical and quality capability as determined by a direct evaluation of the facilities, personnel, and the implementation of the Supplier's quality assurance program. (Done by either the DOE contractor or a third party)

The PMC 2014 Container Survey indicated that for a 55-gallon drum procured within the complex meeting UN-Performance ([Appendix D](#)), Type A Specification Packaging ([Appendix E](#)), and 55-Gallon drums meeting both UN Performance and Type A Specification Packaging ([Appendix F](#)), most DOE contractors do not require the QA SMEs to perform an onsite audit of the packaging suppliers QA program. Therefore QA SMEs will place a packaging supplier on the evaluated suppliers list after qualifying the supplier to "a" and/or "b" above. When the 55-gallon drum is going to be used in a nuclear facility or activity that has a designated safety function QA SMEs elevate the rigor of QA based on the complexity of the DOT package. Based on that evaluation the DOE contractor may require an onsite audit or use a third party audit of the packaging supplier's QA program that will ensure the QA requirements in the procurement document and the critical characteristics identified by the NSS SMEs are met.

6.0 Conclusion

This guidance document was written for those DOE contractors who have implemented both DOE Order 414.1D, Quality Assurance and 10 CFR 830, Subpart A, Quality Assurance Requirements ([Appendix I](#)) using NQA-1-2008/2009a, Quality Assurance Requirements for Nuclear Facility Applications, as their implementing standard for their site quality program. For contractors who have selected a QA standard other than NQA-1, [Appendix H](#) provides various matrices showing how the NQA-1 standard translates into other QA standards, e.g., ISO 9001:2000 and ISO 9001:2008.

[Appendix M](#) provides a process that a DOE contractors procurement representative can use in procuring DOT packagings. The contractors procurement representative, following this process, and with the help of the applicable SME, will ensure all technical and quality assurance requirements are met. This process ensures the procurement representative of the following:

- DOT SMEs working with the material owner select the appropriate DOT packaging,
- DOT SMEs develop the technical requirements in accordance with NQA-1, Requirement 4, *Procurement Document Control, Section 202, Technical Requirements* ([Appendix D](#), [E](#), and [E](#)),
- NSS SMEs, determine the DOT packaging is classified for use in a nuclear facility, when applicable, and through the hazard and accident analysis determines its safety function and identifies the critical characteristics,
- QA SMEs working with DOT and Nuclear Safety SMEs tailor the QA requirements in accordance with NQA-1, Requirement 4, *Procurement Document Control, Section 203, Quality Assurance Program Requirements*, and
- QA SMEs and other SMEs, as required, select and qualify the packaging supplier based on the end use of the DOT packaging.

The EFCOG and PMC working group members encourage NNSA and DOE contractors to use this guidance document when procuring DOT packagings. This guidance is prepared by qualified SMEs within the DOE complex. This guidance document reflects their expertise from multiple disciplines with a combined experience in excess of 150 years. It is the best process developed by the working group for procurement of commonly used 55-gallon drums used for hazardous materials, low-level and mixed waste and radioactive materials. This document has gone through a number of peer reviews prior to this final version. These peer reviews have come from, the Office of Science (3-contractors), Environmental Management (5-contractors), NNSA (3-contractors), and 1 one contractor from Naval Reactors.

The EFCOG and PMC working group members would like to extend our thanks for those who have taken the time to peer review this document.

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Appendix A – Packaging Management Council Survey Results, 2014

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A.1 Packaging Management Council 2014 Container Survey

In August of 2014, the PMC conducted a container survey with the purpose of not only determining quantities and manufacturers of common DOT packagings, but more importantly, to identify the QA requirements (e.g., ISO 9001, NQA-1) that DOE contractors apply when procuring packagings for both on-site and off-site activities. For the purpose of the survey and this document, common packagings are considered packagings that are manufactured with little to no changes to the manufacturer's drawings and specifications (i.e., 55-gallon drums). In addition the survey asked what percentage of contractors procured packagings required to meet the nuclear safety management definition of Safety Class (SC) or Safety Significant (SS), and when purchased as such, what was the basis for that determination? In order to complete this survey, organizations within DOE/NNSA contractors (e.g., procurement, QA, and packaging operations) were requested to reply to the survey questions associated with DOT packaging needs, QA requirements, and applied safety basis.

The conclusions stated below came from 22 different organizations within 15 different DOE/NNSA contractors (5-Office of Science, 7-NNSA, and 3-EM Sites):

- NQA-1 is the standard of choice when implementing both the DOE Order 414.1D and 10 CFR 830. (65% of the DOE sites responding use NQA-1)
- Other DOE contractors used as their implementing standard, ISO 14001:2004, *Environmental Management Systems – Requirements with Guidance for use*, ISO 9001:2008, *Quality Management System – Requirements*, and NAP-24A, *Weapon Quality Policy*.
- When purchasing UN-Performance packaging 32% of the DOE contractors perform a supplier evaluation prior to procurement, while 55% of DOE contractors perform a supplier evaluation prior to procurement for Type A packaging because they needed to meet the SC or SS requirements.
- SC/SS packaging
 - <2.5% were purchased from Fiscal Year (FY) 2012 through FY2014
 - <2.5% are projected to be purchased for FY2015 and FY2016
 - Upon determination of drums being SC or SS, the DOE contractor invokes additional technical and QA requirements.
- 50% of contractors use personnel trained in the DOT regulations as part of their supplier evaluation team
 - When analyzing the responses to the survey an observation was made that it appears that DOE contractors QA personnel conducting audits of packaging suppliers are making DOT determinations without being DOT trained in accordance with 49 CFR 172 Subpart H.
- Most commonly used packaging by DOE contractors
 - 55-Gallon metal drums meeting UN-Performance Packaging requirements
 - 55-Gallon metal drums meeting Type A Specification Packaging requirements
 - 55-Gallon metal drums meeting both UN-Performance and Type A Specification Packaging requirements

From the results of this survey, the working group used a tailored approach in selecting the appropriate QA requirements that apply to UN-Performance packaging, UN-Performance and Type A Packaging, and packagings procured as SC or SS. Once the QA requirements have been selected they are implemented using a graded approach.

Appendix B - Packaging Management Council (PMC) Technical Description for the Procurement of a 208-Liter (55-Gallon) Removable Head, Performance Oriented Package (POP) and 7A Type A, Carbon Steel Drum with Closure Ring

You can retrieve this Technical Description using the following link.

<http://em-opt.wikidot.com/wiki:packaging-management-council>

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Appendix C – DOT Packaging Selection Process

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C.1 Packaging Selection

The process described in this section identified what the DOT SMEs will do in determining the packaging selection

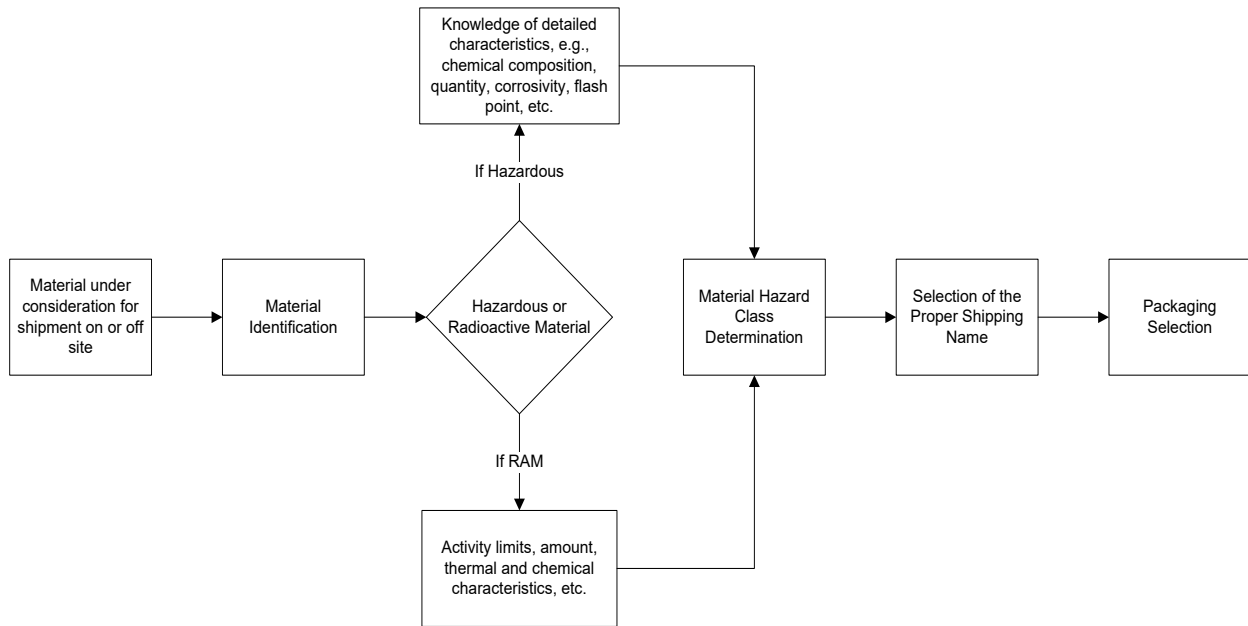


Figure C-1, DOT Packaging Selection Process

C.2 Training

Those individuals involved in the DOT Packaging Selection Process identified in Figure C-1 are required to be trained in accordance with 49 CFR 172 Subpart H, "Training," as follows:

- General awareness/familiarization training
- Function specific training
- Safety training
- Security awareness training
- In-depth security training, as applicable
- Occupational Safety and Health Administration and Environmental Protection Agency training as applicable

They are also to receive recurrent training every three years to keep updated with any changes in the regulations.

When trying to determine if an employee needs to be trained to the DOT regulations. Consider whether or not in the course of that employee's duty, are they required to make decisions as to whether or not the DOT regulations apply. If they do then training to the DOT regulations may be required.

C.3 Material Identification, Classification, and Packaging Selection

For the purpose of this document, the classification of hazardous materials will be discussed only as it relates to domestic shipments within the United States. This section identifies the information needed to determine the proper packaging for the material being shipped. Selection of an acceptable packaging requires proper material identification and material classification.

Material identification and hazard classification is dependent on the information provided by the owner of the material. For hazardous materials the material owner must provide detailed characteristics (e.g., chemical composition, quantity, corrosivity, flash point). For radioactive material identification consists of determining the radiological, physical, thermal, and chemical characteristics of the material to be shipped.

Upon making the hazard classification determination, the DOE SME must choose a hazardous material description and proper shipping name (PSN) that most appropriately describes the material and the hazards that could harm the public and/or the environment. The hazardous material descriptions and PSNs are taken from Column 2 of the Hazardous Materials Table (HMT) in 49 CFR 172.101. It is critical that the hazardous material description and PSN selected for the material to be shipped is the most appropriate found in the table as this description and name provides further guidance as to the authorized packaging to be used; marking, labeling and placarding to be applied; and the unique identification number required for emergency response services in case of an accident or incident.

With the PSN selected from the HMT, refer to Column 8, Packaging. Listed are the authorized packagings for the hazardous material that is specific to the PSN. Column 8 is divided into three columns:

1. Column 8A, Exceptions; this column contains exceptions from some of the requirements of the regulations
2. Column 8B, Non-bulk; this column references sections of 49 CFR 173, which prescribes packaging requirements for non-bulk packagings
3. Column 8C, Bulk, specifies the sections of 49 CFR 173 that prescribes packaging requirements for bulk packagings.

In reviewing columns 8A, 8B, and 8C, the DOT trained individual has selected a 55-gallon open head, carbon steel drum that is compatible with the contents that will meet UN-Performance requirements for liquids and solids and it will also meet Type A requirements for solids.

C.4 Regulatory Requirements

When determining the Technical Requirements, the most critical aspect in the application of the regulations is “containment,” which is accomplished by the packaging meeting the applicable regulatory requirements for the selected package.

Using the 55-gallon open head carbon steel drum as our example the applicable regulatory requirements will be derived from the following regulations:

- 49 CFR 178 Subpart L – Non-Bulk Performance-oriented Packagings Standards
- 49 CFR 178 Subpart M – Testing of Non-Bulk Packagings and Packages
- 49 CFR 178, Subpart K – Specification for Packagings for Class 7 (Radioactive) Materials
- 49 CFR 173.24, General Requirements for Packagings and Packages
- 49 CFR 173.24a, Additional General Requirements for Non-Bulk Packagings and Packages

C.5 Packaging Components Ensuring Containment

Once the specific regulatory requirements have been identified for the selected packaging, the next step in the process is to evaluate the selected packaging and identify the critical components of the packaging that will ensure containment of the contents. Again using the example of a 55-gallon open head carbon steel drum, the following components in Table C-1, *Packaging Components Ensuring Containment*, of the 55-gallon drum are to ensure containment.

Table C.1 Packaging Components Ensuring Containment	
Component	Containment
Steel used to fabricate the Top, Body, and Bottom	Ensure the material used is not damaged and if in sheets make sure it is square and the proper thickness
Gasket Material, Configuration	Ensure gasket is not twisted during installation if so the drum could leak even after closure ring is installed. Ensure gasket meets the temperature requirements for Type A Packaging
Drum Curl	Drum curl is critical because if not formed properly the closure ring may fail to close properly
Seam Weld	Ensure seam weld is properly done, if not the drum may leak. Some drum manufacturers perform a pressure test to ensure seam weld integrity.
Chimes	Ensure chimes are properly formed, round, box, double, or triple and ensure the seaming compound is applied. If the seaming compound is not applied RAM has the potential to leak through even though the chime is properly formed.
Bung Gaskets	Ensure bung gaskets are properly installed even after the torque is applied to ensure proper installation
Closure Ring Assembly	Ensure the closure ring design is the same one that was used when the UN-Performance tests and Type A test were performed. Ensure the closure ring can be closed properly and will reach the appropriate torque value.

Additional characteristics may be derived for operational use such as exterior color, interior coating, e.g., rust inhibitor, operational markings, or dimensional tolerances.

C.6 Packaging Configuration Management

When designing UN-Performance and Type A packagings, no one group is considered the “Designer,” it’s a joint effort between the packaging supplier and DOE contractor. For example, a DOE contractor determines the proper packaging for the contents in consideration. They then develop the technical requirements, which describes to the packaging supplier what the DOE contractor expects. The packaging supplier then takes those technical requirements, or design inputs, and converts them into fabrication documentation. This set of documents may include, but not be limited to:

- Fabrication drawing(s); identifying materials of construction and construction methods
- Procedures identifying manufacturing processes and how DOT tests are performed;
- Completed test reports showing:
 - The date the test took place,
 - Place of test, signature of testers,
 - A detailed description of each test performed including equipment used (and Calibration details), and
 - The damage to each test sample resulting from the tests
- A description as to how the fabricator will load the DOT packaging for testing
- Closure instructions as to how the DOT package is to be closed for transport.

The packaging supplier, to ensure compliance to the DOE contractor’s technical requirements, first reviews this document set internally. Then it is sent to the DOE contractor for their review and concurrence. This concurrence by the DOE contractor ensures that the packaging supplier has met the DOE contractor’s technical requirements. Once concurrence is reached between the packaging supplier and the DOE contractor, this becomes the accepted design or baseline design for that packaging. This design is then compared to existing designs the packaging supplier may already have in their inventory and, if so, they then can submit to the DOT contractor the document set noted above and, if accepted, they can ship the packagings to the DOE contractor. If not, then based on the baseline design test samples are fabricated and sent to a test lab to undergo performance tests. At any time during fabrication of the packaging, if there are any changes to the baseline design that affects the design and/or performance of the drum, the packaging supplier will issue a nonconformance report that will be reviewed and concurred with by both the DOE contractor and DOT packaging supplier. If the resolution of the nonconformance changes the baseline design, those changes are made and documented, and a new baseline design is created. When changing the baseline design it may require the DOE contractor to initiate their change control process.

When changes to the design are made to either UN-Performance packaging or Type A packaging, it will require an evaluation to determine if retesting is required. For UN-Performance packaging, the regulations provide specific guidance in 49 CFR 178.601 (g)(8) as to what design elements constitute a different packaging design. When any

one or more of these design elements change it may require the manufacturer to retest the DOT packaging.

The Type A regulations are not specific as to what constitutes a new design and therefore may require an engineering evaluation to any changes made that affect the design of a Type A packaging. This evaluation may result in retesting the package. The general rule to follow for a Type A packaging is that any design change that is made to a Type A package should be submitted for an engineering evaluation to make sure the package still meets 49 CFR 178.350 – *Specification 7A; general packaging, Type A*.

Upon successful completion of the UN-Performance packaging and/or Type A testing, the baseline design becomes the “Approved Packaging Configuration” and it now meets the DOE Contractor’s Technical Requirements that were submitted to the packaging supplier. The packaging supplier can now take the same fabrication documentation set and implementing the QA Program Requirements that the DOE Contractor has specified in the procurement documents, produce the drums the DOE contractor has ordered.

With this same “Approved Packaging Configuration,” the DOE contractor will develop a receipt inspection procedure and checklist to ensure, upon receipt, the DOT packaging meets the “Approved Packaging Configuration”.

C.7 Packaging Certification

Before the selection of technical and NQA-1 requirements, DOT personnel know that a metal drum is a common commodity used in a number of different industries. When using a metal drum for DOT regulated materials identified in the HMT, with the exception of radioactive materials, the drum must be an approved configuration meeting the requirements in 49 CFR 178 Subpart L, *Non-bulk Performance-Oriented Packaging (POP) Standards*, which includes the marking requirements, and 49 CFR 178 Subpart M – *Testing of Non-bulk Packagings and Packages*. Each drum configuration meeting these requirements is marked on the side and embossed on the bottom by the organization certifying the drum. The DOT defines the organization certifying the metal drum as:

“The person whose name and address or symbol appears as part of the specification markings required by 49 CFR 178 – Specifications For Packagings or, for a packaging marked with the symbol of an approval agency, the person on whose behalf the approval agency certifies the packaging.”

In other words, the manufacturer is the person/entity who certifies that the packaging meets all the applicable requirements in 49 CFR 178 Subparts L and M for the commodities identified in the HMT with the exception of radioactive materials. This is either the organization that fabricated the metal drum or the third party testing

organization that certified the DOT packaging. Whoever certifies the drum is the one who marks or requires the markings to be placed on the drum in accordance with 49 CFR 178.502 and 503.

Radioactive Materials (RAM) are a subset within the HMR and thus Type A quantities of RAM must meet a different set of certification requirements. These requirements are identified in 49 CFR 178.350, *Specification 7A; General Packaging, Type A*. In this case, the DOT uses the term “packaging manufacturer” different than the one used for UN-Performance packaging. The term “packaging manufacturer” as defined in 49 CFR 178.350(c), states the following:

“... The term “packaging manufacturer” means the person certifying that the package meets all requirements of 49 CFR 178.350.”

The packaging supplier who supplies the Type A packaging to the DOE contractor is not the “packaging manufacturer” as defined in 49 CFR 178.350(c). The reason is the packaging supplier of the Type A packaging does not have knowledge of the radioactive contents nor can they determine the increase in radiation or dose rate as a result of any damage that occurred during testing.

Thus, for Type A quantities of RAM, the shipper/offeror becomes the packaging manufacturer because they have knowledge of the characteristics of the RAM to be shipped and will evaluate the load prior to shipment. It is the shipper/offeror’s responsibility to compare the physical characteristics of the planned load with the test load and to show compatibility. If the test load and planned load are different it is the shipper/offeror’s responsibility to provide written justification were the planned payload is bounded by testing/analysis done by the packaging supplier or have the packaging supplier provide additional written information that the current testing/analysis bounds the planned payload. Also, the shipper/offeror is required to determine that, when evaluated against the damage incurred during testing, the dose (activity limit) of the package will not significantly increase. As part of the shipper/offeror’s documentation responsibility to certify the metal drum meets all the applicable requirements in 49 CFR 178.350, the packaging supplier, fabricator, and/or testing organizations will need to provide documentation to the shipper/offeror to comply with 49 CFR 173.415(a). This documentation allows the shipper/offeror to approve the packaging configuration and provide to DOT, upon request, a complete set of documentation of the applicable tests. Where appropriate, an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with the purchaser’s specification and 49 CFR 178.350. Table C.2, *Documents Showing Compliance to DOT Regulations*, below lists the documents the shipper/offeror (i.e. DOE contractor) should request and receive from the packaging supplier upon delivery of the packaging.

Table C.2 Documents Showing Compliance to DOT Regulations	
UN-Performance Packaging	Type A Packaging
<p>Test Report, 49 CFR 178.601 (I). NOTE: The test report usually does not show compliance to the production pressure test required for Liquids. The DOE contractor can request a copy of the procedure used to perform the production pressure test as required by 49 CFR 178.604.</p>	<p>Test Report for tests performed demonstrating compliance with 49 CFR 178.465 for solids. These reports shall include date, place of test, signature of testers, a detailed description of each test performed including equipment used (and calibration details), and the damage to each item of the containment system resulting from the tests. This description of results includes drawings or photographs of the package indicating where visible damage occurred and measurements of damage incurred. Pretest and posttest photographs of the package should be included. Even though pictures are taken, damage to the package is to be documented by measurements. Documentation that merely states that the package passed a test is insufficient.</p>
Fabrication or Engineering Drawings	Fabrication or Engineering Drawing(s) construction methods, features, and materials.
Closure Instructions, 49 CFR 178.2(c)	Closure Instructions, 49 CFR 178.2(c)
Certificate of Conformance as per NQA-1, Requirement 7, Section 503.	Certificate of Conformance as per NQA-1, Requirement 7, Section 503.
	When qualifying DOT packaging as meeting the requirements of 49 CFR 178.350, using 49 CFR 173.461, the packaging supplier will provide to the DOE contractor documentation demonstrating compliance with the design requirements in 49 CFR 173.410 and 173.412 and the test requirements in 49 CFR 173.465 through 49 CFR 173.469.
<p>The test reports generated by the packaging supplier will ensure traceability to the package tested. When a fabrication or engineering drawing is used it will be traceable to the package tested.</p>	

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Appendix D – Technical Requirements for the Procurement of a UN- Performance-oriented Packaging, 55- Gallon, Open Head, Carbon Steel Drum for Solids and Liquids

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This appendix identifies the Technical Requirements for the procurement of a UN-Performance 55-gallon carbon steel open head drum. These requirements are selected from the PMC Steel Drum Specification in Appendix B. These Technical Requirements will allow the DOT Packaging Supplier with concurrence from the DOE contractor to design, test, and manufacture a 55-gallon carbon steel open head drum. This UN-Performance packaging will be used to ship and store on or offsite hazardous materials, wastes and substances.

UN-Performance Packaging Technical Specifications for the Procurement of a 55-Gallon Open Head Carbon Steel Drum	
Regulatory requirements for Hazardous Materials, Waste and substances (non-Radioactive)	Applicable UN-Performance Packaging regulatory requirements for both solids and liquids: General packaging requirements in 49 CFR 173.24 and 24a. 49 CFR 178 Subpart L, Non-bulk Performance-oriented Packaging Standards and 49 CFR 178 Subpart M, Testing of Non-bulk Packagings and Packages
Contents	Limited to solids and liquids
Drum Type	Open head carbon steel drum (UN1A2)
Capacity (Maximum) Liquids	208 Liters (55-gallon)
Material of Construction	Material of Construction – ASTM A1008, Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable or equivalent. Material Thickness for the Top, Body, Bottom, is 1.5mm (16 Gauge). Request Certified Materials Test Report (CMTR) showing compliance with the ASTM Standard.
Minimum Material Thickness requirements	Materials used in the manufacturing of this packaging shall maintain a minimum thickness as required in 49 CFR 173.28(b)(4).
Lid Gasket (glued in place):	Round, EPDM or equivalent, ASTM-D1056-14, Sponge and Expanded Cellular Rubber Products. Request CMTR showing compliance with the ASTM Standard.
Rolling Hoops:	Three
Overall Height drum body without cover and ring	870 mm (34.25-inches) Tolerances as defined on the fabrication drawing
Inside Diameter	572 mm (22.5-inches) Tolerances as defined on the fabrication drawing
Bung Fittings	19 mm (3/4-inch) and 51mm (2-inch) Metal Rieke Style flange with fitting
Bung Gasket	EPDM or equivalent, ASTM-D1056-14, Sponge and Expanded Cellular Rubber Products. Request CMTR showing compliance with the ASTM Standard.
Closure Ring	The closure ring assembly is usually purchased as a component part to the metal drum. The supplier of the metal drum is required to obtain from their supplier a detailed fabrication drawing as to how the closure ring is manufactured. This fabrication drawing is to be in the supplier's document control program. The drawing will identify the materials of construction; thread size for bolt, placement of lugs, size, length and types of welds, if welds are performed in accordance with a specific American Welding Society (AWS) standard (e.g. AWS D1.3, ASME Section IX) that is to be identified. The drawing is to identify in the notes the applicable Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) welding documents used in the performance of the fabrication of the closure ring if applicable. Also in the notes the color of the coating and mil thickness. When a purchased closure ring assembly is used in qualifying the metal drum to tests identified in 49 CFR 178 Subpart M – Testing of non-Bulk Packagings and Packages, and the drum successfully passes these tests, then the closure ring assembly design becomes fixed and should not change without further testing and concurrence with the DOE contractor.
Bolt and Nut Type	Bolt and Nut for closure ring – 16 mm (5/8-inch) x 102 mm (4-inch) ASTM A 307A bolt with nut. The bolt will have a nominal 8 mm (5/16-inch) diameter hole drilled on center a minimum 13mm (1/2-inch) from the end of the bolt. Request CMTR showing compliance with the ASTM Standard.
Chime design	Round or determined by the manufacturers equipment. Request Safety Data Sheet (SDS) and manufacturers documentation for the seaming compound.
Side Seam	Overlap weld or equivalent
Drum Curl	As per manufacturers requirements (see drawing) Note: Following the manufacturer's design for the drum, curl is critical because if not followed it may have an effect on the closure of the drum.

UN-Performance Packaging Rated Net payload – Solids	400 kgs (882 pounds)
UN-Performance Packaging Group for solids	PGI
UN-Performance Packaging Rated Net payload – Liquids	The maximum capacity is 208 Liters (55-gallons)
UN-Performance Packaging Group for Liquids	PG II
Specific Gravity for Liquid	1.5
Hydrostatic Test Pressure – minimum	150 kPa (22 PSI)
Pre-inspection prior to performing the DOT tests.	UN Performance requirements for pre-inspection prior to tests 49 CFR 178.602, Preparation of Packaging and Packages for testing.
Required Test for solids	49 CFR 178.603, Drop Test and Stacking Test; and the packaging should be capable of passing the vibration standard in 49 CFR 178.608 and also meets the requirements in 49 CFR 173.27(c). Request copy of Test report and any associated documentation demonstrating compliance.
UN-Performance Packaging Required Test for liquids	49 CFR 178.603, Drop Test; 178.604, Leakproofness Test, which includes the production Leakproofness test; 178.605, Hydrostatic Pressure Test, 178.606, Stacking Test; and the packaging should be capable of passing the vibration standard in 49 CFR 178.608. Also the drum needs to meet the requirements in 49 CFR 173.27(c). Request copy of Test report and any associated documentation demonstrating compliance.
Exterior Coating	Color Black for body and bottom of the drum with a white lid and the thickness shall be adequate to withstand all types of weather conditions and comply with coating manufacturer's requirements (0.4-Mil minimum thickness typical). Coverage shall be uniform and free from runs, sags, streaks, blisters cracks or de-laminations. Request Safety Data Sheets (SDS) and manufactures documentation showing coating application instructions. Note: Changing the exterior coating does not constitute a design change requiring re-testing.
Interior Coating, rust inhibitor, e.g. epoxy/phenolic Note: When an interior coating is designated as a "Safety Coating" it must meet 49 CFR 178.601(j).	Epoxy Phenolic coating and the thickness shall be in accordance with the manufacturer's requirements (0.4-Mil minimum thickness typical). Coverage shall be uniform and free from runs, sags, streaks, blisters cracks or de-laminations. Request SDS and manufactures documentation showing coating application instructions. Note: Changing the interior coating does not constitute a design change requiring re-testing unless it is designated as a Safety Coating.
UN-Performance Packaging Markings for Solids	UN1A2/X/420/S/YR/USA/MXXXX or manufacturers symbol
Bottom Embossed marking for Solids:	UN1A2/X420/S/16 1.5-1.5-1.5
UN-Performance Packaging Markings for Liquids	UN1A2/Y1.5/150/YR/USA/MXXXX or manufacturers symbol
Bottom Embossed marking for Liquids:	UN1A2Y1.5/150/S/16 1.5-1.5-1.5
DOE Contractor Additional Marking Requirements	Each drum shall have stenciled 6-inches left of the drum seam and between the top and middle rolling hoops in 1-inch letters the assigned lot number and purchase order number.
DOE Contractor Additional Shipping Requirements	Each drum shall have a cardboard sleeve placed around the carbon steel drum prior to shipping. Based on the Supplier's discretion they will put 4-drums to a pallet and then shrink-wrap the four drums together and to the pallet.

Appendix E – Technical Requirements for the Procurement of a Type A Specification Packaging 55-Gallon, open Head, Carbon Steel Drum for Solids

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DOE contractors, when procuring a Type A packaging, usually purchase a packaging that already meets UN-Performance requirements: see appendix A. This appendix identifies the Technical Requirements for the procurement of a 55-gallon carbon steel open head drum meeting the Specification Packaging Requirements identified in 49 CFR 178 Subpart K, Specifications for Packagings for Class 7 (Radioactive) Materials. These specifications were derived from the PMC Steel Drum Specification in Appendix B. These Technical Requirements allows a DOT Packaging Supplier with concurrence from the DOE contractor, to design, test, and manufacture DOT Type A Specification Packaging. This Type A Packaging will be used to ship and store on, or offsite, solid RAM and low-level radioactive waste.

Type A Technical Specification for the Procurement of a 55-Gallon Open Head Carbon Steel Drum	
Regulatory requirements for Type A quantities non-fissile/fissile excepted materials and waste.	Applicable Type A Packaging regulatory requirements for solids: General packaging requirements in 49 CFR 173.24 and 24a. Type A, 49 CFR 178.350, Specification 7A; General Packagings for Class 7 (Radioactive) Materials. Note: When performing the drop tests as required in 49 CFR 173.465(c), the drop test for fissile material identified in 49 CFR 173.465(c)(2) is required at the DOE contractor's discretion.
Type A Packaging Contents	Limited to solids only
Drum Type	Open head carbon steel drum (UN1A2)
Capacity	208 L (55-gallon)
Material of Construction	Material of Construction – ASTM A1008, Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable or equivalent. Request Certified Materials Test Report (CMTR) showing compliance with the ASTM Standard. Material Thickness for the Top, Body, Bottom, is 1.5mm (16 Gauge).
Minimum Material Thickness requirements	Materials used in the manufacturing of this packaging shall maintain a minimum thickness as required in 49 CFR 173.28(b)(4).
Lid Gasket (glued in place):	Round, EPDM or equivalent (Meets temperature requirements of –40°F to +158°F) ASTM-D1056-14, Sponge and Expanded Cellular Rubber Products. Request CMTR showing compliance with the ASTM Standard.
Rolling Hoops:	Three
Overall Height drum body without cover and ring	870 mm (34.25-inches) Tolerances as defined on the fabrication drawing
Inside Diameter	572 mm (22.5-inches) Tolerances as defined on the fabrication drawing
Bung Fittings	19 mm (3/4-inch) and 51mm (2-inch) Metal Rieke Style flange with fitting
Bung Gasket	EPDM or equivalent (Meets temperature requirements of –40°F to +158°F) ASTM-D1056-14, Sponge and Expanded Cellular Rubber Products. Request CMTR showing compliance with the ASTM Standard.
Closure Ring	The closure ring assembly is usually purchased as a component part to the metal drum. The supplier of the metal drum is required to obtain from their supplier a detailed fabrication drawing as to how the closure ring is manufactured. This fabrication drawing is to be in the supplier's document control program. The drawing will identify the materials of construction, thread size for bolt, placement of lugs, size, length and types of welds, if welds are performed in accordance with a specific American Welding Society (AWS) standard (e.g. AWS D1.3, ASME Section IX) that is to be identified. The drawing is to identify in the notes the applicable Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) welding documents used in the performance of the fabrication of the closure ring. Also in the notes after the fabrication is completed the supplier will document the color of the exterior coating and mil thickness. When a purchased closure ring assembly is used in qualifying the metal drum to tests identified in 49 CFR 178 Subpart K – Specifications for Packagings for Class 7 (Radioactive) Materials, and the drum successfully passes these tests then the closure ring assembly design becomes fixed and should not change without further testing and concurrence with the DOE contractor.

Bolt and Nut Type	Bolt and Nut for closure ring – 16 mm (5/8-inch) x 102 mm (4-inch) ASTM A 307A bolt with nut. The bolt will have a nominal 8 mm (5/16-inch) diameter hole drilled on center a minimum 13mm (½-inch) from the end of the bolt. Request CMTR showing compliance with the ASTM Standard.
Chime design	Round or determined by the manufacturers equipment. Request Safety Data Sheet (SDS) and manufactures documentation for the seaming compound.
Side Seam	Overlap weld or equivalent
Drum Curl	As per manufacturers requirement (see drawing) Note: Following the manufacturer’s design for the drum curl is critical because if not followed may have an effect on the closure of the drum.
Rated Net Payload for Type A Packaging – Solids	DOE contractor identifies the Net Payload prior to testing
Type A pre-inspection prior to performing the DOT tests	Type A requirements for pre-inspection prior to tests 49 CFR 173.462, Preparation of specimens for testing.
Type A Required Test for Solids Non Fissile/Fissile Excepted	49 CFR 173.465: (a) – Instructions for performing the tests (b) – Water Spray test (c) – (1) Free Drop Test and (5) Target for free drop test (d) – Stacking Test (e) – Penetration Test Request copy of Test report and any associated documentation demonstrating compliance.
Reduction of Ambient Pressure Test to 60kPa (8.7 psia) (49 CFR 173.412(f))	This test may be performed by placing a loaded drum, which is closed for transportation, in a test chamber and reducing the pressure in the chamber to 60 kPa (8.7 psia)
Recommended material used when testing Type A drums for solids	Descriptions of DOE Forms 1, 2, and 3 Non-fissile/fissile-excepted Radioactive Material that may be used as surrogate contents for testing Form Number 1: Solids—any particle size ▪ A packaging qualified for these contents may contain non-fissile/fissile-excepted radioactive contents of any representative particulate size. Form Number 2: Solids—large particle size only (i.e., sand, concrete, debris, soil) ▪ Contents of a corresponding particulate size such as soil or construction debris. (Glass or plastic lab-ware having fine particulate available for dispersion would not fit this category and requires a packaging qualified for fine particulate, Form Number 1.) Form Number 3: Solids—objects with no significant dispersible or removable contamination (for definition, see 49 CFR 173.443, "Contamination control") ▪ 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.
Exterior Coating	Color White for body and bottom and lid of the drum and the thickness shall be adequate to withstand all types of weather conditions and comply with coating manufacturer’s requirements (0.4-Mil minimum thickness typical). Coverage shall be uniform and free from runs, sags, streaks, blisters cracks or de-laminations. Request SDS and manufactures documentation showing coating application instructions. NOTE: Changing the exterior coating does not constitute a design change requiring re-testing.
Interior Coating, rust inhibitor, e.g. epoxy/phenolic	Epoxy Phenolic coating and the thickness shall be in accordance with the manufacturer’s requirements (0.4-Mil minimum thickness typical). Coverage shall be uniform and free from runs, sags, streaks, blisters cracks or de-laminations. Request SDS and manufactures documentation showing coating application instructions. NOTE: Changing the interior coating does not constitute a design change requiring re-testing.
Type A Marking	"USA DOT 7A Type A" shall not be applied to the drum. The supplier will provide the marking on a fade resistant label having a permanent adhesive that is able to withstand all types of weather conditions.
DOE Contractor Additional Marking Requirements	Each drum shall have stenciled 6-inches left of the drum seam and between the top and middle rolling hoops in 1-inch letters the assigned lot number and purchase order number.
DOE Contractor Additional Shipping Requirements	Each drum shall have a cardboard sleeve placed around the carbon steel drum prior to shipping. Based on the Supplier’s discretion they will put 4-drums to a pallet and then shrink-wrap the four drums together and to the pallet.

**Appendix F – Technical
Requirements for the Procurement
of a 55-Gallon, Open Head, Carbon
Steel Drum Meeting Both UN
Performance, for Solids and
Liquids and Type A Specification
Packaging for Solids**

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This appendix has been provided to DOE contractors because some of the contractors chose to combine both UN-Performance and Type A requirements into a single drum. This appendix combines both Technical Requirements so a DOE contractor can procure a 55-gallon Carbon Steel Open Head Drum that meets both UN-Performance and Type A Packaging Specifications.

Procurement of a 55-Gallon Open Head Carbon Steel Drum, which meets both UN-Performance and Type A Packaging Technical Requirements	
Regulatory requirements for Hazardous Materials, Waste and substances (non-Radioactive)	Applicable UN-Performance Packaging regulatory requirements for both solids and liquids: General packaging requirements in 49 CFR 173.24 and 24a. 49 CFR 178 Subpart L, Non-bulk Performance-oriented Packaging Standards 49 CFR 178 Subpart M, Testing of Non-bulk Packagings and Packages.
Regulatory requirements for Type A quantities non-fissile/fissile excepted materials and waste.	Applicable Type A Packaging regulatory requirements for solids: General packaging requirements in 49 CFR 173.24 and 24a. Type A, 49 CFR 178.350, Specification 7A; General Packagings for Class 7 (Radioactive) Materials solids only. Note: When performing the drop tests as required in 49 CFR 173.465(c), the drop test for fissile material identified in 49 CFR 173.465(c)(2) is required at the DOE contractor's discretion.
UN-Performance Packaging Contents	Solids and Liquids
Type A Packaging Contents	Solids only
Drum Type	Open head carbon steel drum (UN1A2)
Capacity	208 L (55-gallon)
Material of Construction	Material of Construction – ASTM A1008, Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable or equivalent. Material Thickness for the Top, Body, Bottom, is 1.5mm (16 Gauge). Request Certified Materials Test Report (CMTR) showing compliance with the ASTM Standard.
Minimum Material Thickness requirements	Materials used in the manufacturing of this packaging shall maintain a minimum thickness as required in 49 CFR 173.28(b)(4).
Lid Gasket (glued in place):	Round, EPDM or equivalent (Meets temperature requirements of –40°F to +158°F) ASTM-D1056-14, Sponge and Expanded Cellular Rubber Products. Request CMTR showing compliance with the ASTM Standard.
Rolling Hoops:	Three
Overall Height drum body without cover and ring	870 mm (34.25-inches) Tolerances as defined on the fabrication drawing
Inside Diameter	572 mm (22.5-inches) Tolerances as defined on the fabrication drawing
Bung Fittings	19 mm (3/4-inch) and 51mm (2-inch) Metal Rieke Style flange with fitting
Bung Gasket	EPDM or equivalent (Meets temperature requirements of –40°F to +158°F) ASTM-D1056-14, Sponge and Expanded Cellular Rubber Products. Request CMTR showing compliance with the ASTM Standard.
Closure Ring	The closure ring assembly is usually purchased as a component part to the metal drum. The supplier of the metal drum is required to obtain from their supplier a detailed fabrication drawing as to how the closure ring is manufactured. This fabrication drawing is to be in the supplier's document control program. The drawing will identify the materials of construction, thread size for bolt, placement of lugs, size, length and types of welds, if welds are performed in accordance with a specific American Welding Society (AWS) standard (e.g. AWS D1.3, ASME Section IX) that is to be identified. The drawing is to identify in the notes the applicable Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) welding documents used in the performance of the fabrication of the closure ring. Also in the notes after the fabrication is completed the supplier will document the color of the exterior coating and mil thickness. When a purchased closure ring assembly is used in qualifying the metal drum to tests identified in 49 CFR 178 Subpart M – Testing of non-Bulk Packagings and Packages, and the drum successfully passes these tests then the closure ring assembly design becomes fixed and should not change without further testing and concurrence with the DOE contractor.
Bolt and Nut Type	Bolt and Nut for closure ring – 16 mm (5/8-inch) x 102 mm (4-inch) ASTM A 307A bolt with nut. The bolt will have a nominal 8 mm (5/16-inch) diameter hole drilled on center a

	minimum 13mm (½-inch) from the end of the bolt. Request CMTR showing compliance with the ASTM Standard.
Chime design	Round or determined by the manufacturers equipment. Request Safety Data Sheet (SDS) and manufactures documentation for the seaming compound.
Side Seam	Overlap weld or equivalent
Drum Curl	As per manufacturers requirement (see drawing) Note: Following the manufacturer’s design for the drum curl is critical because if not followed may have an effect on the closure of the drum.
UN-Performance Packaging Rated Net payload – Solids	400 kgs (882 pounds)
UN-Performance Packaging Rated Net payload – Liquids	The maximum capacity is 208 Liters (55-gallons)
Rated Net Payload for Type A Packaging – Solids	DOE contractor identifies the Net Payload prior to testing
UN-Performance Packing Group for solids	PG I
UN-Performance Packing Group for Liquids	PG II
Specific Gravity for Liquid	1.5
Hydrostatic Test Pressure – minimum	150 kPa (22 PSI)
POP Pre-inspection prior to performing the DOT tests.	UN Performance requirements for pre-inspection prior to tests 49 CFR 178.602, Preparation of Packaging and Packages for testing.
Type A pre-inspection prior to performing the DOT tests	Type A requirements for pre-inspection prior to tests 49 CFR 173.462, Preparation of specimens for testing.
Un-Performance Packaging Required Test for solids	49 CFR 178.603, Drop Test, Stacking Test, and the packaging should be capable of passing the vibration standard in 49 CFR 178.608 and also meets the requirements in 49 CFR 173.27(c). Request copy of Test report and any associated documentation demonstrating compliance
UN-Performance Packaging Required Test for liquids	49 CFR 178.603, Drop Test; 178.604, Leakproofness Test, which includes the production Leakproofness test; 178.605, Hydrostatic Pressure Test, 178.606, Stacking Test; and the packaging should be capable of passing the vibration standard in 49 CFR 178.608. Also needs to meet the requirements in 49 CFR 173.27(c). Request copy of Test report and any associated documentation demonstrating compliance
Type A Required Test for Solids Non Fissile/Fissile Excepted	49 CFR 173.465: (a) – Instructions for performing the tests (b) – Water Spray test (c) – (1) Free Drop Test and (5) Target for free drop test (d) – Stacking Test (e) – Penetration Test Request copy of Test report and any associated documentation demonstrating compliance
Recommended material used when testing Type A drums	Descriptions of DOE Forms 1, 2, and 3 Non-fissile/fissile-excepted Radioactive Material that may be used as surrogate contents for testing Form Number 1: Solids—any particle size ▪ A packaging qualified for these contents may contain non-fissile/fissile-excepted radioactive contents of any representative particulate size. Form Number 2: Solids—large particle size only (i.e., sand, concrete, debris, soil) ▪ Contents of a corresponding particulate size such as soil or construction debris. (Glass or plastic lab-ware having fine particulate available for dispersion would not fit this category and requires a packaging qualified for fine particulate, Form Number 1.) Form Number 3: Solids—objects with no significant dispersible or removable contamination (for definition, see 49 CFR 173.443, "Contamination control") ▪ 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.
Exterior Coating	Color Black for body and bottom of the drum with a white lid and the thickness shall be adequate to withstand all types of weather conditions and comply with coating manufacturer’s requirements (0.4-Mil minimum thickness typical). Coverage shall be uniform and free from runs, sags, streaks, blisters cracks or de-laminations. Request Safety Data Sheets (SDS) and manufactures documentation showing coating application instructions.

	Note: Changing the exterior coating does not constitute a design change requiring re-testing.
Interior Coating, rust inhibitor, e.g. epoxy/phenolic Note: For POP only when an interior coating is designated as a "Safety Coating" it must meet 49 CFR 178.601(j).	Epoxy Phenolic coating and the thickness shall be in accordance with the manufacturer's requirements (0.4-Mil minimum thickness typical). Coverage shall be uniform and free from runs, sags, streaks, blisters cracks or de-laminations. Request Safety Data Sheets (SDS) and manufactures documentation showing coating application instructions. Note: Changing the interior coating does not constitute a design change requiring re-testing unless it is designated as a Safety Coating for POP only.
UN-Performance Packaging Markings for Solids	UN1A2/X/420/S/YR/USA/MXXXX or manufacturers symbol
Bottom Embossed marking for Solids:	UN1A2/X420/S/16 1.5-1.5-1.5
UN-Performance Packaging Markings for Liquids	UN1A2/Y1.5/150/YR/USA/MXXXX or manufacturers symbol
Bottom Embossed marking for Liquids:	UN1A2Y1.5/150/S/16 1.5-1.5-1.5
Type A Marking	"USA DOT 7A Type A" shall not be applied to the drum. The supplier will provide the marking on a fade resistant label having a permanent adhesive that is able to withstand all types of weather conditions.
DOE Contractor Additional Marking Requirements	Each drum shall have stenciled 6-inches left of the drum seam and between the top and middle rolling hoops in 1-inch letters the assigned lot number and purchase order number.
DOE Contractor Additional Shipping Requirements	Each drum shall have a cardboard sleeve placed around the carbon steel drum prior to shipping. Based on the Supplier's discretion they will put 4-drums to a pallet and then shrink-wrap the four drums together and to the pallet.

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Appendix G – Drums Qualified for use in Nuclear Facilities or Activities

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G.1 Accident and Hazard Analysis determine safety function – Safety Class or Safety Significant

This appendix covers DOT packaging that has been designated either as Safety Class (SC) or Safety Significant (SS) Structures, Systems, and Components (SSCs) as defined in 10 CFR 830.3, *Definitions*, (Appendix N). The safety functions performed by the packaging in support of the overall safety function are described in the Documented Safety Analysis (DSA) for a nuclear facility or activity.

DOE-STD-3009-2014, dated November 2014, Section 4, Documented Safety Analysis (DSA) Format and Content, Chapter 4, Safety Structures, Systems, and Components, (see Sections 4.3.X.1 for SC and 4.4.X.1 for SS) states the reasons for designating the SSC as SC or SS as determined through the hazard and accident analysis. The analysis will identify the safety function or functions that have been determined.

The DOT Personnel will need to know the safety functions being credited, so those critical characteristics can be identified and included in the technical requirements that are attached to the procurement documents (Appendix D, E, and F). The QA Personnel can then identify the appropriate quality requirements to ensure operability of the drum safety function(s) with the approved QA implementation.

If a SC or SS control is found necessary, all preventive and mitigating controls associated with the sequence of failures that result in a given release scenario are candidates for consideration. Preventive or mitigating controls are selected using a judgment-based process considering a hierarchy of controls that gives preference to passive engineered safety features over active ones; engineered safety features over Administrative Controls or Specific Administrative Controls; and preventive over mitigative controls.

Ensure the drums are procured under the DOE site approved Quality Assurance Program (QAP) as designated under the safety management programs cited in the facility or Transportation DSA. American Society Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1 -2008/2009a is the current standard for QAP requirements. If compliance to the selected NQA-1 requirements is not achievable then a path forward for a commercial grade dedication process may be appropriate.

G.2 Training for Nuclear Safety Specialist

The Department of Energy has developed a Technical Standard, DOE-STD-1183-2007, “Nuclear Safety Specialist Functional Area Qualification Standard,” that identifies the required technical competencies for a Nuclear Safety Specialist for DOE Personnel. As a trained Nuclear Safety Specialist they are required to demonstrate familiarity and have a level of knowledge in each of the sections listed in the required technical competencies.

DOE contractors are required to develop a “Training implementation Matrix” according to DOE Order 426.2, Change 1, *Personnel Selection, Training, Qualification and Certification Requirements for DOE Nuclear Facilities*, Contractor Requirements

Document (CRD). This training Matrix is approved by the DOE contractor's site office. Within this training matrix the DOE contractor will identify the education and experience requirements that is required for contractor personnel to function as a Nuclear Safety Specialist.

G.3 Example of a Type A Specification Packaging meeting a Nuclear Safety Management Safety Function

A group of qualified Nuclear Safety Specialists develop a Transportation Safety Document (TSD) using 10 CFR 830 Subpart B, Safety Basis Requirements. In this document they will designate a 55-gallon open head carbon steel drum meeting both UN-Performance and Type A Specification Packaging requirements. Through the process of both an Accident and Hazard Analysis they have identified this 55-gallon drum as meeting a safety function and designated the drum as Safety Significant. The defined safety function for this 55-gallon open head carbon steel drum is:

A "packaging," which meets minimum performance requirements and reduces the likelihood of a release of radioactive material during accidents that involve drops, penetrations, crushes, and thermal insult as well as maintaining geometry and spacing for criticality safety.

Using this safety function the DOE contractor's onsite TSD identifies the packaging performance envelope, which addresses design basis conditions for containment, drop, puncture, crush, fire, water spray, heat, cold, reduced external pressure, increased external pressure, vibration, external radiation, criticality, incompatible materials, and corrosives. Of these design basis conditions, the transportation safety requirements address the requirements for containment, drop, puncture, and crush since the packaging performance envelope does not meet the design basis conditions for these criteria. Packaging shall meet the following characteristics, as referenced below.

- Containment, 49 CFR 173.410, General Design Requirements and 49 CFR 173.412, Additional Design Requirements for Type A Packages
- Puncture, 49 CFR 173.465 (e), Type A Packaging Tests
- Drop, 49 CFR 173.465 (c)(1) and (2), Type A Packaging Tests
- Crush, 49 CFR 173.465 (d), Type A Packaging Tests

Note: Each of the above performance tests identified in 49 CFR 173.465 will be preceded as required by regulations by a water spray test in 49 CFR 173.465(b).

When packaging is evaluated against these four criteria and complies (along with additional controls) established by the TSD, the packaging safety function will be met. Along with these test criteria the packaging will also meet the design requirements in 49 CFR 173.412.

Appendix H – Quality Assurance as applied to DOE Contractors

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H.1 Quality Assurance

Quality Assurance within the DOE is established through DOE Order 414.1D, *Quality Assurance*. This Order is also passed down to DOE organizations through other DOE orders, e.g. DOE Order 460.1C, *Packaging and Transportation Safety*, NNSA Order 461.1B, *Packaging and Transportation for Offsite Shipment of Materials of National Security Interest*. DOE Order 414.1D, applies to all DOE contractors that have accepted the order into their contract, including NNSA contractors.

Attachment 1 in DOE O 414.1D, Contractor Requirements Document (CRD), establishes how a QAP is developed and implemented. The CRD Attachment 2 establishes the ten (10) criteria that make up the DOE QA requirements. In Section 1(c) of Attachment 1, the Order states that a DOE contractor is to select an appropriate national or international consensus standard to implement the 10 criteria. Once the contractor has selected the national or international consensus standard, the contractor will then write their QAP around that standard and submit it to their local DOE field office for approval. As noted in Appendix A the common QA Standard used by DOE contractors is ASME NQA-1. Once the QAP is approved, that document becomes the contractor's approved quality program.

H.2 Quality Assurance within Nuclear Facilities

DOE contractors who have activities (e.g., onsite transportation) and facilities classified as a Hazard Category 1, 2 and 3 as determined by DOE-STD 1027-92, fall under 10 CFR 830 *Nuclear Safety Management*, unless excepted by 10 CFR 830.2¹. The QA requirements for nuclear facilities are not governed by DOE Orders but by the regulatory requirements in 10 CFR 830, *Nuclear Safety Management* and sometimes referred to as the Rule, with the QA requirements identified in 10 CFR 830 Subpart A, *Quality Assurance Requirements*. When you compare the QA requirements in 10 CFR 830 Subpart A with that of DOE Order 414.1D CRD Attachment 2, the requirements are the same with some very minor variations (Appendix I). The implementation of these requirements (the 10-criteria) follows the same philosophy as that of DOE Order 414.1D CRD Attachment 1(c). The DOE contractor is to select a "voluntary consensus standard" to implement the "Quality Assurance Criteria in 10 CFR 830.122." Recognizing this, a DOE contractor may use the same national or international consensus standard used to implement the QA criteria in DOE Order 414.1D Attachment 2, which is documented in the contractor's approved QAP by the DOE Field office.

Even though a DOE nuclear facility is governed by the regulatory requirements in 10 CFR 830, *Nuclear Safety Management*, DOE Order 414.1D CRD provides direction as to the selection of the consensus standard that will be used to implement the QA requirements in 10 CFR 830.122. In DOE Order 414.1D, CRD Section 1, (c), 1(a-c), for Hazard Categories 1, 2, or 3, nuclear facilities, DOE provides direction as to the applicable voluntary consensus standard that will be used in a nuclear facility, as follows:

¹ Transportation activities that are regulated by the DOT are specifically excluded in 10 CFR 830.2 (c).

- Existing facilities, or new facilities and major modifications to existing facilities achieving Critical Decision 1 prior to the issuance of the Order containing this CRD, continue to use the consensus standard cited in the DOE-approved QAP consistent with Secretarial Officer direction.
- New facilities and major modifications to existing facilities achieving Critical Decision-1 after the Order containing this CRD has been issued, use NQA-1-2008 with the NQA-1a-2009 addenda (or a later edition), QA Requirements for Nuclear Facility Applications, Part I and applicable requirements of Part II².
- Consensus standard(s) that provide an equivalent level of quality requirements as required in Paragraphs 1.c(1) of DOE Order 414.1D, CRD Attachment 1 may be used in lieu of those specified to implement the requirements of this CRD. The QAP must document how this consensus standard is (or a set of consensus standards are) used, as well as how they are equivalent to the consensus standard listed in Section 1(c)(1)(c) of 414.1D CRD.

Appendix G provides a brief discussion when the DOT packaging may be considered “SC” or “SS” and what should be done to address the additional technical requirements based on the Safety Function(s) and how the additional QA requirements are selected.

H.3 Radiological, Non-nuclear and Chemically Hazardous Facilities and Activities

DOE Order 414.1D, Quality Assurance, Attachment 1, Contractor Requirements Document, DOE Order 414.1D, Quality Assurance, Section 1, (c), 1, (c), states, “For other activities and facilities (e.g., less than hazard category 3, non-nuclear, or chemically hazardous) use in whole, or in part, of appropriate standards. Examples of these standards may include:

- ASME NQA 1-2008 with the NQA-1a-2009 addenda, QA Requirements for Nuclear Facility Applications, Part I and applicable requirements of Part II;
- ASME NQA 1-2000, *Quality Assurance Requirements for Nuclear Facility Applications*, Part I and applicable requirements of Part II;
- ANSI/ISO/ASQ Q9001-2008, *Quality Management System: Requirements*; and,
- ANSI/ASQ Z 1.13-1999, *Quality Guidelines for Research*.

H.4 Selection and Implementation of a National or International Consensus Standard

As stated in Appendix A, a recent survey conducted by the PMC in August 2014, dealing with UN-Performance (shipping Solids and Liquids) and Type A Specification Packaging for radioactive materials (solids) showed that a majority of DOE contractors responded are using NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*, Part I and applicable requirements of Part II (various years) to implement the 10 – Criteria in both DOE Order 414.1D and 10 CFR 830 Subpart A. The PMC survey also showed there are some DOE contractors who use other national or international consensus standard to implement the Order and a different one to implement the Rule.

² Where NQA – 1, Part II language uses the term “nuclear power plant” or “nuclear reactor,” these terms are considered equivalent to the term “nuclear facility” used in this CRD.

Whatever national or international consensus standard, e.g., NQA-1, ANSI/ASQ/ISO 9001, ANSI/ASQ Z1.13, is selected to implement the Order and the Rule, the contractor develops their site QAP based on that specific standard. This QAP is submitted to the DOE Field Office for approval per DOE Order 414.1D, CRD, Attachment 1, Paragraph 2.a.

The ASME NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications, Part IV, Guidance on The Application and Use of NQA-1*, provides a number of matrices comparing NQA-1 with other quality standards. For Example;

- Subpart 4.3 – Guide to Modification of an ISO 9001-2000 Quality Program to Meet NQA-1–2000 Requirements
- Subpart 4.5 – Application Guide on the Use of NQA-1–2000 for Compliance With Department of Energy Quality Assurance Requirements 10 CFR 830, Subpart A and DOE O 414.1
- Subpart 4.6 – Application Guidance on the Use of NQA-1-2000 for Compliance With 10 CFR 71 and/or 10 CFR 72 Requirements

If the DOE contractor has access to the NQA-1-2015, *Quality Assurance Requirements for Nuclear Facility Applications*, standard in Part IV, *Guidance on The Application and Use of NQA-1*, Subpart 4.1, *Guides on Use and comparison of NQA-1 With Other Quality Requirements*, provides additional matrices comparing NQA-1 with other quality requirements. For Example:

- Section 4.1.1, Guidance to Modification of an ISO 9001:2008, Quality Management Systems Standard for Compliance With NQA-1–2008, Part I With the NQA-1a–2009 Addenda
- Section 4.1.2, Guidance on the Use of NQA-1–2008/1a–2009 for Compliance With Department of Energy Quality Assurance Requirements 10 CFR 830, Subpart A and DOE O 414.1
- Section 4.1.3, Guidance on the Use of NQA-1–2000 for Compliance With 10 CFR 71 and/or 10 CFR 72 Requirements
- Section 4.1.4, Guidance to Modification of an IAEA GS-R-3 Quality Program to Meet NQA-1a–2009 Requirements and Modification of an NQA-1a–2009 Quality Program to Meet IAEA GS-R-3 Requirements

These matrices will help DOE contractors who have selected a QA standard other than NQA-1-2008/2009a, e.g., ISO 9001:2008 Quality Program as to how to determine, which QA requirements in NQA-1 translate into the selected standard.

H.5 Training for QA Personnel

Once the DOE contractor has selected the national or international consensus standard, the QA personnel should to be trained to that standard. DOE Order 414.1D CRD 1c (2) lists several examples of these national or international standards and within each standard there is usually a training element.

Table H-1 below list some of the training requirements for two national or international consensus standards identified in DOE O 414.1D CRD 1c (2).

Table H-1, Examples of Training Requirements

ASME NQA-1-2008	ANSI/ASQ/ISO 9001:2008
<ul style="list-style-type: none"> ▪ Prospective Lead Auditors shall receive training to the extent necessary to assure auditing competence including ▪ Knowledge and understanding of this Standard and other nuclear-related codes, standards, regulations, and regulatory guides, as applicable ▪ General structure of QA programs as a whole and applicable elements as defined in this Standard ▪ Auditing techniques of examining, questioning, evaluating, and reporting; methods of identifying and following up on corrective action items; and closing out audit findings ▪ Planning audits of activities affecting quality ▪ On-the-job training ▪ Certification requirements (Requirement 2, Section 303.2) 	<p>ISO 9001:2008, Section 6.2.2, Competence, Training, and Awareness.</p> <p>ISO 9001:2015, Sections 7.1.2 People; 7.1.6 Organizational knowledge; 7.2 Competence; 7.3 Awareness</p> <p>Note: Even though ISO 9001:2008 and ISO 9001:2015 Standard does not clearly state that QA personnel must be trained to the standard, the industry recommends that QA personnel in order to perform in that function receive training to the standard.</p>

When selecting the QA requirements for items or services, it is recommended this individual be trained and certified as an Auditor/Lead Auditor. For example, NQA-1, Appendix 2A-3, Non-mandatory Guidance in the Education and Experience of Lead Auditors provides a methodology that DOE Contractors may use in qualifying Auditors/Lead Auditors. This will ensure that QA personnel understand how to select and evaluate requirements to ensure that the defined technical requirements are incorporated into procurement documents and will be met upon receipt at the DOE contractor's facility.

Appendix I – Comparison of QA requirements Between DOE Order 414.1D, Quality Assurance and 10 CFR 830.122, Quality Assurance Criteria

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Comparison between DOE Order 414.1D, Quality Assurance, Contractors Requirement Document (CRD), Attachment 2 and 10 CFR 830.122, Quality Assurance Criteria

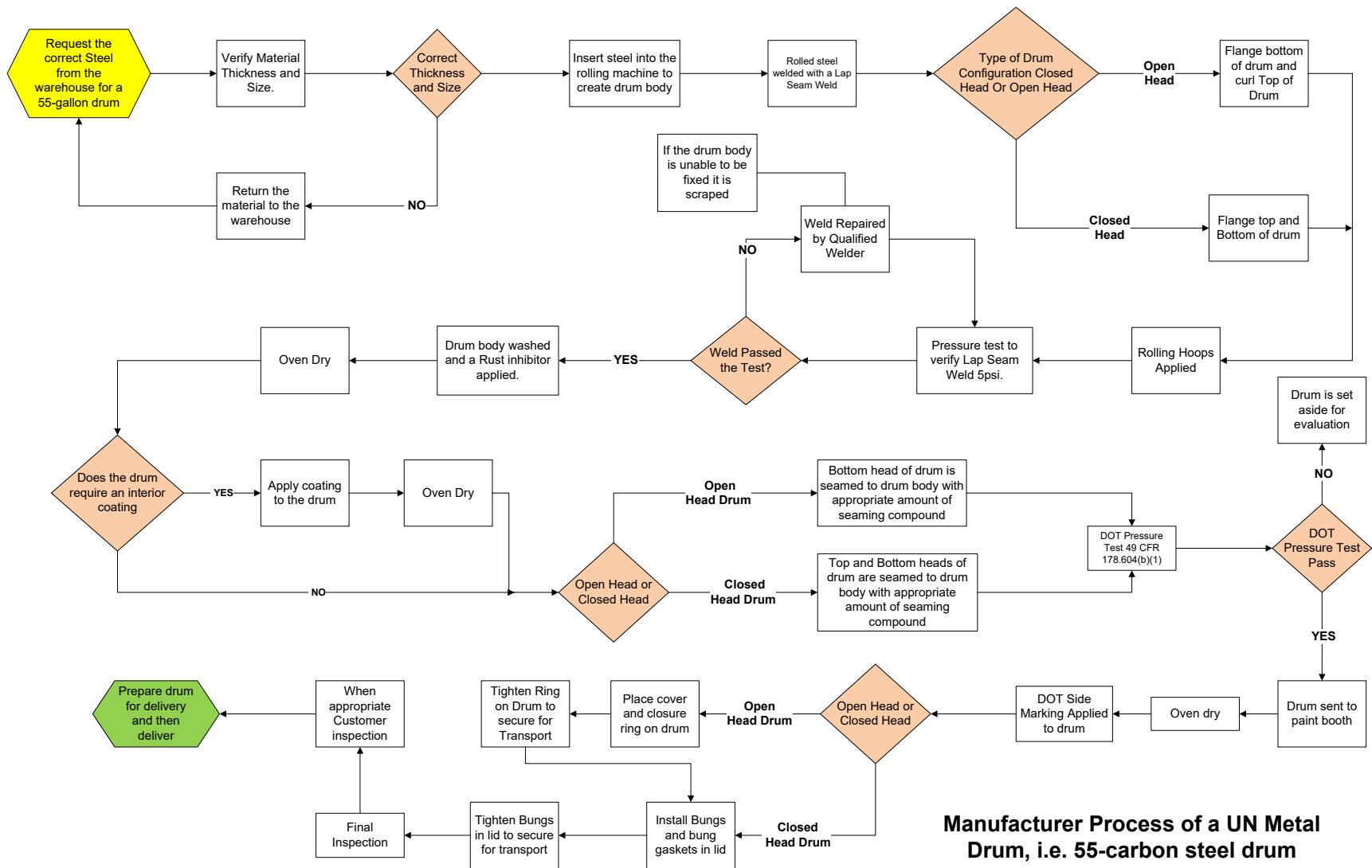
DOE Order 414.1D, Attachment 2 Dated April 25, 2011	10 CFR 830.122, Quality Assurance Criteria Dated March 4, 2015
Criterion 1 – Program	
<p>a. Establish an organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.</p> <p>b. Establish management processes, including planning, scheduling, and providing resources for the work.</p>	<p>1) Establish an organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.</p> <p>2) Establish management processes, including planning, scheduling, and providing resources for the work.</p>
Criterion 2 – Personnel Training and Qualification	
<p>a. Train and qualify personnel to be capable of performing their assigned work.</p> <p>b. Provide continuing training to personnel to maintain their job proficiency.</p>	<p>1) Train and qualify personnel to be capable of performing their assigned work.</p> <p>2) Provide continuing training to personnel to maintain their job proficiency.</p>
Criterion 3 – Quality Improvement	
<p>a. Establish and implement processes to detect and prevent quality problems.</p> <p>b. Identify, control, and correct items, services, and processes that do not meet established requirements.</p> <p>c. Identify the causes of problems, and include prevention of recurrence as a part of corrective action planning.</p> <p>d. Review item characteristics, process implementation, and other quality related information to identify items, services, and processes needing improvement.</p>	<p>1) Establish and implement processes to detect and prevent quality problems.</p> <p>2) Identify, control, and correct items, services, and processes that do not meet established requirements.</p> <p>3) Identify the causes of problems and work to prevent recurrence as a part of correcting the problem.</p> <p>4) (4) Review item characteristics, process implementation, and other quality-related information to identify items, services, and processes needing improvement.</p>
Criterion 4 – Documents and Records	
<p>a. Prepare, review, approve, issue, use, and revise documents to prescribe processes, specify requirements, or establish design.</p> <p>b. Specify, prepare, review, approve, and maintain records.</p>	<p>1) Prepare, review, approve, issue, use, and revise documents to prescribe processes, specify requirements, or establish design.</p> <p>2) Specify, prepare, review, approve, and maintain records.</p>
Criterion 5 – Work Processes	
<p>a. Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements using approved instructions, procedures, or other appropriate means.</p> <p>b. Identify and control items to ensure proper use.</p> <p>c. Maintain items to prevent damage, loss, or deterioration.</p> <p>d. Calibrate and maintain equipment used for process monitoring or data collection.</p>	<p>1) Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means.</p> <p>2) Identify and control items to ensure their proper use.</p> <p>3) Maintain items to prevent their damage, loss, or deterioration.</p> <p>4) Calibrate and maintain equipment used for process monitoring or data collection.</p>

Comparison Between DOE Order 414.1D, Quality Assurance, Contractors Requirement Document (CRD), Attachment 2 and 10 CFR 830.122, Quality Assurance Criteria

DOE Order 414.1D, Attachment 2	10 CFR 830.122, Quality Assurance Criteria
Criterion 6 – Design	
<ul style="list-style-type: none"> a. Design items and processes using sound engineering/scientific principles and appropriate standards. b. Incorporate applicable requirements and design bases in design work and design changes. c. Identify and control design interfaces. d. Verify or validate the adequacy of design products using individuals or groups other than those who performed the work. e. Verify or validate work before approval and implementation of the design. 	<ul style="list-style-type: none"> 1. Design items and processes using sound engineering/scientific principles and appropriate standards. 2. Incorporate applicable requirements and design bases in design work and design changes. 3. Identify and control design interfaces. 4. Verify or validate the adequacy of design products using individuals or groups other than those who performed the work. 5. Verify or validate work before approval and implementation of the design.
Criterion 7 – Procurement	
<ul style="list-style-type: none"> a. Procure items and services that meet established requirements and perform as specified. b. Evaluate and select prospective suppliers on the basis of specified criteria. c. Establish and implement processes to ensure that approved suppliers continue to provide acceptable items and services. 	<ul style="list-style-type: none"> 1) Procure items and services that meet established requirements and perform as specified. 2) Evaluate and select prospective suppliers on the basis of specified criteria. 3) Establish and implement processes to ensure that approved suppliers continue to provide acceptable items and services.
Criterion 8 – Inspection and Acceptance Testing	
<ul style="list-style-type: none"> a. Inspect and test specified items, services, and processes using established acceptance and performance criteria. b. Calibrate and maintain equipment used for inspections and tests. 	<ul style="list-style-type: none"> 1) Inspect and test specified items, services, and processes using established acceptance and performance criteria. 2) Calibrate and maintain equipment used for inspections and tests.
Criterion 9 – Management Assessment	
<ul style="list-style-type: none"> a. Ensure that managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives. 	<ul style="list-style-type: none"> 1) Ensure managers assess their management processes and identify and correct problems that hinder the organization from achieving its objectives.
Criterion 10 – Independent Assessment	
<ul style="list-style-type: none"> a. Plan and conduct independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement. b. Establish sufficient authority and freedom from line management for independent assessment teams. c. Ensure persons who perform independent assessments are technically qualified and knowledgeable in the areas to be assessed. 	<ul style="list-style-type: none"> 1) Plan and conduct independent assessments to measure item and service quality, to measure the adequacy of work performance, and to promote improvement. 2) Establish sufficient authority, and freedom from line management, for the group performing independent assessments. 3) Ensure persons who perform independent assessments are technically qualified and knowledgeable in the areas to be assessed.

Appendix J – Manufacturing Process of a UN Metal Drum, i.e., 55 Carbon Steel Drum

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Manufacturer Process of a UN Metal Drum, i.e. 55-carbon steel drum

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Appendix K – Analysis and Selection of NQA-1 Requirements for a 55-gallon, Open Head, Carbon Steel Drum

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**Table K-1 – Selected NQA-1 Requirements
for a 55-Gallon Drum**

Technical Requirements For a 55 – Gallon Drum	Regulatory Requirement	Assigned NQA-1 QA Requirements
Drum Type (UN1A2) Open Head and Type A	49 CFR 178.504 (a), 49 CFR 173.24(b)(1)(2)	Requirement 5 – Instructions, Procedures, and Drawings, 100
Capacity 208L (55-gallons) for both Liquids and solids	49 CFR 178.504 (b)(8), 49 CFR 173.24(b)(1)(2)	Requirement 5 – Instructions, Procedures, and Drawings, 100
Material of Construction – ASTM A1008, Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Harden-able or equivalent. Thickness 1.4mm	49 CFR 178.504 (b)(1) 49 CFR 178.601 (g)(8) 49 CFR 173.28 (b)(4) 49 CFR 173.412 (c)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800
Rolling Hoops: Three	49 CFR 178.504 (b)(4)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Actual placement of rolling hoops may come from ANSI/MH2
Overall Height drum body without cover and ring, 870 mm (34.25-inches) Tolerances as defined on the fabrication drawing	DOE Contractor Specified	Requirement 5 – Instructions, Procedures, and Drawings, 100
Inside Diameter 572 mm (22.5-inches) Tolerances as defined on the fabrication drawing	DOE Contractor Specified	Requirement 5 – Instructions, Procedures, and Drawings, 100
Chime design – Round or Box	49 CFR 178.504 (b)(3)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Chime cuts will be taken to ensure it is manufactured properly
Side Seam – Overlap weld or equivalent	49 CFR 178.504 (b)(2)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 9 – Special Processes as applicable (see Note 1)
Drum Curl	Packaging Supplier determines Curl design	Requirement 5 – Instructions, Procedures, and Drawings (see Note 2)
400 Kgs (882 pounds) Net Mass when testing for UN-Performance Packaging	49 CFR 178.504 (b)(9) 49 CFR 178.601(l)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
400 Kgs (882 pounds) Net Mass when testing for Type A Packaging	49 CFR 173.465	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
Net capacity for a 208 Liter (55-Gallons) drum (448 pounds)	49 CFR 178.504 (b)(8)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
Packing group for solids – PGI	49 CFR 178.603, 604, 605, 606, and 608	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
Packing group for liquids – PGII	49 CFR 178.603, 604, 605, 606, and 608	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
Liquids Specific Gravity 1.5	49 CFR 178.603 and 606	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
Hydrostatic Test Pressure – 150 kPa	49 CFR 178.605	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, – 100, 200, 300, 500, 600, and 601
Pre-inspection prior to performing the UN-Performance tests.	49 CFR 178.602, Preparation of Packaging and Packages for testing.	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 10 – Inspection, 100, 200 and 400 and 401
Pre-inspection prior to performing the Type A tests.	49 CFR 178.462, Preparation of Specimens for Testing.	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 10 – 100, 200 and 400 and 401

Air Shipments	173.27(c)	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control, 100, 200, 300, 500, 600, and 601
UN-Performance Test for both non-radioactive liquids and solids hazardous materials Drop Test Leakproofness Test Hydrostatic Pressure Test Stacking Test Vibration Standard	49 CFR 178.603, 604, 605, 606, and 608	Refer to Table K-5, UN-Performance Packaging Testing
Type A, Required Tests for Radioactive solid Materials	49 CFR 178.465, Type A Packaging Tests (b) Water Spray Test (c)(1) Free Drop Test (d) Stacking Test (e) Penetration Test	Refer to Table K-6, Type A Specification Packaging Testing
Reduction of ambient pressure test.	49 CFR 178.412 (f)	Refer to Table K-6, Type A Specification Packaging Testing
UN Marking – Solid – UN1A2/X425/S/Yr/USA/MXXXX	49 CFR 178.504 (b)(1) 49 CFR 178.3 (a)	Requirement 10 – Inspection 100, 200, 400, 500, 600, and 800 Requirement 13 – Handling, Storage, and Shipping, 100 and 600
UN Marking Liquid – UN1A2/Y1.5/150/Yr/USA/MXXXX	49 CFR 178.504 (b)(1) 49 CFR 178.3 (a)	Requirement 10 – Inspection, 100, 200, 400, 500, 600, and 800 Requirement 13 – Handling, Storage, and Shipping, 100 and 600
Type A Marking "USA DOT 7A Type A"	49 CFR 178.350 (b) 49 CFR 172.310 (b) 49 CFR 178.3(a)(4)	Requirement 10 – Inspection, 100, 200, 400, 500, 600, and 800 Requirement 13 – Handling, Storage, and Shipping, 100 and 600
DOE Contractor Additional Marking Requirement Each drum shall have stenciled 6-inches left of the drum seam and between the top and middle rolling hoop in 1-inch letters the assigned lot number and purchase order number.	Specified by the DOE contractor	Requirement 10 – Inspection, 100, 200, 400, 500, 600, and 800 Requirement 13 – Handling, Storage, and Shipping, 100 and 600
<p>Note 1: The DOT does not incorporate by reference (49 CFR 171.7) any American Welding Society (AWS) standards for UN-Performance and Type A Specification Packaging. A seam weld on a drum is usually a Resistance Seam Weld where the material is overlapped and as the material pass through the two wheels an electrical current passes between the two wheels fusing the material together. There are two ways that packaging suppliers have used to qualify this weld. The first, is after the weld is made the drum body is pressurized to see if the weld leaks. If it doesn't leak the weld passes (this is not the DOT required Leakproofness production test) and continues on in the production process. But when the weld doesn't pass, the drum body is pulled from production and the weld is re-worked by a qualified welder, usually by an AWS qualified welder, then the drum body is pressurized and if it doesn't leak it will continue on in the production process, but if it fails a second time the drum body is scrapped.</p> <p>A second method of qualifying a seam weld in the absence of any official standard, i.e. AWS, is to do the following:</p> <ul style="list-style-type: none"> ▪ Packaging Manufacturer creates a procedure on how to operate the seam welding, with all of the parameters identified from the manufacturer of the seam welder. ▪ Train the seam welder to this procedure ▪ Have the seam welder perform this activity on all types of materials that will go through the seam welder ▪ Cut coupons that can be sent out and tested, e.g. tensile pull test, and if they pass then the welder and the machines are consider qualified to perform the applicable seam welds. <p>This process is not in any way official but may lend credibility to the individual performing the seam welds and the seam welder.</p>		
<p>Note 2: The drum curl design is critical to the closure of the drum. The mating surface is on the lid that has a EPDM gasket glued into the mating surface. If the Curl is not properly formed when the lid and the closure ring are installed the closure ring will not properly close. As part of the first article inspection it is recommended that the drum curl is included in that inspection.</p>		

Table K-2 – NQA-1 Requirements for Packaging Components Purchased by the Packaging Supplier

Technical Requirements for a 55 – Gallon Drum	Regulatory Requirement	Assigned NQA-1 QA Requirements
Lid Gasket (glued in place) Round, EPDM or equivalent. Temperature Requirements, – 40°F to +158°F (49 CFR 173.412 (c)) ASTM-D1056, Sponge and Expanded Cellular Rubber Products	49 CFR 178.504 (b)(5)(6) 49 CFR 173.412 (c)	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
Bung Fittings – 19 mm (3/4-inch) and 51 mm (2-inch) Metal Style flange with fitting, (e.g., Rieke)	49 CFR 173.412 (c)	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
Bung Gasket EPDM or equivalent (Meets Type A conditions of – 40°F to +158°F (49 CFR 173.412 (c))). ASTM-D1056, Sponge and Expanded Cellular Rubber Products	49 CFR 173.412 (c)	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
Closure Ring – 12-gauge carbon steel or equivalent	49 CFR 173.24(f)(1)(2) 49 CFR 173.24(g)(3) 49 CFR 173.412 (c) 49 CFR 178.2(c)(i)	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
Bolt and Nut for closure ring – 16 mm (5/8-inch) x 102 mm (4-inch) ASTM A 307A bolt with nut. The bolt will have a nominal 8 mm (5/16-inch) diameter hole drilled on center a minimum 13mm (½-inch) from the end of the bolt.	49 CFR 173.24(f)(1)(2) 49 CFR 173.24(g)(3) 49 CFR 173.412 (c) 49 CFR 173.412 (a)	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
Seaming Compound used in manufacturing the chime. Request Safety Data Sheet (SDS)	No Regulatory Requirement	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800
Glue used to install the gasket in the drum lid. Request Safety Data Sheet (SDS)	No Regulatory Requirement	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300

		Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800
Exterior Coating – minimum 4-mil thickness. Color Black body and bottom and white lid. Request Safety Data Sheet (SDS)	DOE contractor will specify the color	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings Requirement 6 – Document Control, 100, 200, and 300 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
Interior Coating – minimum 4-mil thickness. Epoxy Phenolic Lining	49 CFR 178.504(b)(7) 49 CFR 178.601 (j)	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 600 and 800
<p>Note 1: The closure ring assembly is usually purchased as a component part to the metal drum. Thus the supplier of the metal drum is required to obtain from their supplier a detailed fabrication drawing as to how the closure ring is manufactured. This fabrication drawing is to be in the supplier's document control program. The drawing will identify the materials of construction; thread size for bolt, placement of lugs, size, length and types of welds. Welds are performed in accordance with a specific AWS standard (e.g. AWS D1.3, ASME Section IX) identified on the drawing. The drawing identifies the applicable Welding Procedure Specification (WPS), Procedure Qualification Record (PQR), and Welder procedure Qualification Record (WPQR) welding documents used in the performance of the fabrication of the closure ring. Also include in the notes are the color of the exterior coating and mil thickness used in painting the closure ring. When the supplier of the metal drum purchases the closure ring assembly and that assembly is used in the performance tests for both UN-Performance Packaging and Type A Specification Packaging qualifies the packaging to the regulatory requirements for that closure ring assembly and then the design becomes fixed and cannot change without further retesting and/or engineering analysis.</p>		

**Table K-3 – NQA-1 Requirements for the
General Design Requirements in 49 CFR 173.410**

Regulatory Requirements	Discussion	Assigned NQA-1 QA Requirements
<p>§173.410 General design requirements. In addition to the requirements of subparts A and B of this part, each package used for the shipment of Class 7 (radioactive) materials must be designed so that—</p>	<p>Subpart A—General and Subpart B—Preparation of Hazardous Materials for Transportation</p>	
<p>(a) The package can be easily handled and properly secured in or on a conveyance during transport.</p>	<p>The metal drum is round and easily handled and properly secured in or on a conveyance during transport. This can be verified through the use of a fabrication drawing showing how the metal drum is manufactured</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(b) Each lifting attachment that is a structural part of the package must be designed with a minimum safety factor of three against yielding when used to lift the package in the intended manner, and it must be designed so that failure of any lifting attachment under excessive load would not impair the ability of the package to meet other requirements of this subpart. Any other structural part of the package which could be used to lift the package must be capable of being rendered inoperable for lifting the package during transport or must be designed with strength equivalent to that required for lifting attachments.</p>	<p>There are no lifting attachments on a metal drum therefore this requirement does not apply to a metal drum. This can be verified through the use of a fabrication drawing showing how the metal drum is manufactured</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(c) The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.</p>	<p>The only parts of the metal drum that protrude are the rolling hoops and lug and bolt closure part of the closure ring. Upon review these can be easily decontaminated. This can be verified through the use of a fabrication drawing showing how the metal drum is manufactured</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(d) The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.</p>	<p>The only place on a metal drum that is readily identifiable that might catch water is the lid of the drum after the drum has been properly closed. When properly closed the lid can accumulate approximately ½-inch or greater of standing water. This can be verified through the use of a fabrication drawing showing how the metal drum is manufactured</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(e) Each feature that is added to the package will not reduce the safety of the package.</p>	<p>The 55-gallon drum has no additional features that have been added to the metal drum that will reduce the safety of the packaging. This can be verified through the use of a fabrication drawing showing how the metal drum is manufactured.</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(f) The package will be capable of withstanding the effects of any acceleration, vibration or vibration resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (see §§173.24, 173.24a, and 173.24b).</p>	<p>49 CFR 173.24a(a)(5) refers to 49 CFR 178.608, Vibration Standard.</p>	<p>Refer to Table K-6, Type A Specification Packaging Testing</p>

<p>(g) The materials of construction of the packaging and any components or structure will be physically and chemically compatible with each other and with the package contents. The behavior of the packaging and the package contents under irradiation will be taken into account.</p>	<p>The Shipper of the packaging will perform an analysis of the contents that are used during the testing are physically and chemically compatible with each other and the package.</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(h) All valves through which the package contents could escape will be protected against unauthorized operation.</p>	<p>There are no valves through which contents could escape on a metal drum therefore this requirement does not apply to a metal drum. This can be verified through the use of a fabrication drawing showing how the metal drum is manufactured</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings</p>
<p>(i) For transport by air— (1) The temperature of the accessible surfaces of the package will not exceed 50 °C (122 °F) at an ambient temperature of 38 °C (100 °F) with no account taken for insulation; (2) The integrity of containment will not be impaired if the package is exposed to ambient temperatures ranging from -40 °C (-40 °F) to +55 °C (131 °F); and (3) A package containing liquid contents must be capable of withstanding, without leakage, an internal pressure that produces a pressure differential of not less than the maximum normal operating pressure plus 95 kPa (13.8 psi).</p>	<p>This Type A package is only designed and tested to transport solids. Therefore this requirement does not apply to a metal drum.</p>	<p>N/A</p>

Table K-4 – NQA-1 Requirements for the Additional Design Requirements For Type A Packages in 49 CFR 173.412		
Regulatory Requirements	Discussion	Assigned NQA-1 QA Requirements
<p>§173.412 Additional Design requirements For Type A Packages. In addition to meeting the general design requirements prescribed in §173.410, each Type A packaging must be designed so that—</p>		
<p>(a) The outside of the packaging incorporates a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been opened. In the case of packages shipped in closed transport vehicles in exclusive use, the cargo compartment, instead of the individual packages, may be sealed.</p>	<p>Closure ring bolt used in the closure ring – 5/8-inch x 4-inch ASTM A307 bolt. The bolt will have a nominal 5/16-diameter hole drilled on center a minimum 1/2-inch from the end of the bolt. This allows for the use if a Tamper-Indicating-Device (TID). Bolts are usually not supplied with the closure ring and therefore are purchased separately.</p>	<p>Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 10 – Inspection, 200, 600 and 800</p>
<p>(b) The smallest external dimension of the package is not less than 10 cm (4 inches).</p>	<p>This can be verified through the use of a fabrication drawings showing how the metal drum is manufactured</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(c) Containment and shielding is maintained during transportation and storage in a temperature range of -40 °C (-40 °F) to 70 °C (158 °F). Special attention shall be given to liquid contents and to the potential degradation of the packaging materials within the temperature range.</p>	<p>This is a design requirement not a performance requirement. The Hanford 7A Book (DOE/RL-96-57, Rev. 0-F, Vol. 1 (Formerly WHC-EP-0558, Rev. 3, the "Blue Book")) stated the following for this requirement: "Metals used in these drums will not become excessively brittle at -40 °C and all gaskets used also meet this requirement. None of these packagings are authorized for liquids; so freezing of contents is not a concern. Temperatures of +70 °C will not result in any significant decrease in containment integrity."</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(d) The packaging must include a containment system securely closed by a positive fastening device that cannot be opened unintentionally or by pressure that may arise within the package during normal transport. Special form Class 7 (radioactive) material, as demonstrated in accordance with §173.469, may be considered as a component of the containment system. If the containment system forms a separate unit of the package, it must be securely closed by a positive fastening device that is independent of any other part of the package.</p>	<p>49 CFR 178.2(c)(i)(B) – Closure Instructions provided by the drum fabricator that performed the DOT tests successfully. This documents how the DOT package was closed during testing.</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<p>(e) For each component of the containment system account is taken, where applicable, of radiolytic decomposition of materials and the generation of gas by chemical reaction and radiolysis.</p>	<p>This is a shipper/offeror responsibility</p>	<p>This is a shipper/offeror responsibility</p>
<p>(f) The containment system will retain its radioactive contents under the reduction of ambient</p>	<p>This test may be performed by placing a drum inside a test chamber, while reducing</p>	<p>Refer to Table K-6, Type A Specification Packaging Testing</p>

pressure to 60 kPa (8.7 psia).	the pressure inside the chamber to the 60 kPa.	
(g) Each valve, other than a pressure relief device, is provided with an enclosure to retain any leakage.	There are no valves through which contents could escape on a metal drum therefore this requirement does not apply to a metal drum. This can be verified through the use of a fabrication drawings showing how the metal drum is manufactured	Requirement 5 – Instructions, Procedures, and Drawings, 100
(h) Any radiation shield that encloses a component of the packaging specified as part of the containment system will prevent the unintentional escape of that component from the shield.	This is a shipper/offeror responsibility	This is a shipper/offeror responsibility
(i) Failure of any tie-down attachment that is a structural part of the packaging, under both normal and accident conditions must not impair the ability of the package to meet other requirements of this subpart.	There are no tie-down attachments that are a structural part of the packaging. This can be verified through the use of a fabrication drawings showing how the metal drum is manufactured	Requirement 5 – Instructions, Procedures, and Drawings
(j) When evaluated against the performance requirements of this section and the tests specified in §173.465 or using any of the methods authorized by §173.461(a), the packaging will prevent— (1) Loss or dispersal of the radioactive contents; and (2) A significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test.	See Note below.	Refer to Table K-6, Type A Specification Packaging Testing
(k) Each packaging designed for liquids will— (1) Be designed to provide for ullage to accommodate variations in temperature of the contents, dynamic effects and filling dynamics; (2) Meet the conditions prescribed in paragraph (j) of this section when subjected to the tests specified in §173.466 or evaluated against these tests by any of the methods authorized by §173.461(a); and (3) Either— (i) Have sufficient suitable absorbent material to absorb twice the volume of the liquid contents. The absorbent material must be compatible with the package contents and suitably positioned to contact the liquid in the event of leakage; or (ii) Have a containment system composed of primary inner and secondary outer containment components designed to enclose the liquid contents completely and ensure retention of the	This requirement is not applicable as the Type A drum is only for solids	This requirement is not applicable as the Type A drum is only for solids

<p>liquid within the secondary outer component in the event that the primary inner component leaks.</p>		
<p>(I) Each package designed for gases, other than tritium not exceeding 40 TBq (1080Ci) or noble gases not exceeding the A₂ value appropriate for the noble gas, will be able to prevent loss or dispersal of contents when the package is subjected to the tests prescribed in §173.466 or evaluated against these tests by any of the methods authorized by §173.461(a).</p>	<p>This requirement is not applicable as the Type A drum is only for solids</p>	<p>This requirement is not applicable as the Type A drum is only for solids</p>
<p>Note: The DOE contractor will evaluate the packaging supplier's test report, which will include the damage occurred during testing. When there is no loss or dispersal of the radioactive contents and there is no significant increase in the radiation levels recorded or calculated at the external surfaces for the condition before the test then the container passes the test</p>		

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Table K-5 – UN-Performance Packaging Testing		
Regulatory Requirements	Discussion	Assigned NQA-1 QA Requirements
49 CFR 178.604, Leakproofness Test – Production Testing	A procedure shall be developed that captures the regulatory requirement for the production pressure test. This test is only required when packaging is to contain liquids.	Requirement 5 – Instructions, Procedures, and Drawings, 100
Packaging contents used for testing:	Procedure may be developed for the procurement of testing materials used as surrogate contents and how to load the packaging. Solids and Liquids – The DOE contractor will need to ensure that the contents used during testing are equivalent to the material they will put in commerce. They also ensure the material is compatible with the packaging material. Liquids – The DOE contractor ensures that the Hydrostatic Pressure is acceptable and the liquid has a specific gravity that meets material in question.	Requirement 4 – Procurement Document Control, 100, 200, 300, and 400 Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800
49 CFR 178.602, Preparation of Packagings and Packages for Testing	A procedure shall be developed that captures the regulatory requirements that prepare a package for testing	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 11 – Test Control. 100, 200 (a)(b), 300
49 CFR 178.601 General Requirements 49 CFR 178.603, Drop Test 49 CFR 178.604, Leakproofness Test 49 CFR 178.605, Hydrostatic Pressure Test 49 CFR 178.606, Stacking Test 49 CFR 178.608, Vibration Standard	Each test sample must have its configuration documented in a fabrication drawing and assigned a unique number. Each drum tested will have recorded its assigned unique number on the test report, which will have its own unique number. The Fabrication Drawing will also be recorded on the test report. This traceability will ensure that when the specified design has passed all applicable tests, the approved design is documented. The Department of Transportation has not incorporated by reference (49 CFR 171.7) to any national or international standards that explain or provide guidance on how to conduct the UN-Performance Tests described in 49 CFR 178 Subpart M – Testing of Non-bulk Packagings and Packages. Packaging Suppliers that self certify may use national or international standards to develop procedures on how these tests are performed. Procedures are to be developed that show how each of these tests are to be performed. These procedures are to also include the pass/fail criteria.	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 11 – Test Control, 100, 200 (a)(b), 300, 500, 600 and 601
49 CFR 178.601(l) Test Report	The Packaging Supplier will develop a test report incorporating all elements required in this section of the regulations. They may choose to record more information at their discretion. The completed test report is to be maintained as a QA record.	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 17 – Quality Assurance Records, 100, 200, 300, 700, and 800 (a-e).
Equipment used in the performance of these tests that requires calibration	The complexity of the calibration program is determined by the complexity of the equipment that will be calibrated.	Requirement 12 – Control of Measuring and Test Equipment, 100, 200, 300, and 400
General requirements for transportation by aircraft –	This regulatory requirement is for when the packaging is going to be used in transporting contents by air.	Requirement 5 – Instructions, Procedures, and Drawings, 100

Pressure requirements, 49 CFR 173.27 (c)		Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 11 – Text Control, 100, 200 (a)(b), 300, 500, 600 and 601
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Table K-6 –Type A Specification Packaging Testing

Regulatory Requirements	Discussion	Assigned NQA-1 QA Requirements
<p>Descriptions of DOE Forms 1, 2, and 3 Non-fissile/fissile-excepted Radioactive Material that may be used as surrogate contents for testing</p> <p>Form Number 1: Solids—any particle size</p> <ul style="list-style-type: none"> ▪ A packaging qualified for these contents may contain non-fissile/fissile-excepted radioactive contents of any representative particulate size. <p>Form Number 2: Solids—large particle size only (i.e., sand, concrete, debris, soil)</p> <ul style="list-style-type: none"> ▪ Contents of a corresponding particulate size such as soil or construction debris. (Glass or plastic lab-ware having fine particulate available for dispersion would not fit this category and requires a packaging qualified for fine particulate, Form Number 1.) <p>Form Number 3: Solids—objects with no significant dispersible or removable contamination (for definition, see 49 CFR 173.443, "Contamination control")</p> <ul style="list-style-type: none"> ▪ 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 	<p>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, which affects the gross weight, which affects the requirements invoked for packaging handling features.</p> <p>The complexity of containing solids increases, as the particle size gets smaller. In the U.S. Department of Energy's (DOE) DOT-7A Test and Evaluation Document (DOE 1996 and DOE 1998), solid materials are classed into one of three material forms as noted (HNF-SD-TTI-006, Revision 1).</p> <p>When performing the Type A test the DOE contractor may choose form 1, or 2, or 3, or a combination of all three.</p> <p>Procedure may be developed for the procurement of testing materials used as surrogate contents and how to load the packaging.</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings Requirement 4 – Procurement Document Control, 100, 200, 300, and 400</p> <p>Requirement 7 – Control of Purchased Items and Services, 100, 200, 500, and 800</p>
<p>49 CFR 173.462, Preparation of Specimens for Testing</p>	<p>A procedure shall be developed that captures the regulatory requirements that prepare a package for testing.</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100</p>
<ul style="list-style-type: none"> ▪ 49 CFR 173.465 (b) Water Spray Test ▪ 49 CFR 173.465 (c)(1) and (5), Free Drop (non Fissile test only) ▪ 49 CFR 173.465 (d), Stacking Test ▪ 49 CFR 173.465 (e), Penetration Test ▪ Note the water spray should precede each test. ▪ These tests are successful if the requirements of 173.412(j) are met. 	<p>Each test sample must have its configuration documented in a fabrication drawing and assigned a unique number. Each drum tested will record its assigned unique number on the test report, which will have its own unique number. The Fabrication Drawing will also be recorded on the test report. This traceability will ensure that when the specified design being tested has passed all applicable tests, the approved design is documented.</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 11 – Test Control, 100, 200 (a)(b), 300, 500, 600 and 601</p>
<p>49 CFR 173.410 (f) The package will be capable of withstanding the effects of any acceleration, vibration or vibration</p>	<p>This is the vibration test described in 49 CFR 178.608, Vibration Standard. The reference to the vibration standard comes from 49 CFR 173.24a(a)(5).</p>	<p>Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300</p>

resonance that may arise under normal conditions of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use (see §§173.24, 173.24a, and 173.24b).		Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 11 – Test Control, 100, 200 (a)(b), 300, 500, 600 and 601
49 CFR 173.412(f), referred to as the “reduction of ambient pressure test to 60 kPa.	This test may be performed by placing a drum inside a test chamber, while reducing the pressure inside the chamber to the 60 kPa.	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 11 – Test Control, 100, 200 (a)(b), 300, 500, 600 and 601
Test Report 49 CFR 173.415 (a)(1)(i) If the packaging is subjected to the physical tests of §173.465, and if applicable, §173.466, documentation of testing, including date, place of test, signature of testers, a detailed description of each test performed including equipment used, and the damage to each item of the containment system resulting from the tests.	The Packaging Supplier will develop a test report incorporating all elements required in this section of the regulations. They may choose to record more information at their discretion. The completed Test report is to be maintained as a QA record. As a reference to reporting information the Packaging Supplier may use 49 CFR 178.601(l).	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 17 – Quality Assurance Records, 100, 200, 300, 700, and 800 (a-e).
Equipment used in the performance of these tests that requires calibration	The complexity of the calibration program is determined by the complexity of the equipment that will be calibrated.	Requirement 12 – Control of Measuring and Test Equipment, 100, 200, 300, and 400
General requirements for transportation by aircraft – Pressure requirements, 49 CFR 173.27 (c)	This regulatory requirement is for when the packaging is going to be used in transporting contents by air.	Requirement 5 – Instructions, Procedures, and Drawings, 100 Requirement 6 – Document Control, 100, 200, and 300 Requirement 8 – Identification and Control of Items, 100 and 202 Requirement 11 – Test Control, 100, 200 (a)(b), 300, 500, 600 and 601
Note: The Department of Transportation has not incorporated by reference (49 CFR 171.7) any national or international standards that explain or provide guidance on how to conduct the UN-Performance Tests described in 49 CFR 178 Subpart M – Testing of Non-bulk Packagings and Packages. Packaging Suppliers that self certify may use national or international standards to develop procedures on how these test are performed. Procedures are to be developed that show how each of these tests are to be performed. These procedures are to also include the pass/fail criteria.		

Table K-7, Requested Documents showing compliance to DOT Regulations and additional Documentation

UN-Performance Packaging	Type A Packaging
<p>Test Report, 49 CFR178.601 (I). NOTE: The test report usually does not show compliance to the production pressure test required for Liquids. The DOE contractor can request a copy of the procedure used to perform the production pressure test as required by 49 CFR 178.604.</p>	<p>Type A Test Reports 49 CFR 173.415 (a)(1)(i) Test Report for tests performed demonstrating compliance with 49 CFR 178.465 for solids. These reports shall include date, place of test, signature of testers, a detailed description of each test performed including equipment used, and the damage to each item of the containment system resulting from the tests. This description of results includes drawings or photographs of the package indicating where visible damage occurred and measurements of damage incurred. Pretest and posttest photographs of the package should be included. Even though pictures are taken, damage to the package is to be documented by measurements. Documentation that merely states that the package passed the test is insufficient. When qualifying DOT packaging as meeting the requirements of 49 CFR 178.350, using 49 CFR 173.461, the packaging supplier will provide to the DOE contractor documentation demonstrating compliance with the design requirements in 49 CFR 173.412 and the test requirements in 49 CFR 173.465 through 49 CFR 173.469.</p>
<p>Drawings Packaging Supplier will provide a fabrication drawing showing materials of construction, dimensions, closure mechanism, and list all materials and components in the bill of materials.</p>	<p>Drawings Packaging Supplier will provide a fabrication drawing showing materials of construction, dimensions, closure mechanism, and list all materials and components in the bill of materials.</p>
<p>Closure Instructions, 49 CFR 178.2(c) 49 CFR 173.24 (f)</p>	<p>Closure Instructions, 49 CFR 178.2(c) 49 CFR 173.24 (f)</p>
<p>Certificate of Conformance (CofC) Provide a CofC as per NQA-1, Requirement 7, Section 503.</p>	<p>Certificate of Conformance (CofC) Provide a CofC as per NQA-1, Requirement 7, Section 503.</p>
<p>Inspection Reports</p> <ul style="list-style-type: none"> ▪ Final Inspection ▪ UN Performance requirements for pre-inspection prior to tests 49 CFR 178.602, Preparation of Packaging and Packages for testing. 	<p>Inspection Reports</p> <ul style="list-style-type: none"> ▪ Final Inspection ▪ Type A requirements for pre-inspection prior to tests 49 CFR 173.462, Preparation of specimens for testing.
<p>Welder Qualification When a Packaging Supplier has welders qualified to an American Welding Society (AWS) they will provide the following documentation: Welding Procedure Specification (WPS) Procedure Qualification Record (WQR) Welder procedure Qualification Record (WPQR)</p>	<p>Welder Qualification When a Packaging Supplier has welders qualified to an American Welding Society (AWS) they will provide the following documentation: Welding Procedure Specification (WPS) Procedure Qualification Record (WQR) Welder procedure Qualification Record (WPQR)</p>
<p>Certified Materials Test Report (CMTR) Provide a CMTR for materials qualified to an ASTM standard</p>	<p>Certified Materials Test Report (CMTR) Provide a CMTR for materials qualified to an ASTM standard</p>
<p>Safety Data Sheets (SDS) Provide SDS for the following:</p> <ul style="list-style-type: none"> ▪ Seaming Compound used when forming the Chime ▪ Exterior Coating (paint) ▪ Interior Coating – Rust Inhibitor, e.g. epoxy/phenolic ▪ Glue used to glue the gasket in the lid 	<p>Safety Data Sheets (SDS) Provide SDS for the following:</p> <ul style="list-style-type: none"> ▪ Seaming Compound used when forming the Chime ▪ Exterior Coating (paint) ▪ Interior Coating – Rust Inhibitor, e.g. epoxy/phenolic ▪ Glue used to glue the gasket in the lid
<p>Note: The test reports generated by the packaging supplier will ensure traceability to the package tested. When a fabrication or engineering drawing is used it will be traceable to the package tested.</p>	

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Appendix L – Selected NQA-1 Requirements For a 55-Gallon, Open Head, Carbon Steel Drum

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Packaging Supplier NQA-1 Tailored QA Requirements						
Requirement 1, Organization		Requirement 7, Control of Purchased Items and Services		Requirement 13, Handling, Storage, and Shipping		
100-Basic	X	100-Basic	X	100-Basic	X	
200-Structure and Responsibility	X	200-Supplier Evaluation and election	X	200-Special Requirements	N/A	
300-Interface Control	X	300-Bid Evaluation	N/A	300-Procedures	N/A	
Requirement 2, Quality Assurance Program		400-Control of Supplier-Generated Documents		400-Tools and Equipment		
100-Basic	X	500-Acceptance of Item or Service	X	500-Operators	N/A	
200-Indoctrination and Training	X	600-Control of Supplier Non-conformances	N/A	600-Marking and Labeling	X	
300- Qualification Requirements	X	700-Commercial Grade Items and Services	N/A	Requirement 14, Inspection, Test, and Operating Status		
400-Records of Qualifications	X	800-Records	X	100-Basic	N/A	
500- Records	X	Requirement 8, Identification and Control of Items		Requirement 15, Control of Nonconforming Items		
Requirement 3, Design		200-Identification Methods	X	100-Basic	X	
100-Basic	N/A	300-Specific Requirements	N/A	200-Identification	X	
200-Design Input	N/A	Requirement 9, Control of Special Processes		300-Segregations	X	
300-Design Process	N/A	100-Basic	N/A	400-Disposition	X	
400-Design Analysis	N/A	200-Process Control	N/A	Requirement 16, Corrective Action		
500- Design Verification	N/A	300-Responsibility	N/A	100-Basic	X	
600-Change Control	N/A	400-Records	N/A	Requirement 17, Quality Assurance Records		
700-Interface Control	N/A	Requirement 10, Inspection		100-Basic	X	
800-Software Design Control	N/A	100-Basic	X	200-Generation of Records	X	
900-Documentation and Records	N/A	200-Inspection Requirements	X	300-Authentication of Records	X	
Requirement 4, Procurement Document Control		300-Inspection Hold Points	N/A	400-Classification	N/A	
100-Basic	X	400-Inspection Planning	X	500-Receipt and Control of Records	X	
200-Content of the Procurement Documents	X	500- In-Process Inspection	X	600-Storage	X	
300-Procurement Document Review	X	600-Final Inspection	X	700-Retention	X	
400-Procurement Document Changes	X	700-Inspections During Operations	N/A	800-Maintenance of Records	X	
Requirement 5, Instructions, Procedures and Drawings		800-Records	X	Requirement 18, Audits		
100-Basic	X	Requirement 11, Test Control		100-Basic	X	
Requirement 6, Document Control		100-Basic	X	200-Scheduling	X	
100-Basic	X	200-Test Requirements	X	300-Preparation	X	
200-Document Control	X	300-Test Procedures (Other Than for computer programs)	X	400-Performance	X	
300-Document Changes	X	400-Computer Program Test Procedures	N/A	500-Reporting	X	
		500-Test Results	X	600-Response	X	
		600-Test Records	X	700-Follow-up action	X	
		Requirement 12, Control of Measuring and Test Equipment		800-Records		X
		100-Basic	X			
		200-Selection	X			
		300-Calibration and Control	X			
400-Records	X					
<p>Note 1: NQA-1 Requirement 9, Control of Special Processes is implemented when a Packaging Supplier implements a welding program to repair welds based on an AWS standard. When implemented they will also include NQA-1 Requirement 2, Quality Assurance Program, Section 200, Qualification Requirements (e.g., 301 and 302).</p> <p>Note 2: As noted in section 4.3.1, When tailoring QA Requirements there are a set of common NQA-1 Requirements that each Packaging Supplier will have as part of their QA Program. Each element of these common requirements is checked, but the Packaging Supplier is to evaluate each element and apply using the graded approach.</p>						

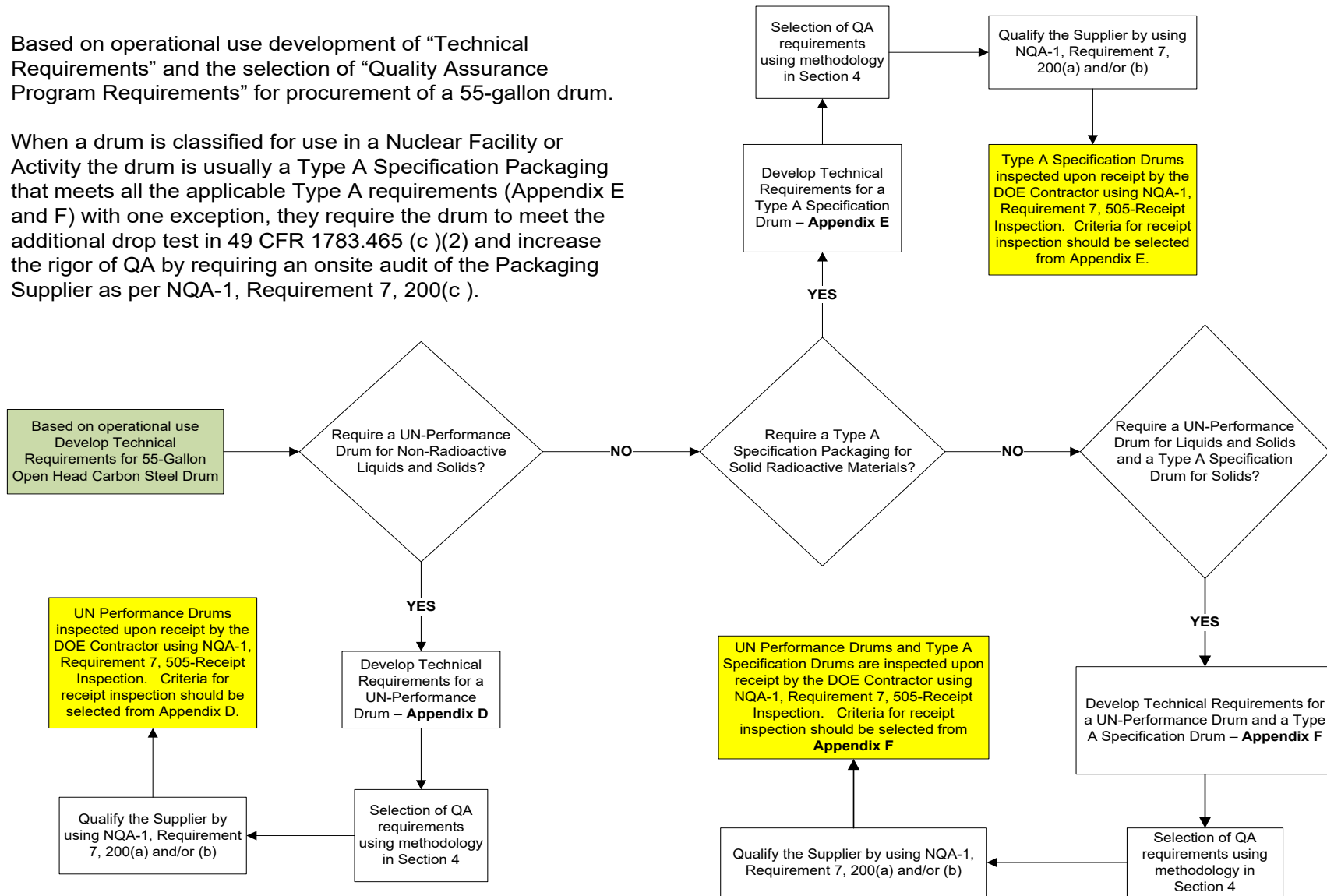
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Appendix M – DOT Packaging Procurement Process

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Based on operational use development of “Technical Requirements” and the selection of “Quality Assurance Program Requirements” for procurement of a 55-gallon drum.

When a drum is classified for use in a Nuclear Facility or Activity the drum is usually a Type A Specification Packaging that meets all the applicable Type A requirements (Appendix E and F) with one exception, they require the drum to meet the additional drop test in 49 CFR 1783.465 (c)(2) and increase the rigor of QA by requiring an onsite audit of the Packaging Supplier as per NQA-1, Requirement 7, 200(c).



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Appendix N – Acronyms and Definitions

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Acronyms

Acronym	Definition
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASQ	American Society for Quality
CFR	Code of Federal Regulations
CRD	Contractor Requirements Document
DBC	Design Basis Conditions
DOE	Department of Energy
DOT	Department of Transportation
DSA	Documented Safety Analysis
EFCOG	Energy Facility Contractors Group
FY	Fiscal Year
HMR	Hazards Material Regulations
HMT	Hazardous Materials Table
ISO	International Standard Organization
NNSA	National Nuclear Security Administration
NQA	Nuclear Quality Assurance
NSBG	Nuclear Safety Basis Group
NSS	Nuclear Safety Specialist
PMC	Packaging Management Council
POP	Performance-oriented Packaging
PSN	Proper Shipping Name
QA	Quality Assurance
QAP	Quality Assurance Program
RAM	Radioactive Materials
SC	Safety Class
SCQTT	Supply Chain Quality Task Team
SME	Subject-Matter-Expert
SSC	Structures, Systems, and Components
SS	Safety Significant
TSD	Transportation Safety Document
UN	United Nations

Definitions

Term	Definition
Accident Analysis	The process of deriving a set of formalized design/evaluation basis accidents from the hazard evaluation and determining their consequences. Accident analysis results are used to identify the need to designate safety class and safety significant controls (DOE-STD-3009-2014).
Bulk	Means a packaging, other than a vessel or a barge, including a transport vehicle or freight container, in which hazardous materials are loaded with no intermediate form of containment. A Large Packaging in which hazardous materials are loaded with an intermediate form of containment, such as one or more articles or inner packagings, is also a bulk packaging. Additionally, a bulk packaging has: <ul style="list-style-type: none"> ▪ A maximum capacity greater than 450 L (119 gallons) as a receptacle for a liquid; ▪ A maximum net mass greater than 400 kg (882 pounds) and a maximum capacity greater than 450 L (119 gallons) as a receptacle for a solid; or ▪ A water capacity greater than 454 kg (1000 pounds) as a receptacle for a gas as defined in §173.115 of this subchapter (49 CFR 171.8)
Critical Characteristics	Important design, material, and performance characteristics of a commercial grade item or service that, once verified, will provide reasonable assurance that the item or service will perform its intended safety function. (NQA-1-2009a Part II, Section 2.14)
Design Basis Conditions	The set of requirements that bound the design of structures, systems, and components within the facility. Some, but not necessarily all, aspects of the design basis are important to safety (DOE-STD-3009-2014).
Hazard Analysis	The identification of materials, systems, processes, and plant characteristics that can produce undesirable consequences (hazard identification), followed by the assessment of hazardous situations associated with a process or activity (hazard evaluation). Qualitative techniques are usually employed to pinpoint weaknesses in design or operation of the facility that could lead to accidents. The hazard evaluation includes an examination of the complete spectrum of potential accidents that could expose members of the public, onsite workers, facility

	workers, and the environment to radioactive and other hazardous materials (DOE-STD-3009-2014).
Hazard Categorization	Evaluation of the consequences of unmitigated radiological releases to categorize facilities in accordance with the requirements of 10 C.F.R. Part 830. Note: 10 C.F.R. Part 830 requires categorization consistent with DOE-STD-1027, <i>Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports</i> (DOE-STD-3009-2014).
Important to Safety	Classification of packaging and transportation systems, structures, and components with physical characteristics or functions that are essential to the safe storage and transportation of nuclear material without undue risk to the health and safety of the public or on-site worker.
Manufacturer	Means the person whose name and address or symbol appears as part of the specification markings required by this part or, for a packaging marked with the symbol of an approval agency, the person on whose behalf the approval agency certifies the packaging (49 CFR 178.2)
Non-Bulk	Means a packaging which has: <ul style="list-style-type: none"> ▪ A maximum capacity of 450 L (119 gallons) or less as a receptacle for a liquid; ▪ A maximum net mass of 400 kg (882 pounds) or less and a maximum capacity of 450 L (119 gallons) or less as a receptacle for a solid; ▪ A water capacity of 454 kg (1000 pounds) or less as a receptacle for a gas as defined in 49 CFR 173.115 ; or ▪ Regardless of the definition of bulk packaging, a maximum net mass of 400 kg (882 pounds) or less for a bag or a box conforming to the applicable requirements for specification packagings, including the maximum net mass limitations, provided in 49 CFR 178 Subpart L (49 CFR 171.8).
Normal Conditions of Transport (NCT)	A term used in both the DOT and IAEA regulations to encompass rough handling and minor mishaps during transportation. Type A packages are required to demonstrate that they can withstand normal conditions of transport by meeting the performance and containment requirements of 49 CFR 173.412, 465, and 466 (ANSI N14.7 Standard).
Offeror	Any person who does either or both of the following. <ul style="list-style-type: none"> ▪ Performs, or is responsible for performing, any pre-transportation function required under this [CFR] subchapter for transportation of the hazardous material in commerce.

	<ul style="list-style-type: none"> ▪ Tenders or makes the hazardous material available to a carrier for transportation in commerce. <p>A carrier is not an offeror when it performs a function required by this [CFR] subchapter as a condition of acceptance of a hazardous material for transportation in commerce (e.g., reviewing shipping papers, examining packages to ensure that they are in conformance with this subchapter, or preparing shipping documentation for its own use) or when it transfers a hazardous material to another carrier for continued transportation in commerce without performing a pre-transportation function (ANSI N14.7)</p>
Package	<p>Means a packaging plus its contents (49 CFR 171.8).</p> <p>Or</p> <p>Means the packaging together with its radioactive contents as presented for transport (49 CFR 173.403)</p>
Packaging	<p>Means a receptacle and any other components or materials necessary for the receptacle to perform its containment function in conformance with the minimum packing requirements of this subchapter. For radioactive materials packaging, (49 CFR 171.8)</p> <p>Or</p> <p>Means, for Class 7 (radioactive) materials, the assembly of components necessary to ensure compliance with the packaging requirements of this subpart. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, service equipment for filling, emptying, venting and pressure relief, and devices for cooling or absorbing mechanical shocks. The conveyance, tie-down system, and auxiliary equipment may sometimes be designated as part of the packaging (49 CFR 173.403)</p>
Packaging Manufacturer	<p>For Type A radioactive material packages the packaging manufacturer is the person certifying that the package meets all requirements of 49 CFR 178.350. This is usually the shipper/offeror's responsibility (ANSI N14.7 Standard)</p>
Quality Assurance	<p>Means a systematic program of controls and inspections applied by each person involved in the transport of radioactive material which provides confidence that a standard of safety prescribed in this subchapter is achieved in practice (49 CFR 173.403).</p>

Routine Conditions of Transport (RCT)	Routine conditions of transport are incident free with no mishaps. Type A packages are required to demonstrate that they can withstand routine conditions of transport by meeting the requirements of 49 CFR 173.24, 24a, 24b, and 173.410 (ANSI N14.7 Standard).
Safety Class	Means the structures, systems, or components, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from safety analyses (10 CFR830.3).
Safety Significant	Means the structures, systems, and components which are not designated as safety class structures, systems, and components, but whose preventive or mitigative function is a major contributor to defense in depth and/or worker safety as determined from safety analyses (10 CFR 830.3).
Shipper	Any person, organization, or government that prepares a consignment for transport and is named as consignor in the transport documents (ANSI N14.7 Standard).
Specific Administrative Control	An administrative control that is identified to prevent or mitigate a hazard or accident scenario and has a safety function that would be safety significant or safety class if the function were provided by a structure, system or component. Note: DOE-STD-1186-2004, <i>Specific Administrative Controls</i> , or successor document, provides additional information about SACs.
Subject-Matter-Expert (SME)	The Subject Matter Expert is that individual who exhibits the highest level of expertise in performing a specialized job, task, or skill within the organization.
Technical Safety Requirements	The limits, controls, and related actions that establish the specific parameters and requisite actions for the safe operation of a nuclear facility and include, as appropriate for the work and the hazards identified in the DSA for the facility: safety limits, operating limits, surveillance requirements, administrative and management controls, use and application provisions, and design features, as well as a bases appendix (DOE-STD-3009-2014).
Type A Package	Means a packaging that, together with its radioactive contents limited to A ₁ or A ₂ as appropriate, meets the requirements of 49 CFR 173.410 and 49 CFR 173.412 and is designed to retain the integrity of containment and shielding required by this part under normal conditions of transport as demonstrated by the tests set forth in 49 CFR 173.465 or 49 CFR 173.466, as appropriate. A Type A package does not require Competent Authority approval (49 CFR 173.403)

Type B Package	Means a packaging designed to transport greater than an A ₁ or A ₂ quantity of radioactive material that, together with its radioactive contents, is designed to retain the integrity of containment and shielding required by this part when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR part 71 (49 CFR 173.403).
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Appendix O – References

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- 10 CFR 830, Nuclear Safety Management
- 49 CFR Transportation, Parts 171-180
- ANSI/ASQ Z 1.13-1999, Quality Guidelines for Research.
- ASME NQA Technical Interpretation 10-1365, March 22, 2012
- ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications"
- ASME NQA 1-2008 with the NQA-1a-2009 addenda, QA Requirements for Nuclear Facility Applications, Part I and applicable requirements of Part II
- ASME NQA 1-2000, Quality Assurance Requirements for Nuclear Facility
- ASME NQA-1-2015, Quality Assurance Requirements for Nuclear Facility Applications
- ASTM A1008/A1008M-12 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Harden-able
- ASTM D1056-14 – Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber
- ASTM A307A – Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
- DOE Order 414.1D, Quality Assurance
- DOE Order 426.2, Change 2, Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities
- DOE Order 460.1C, Packaging and Transportation Safety
- DOE Order 461.1B, Packaging and Transportation for Offsite Shipment of Materials of National Security Interest
- DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports
- DOE-STD-3009-2014, Preparation of Nonreactor Nuclear Facility Documented Safety Analysis
- DOE-STD-1183-2007, Nuclear Safety Specialist Functional Area Qualification Standard
- HNF-SD-TP-TI-006, Revision 1, November 2000, Documentation and Verification Required for Type A Packaging use
- HNF-SD-TP-TI-006, Revision 1, November 2000, Packaging Qualification Checklist, DOT-7A Type A, Appendix A
- ISO 9001:2008, Quality Management Systems – Requirements
- ISO 9001:2015, Quality Management Systems – Requirements
- ISO 14001:2004, Environmental Management Systems – Requirements with Guidance for us
- Packaging Management Council (PMC) Technical Description for the Procurement of a 208-Liter (55-Gallon) Removable Head, Performance Oriented Package (POP) and 7A Type A, Carbon Steel Drum with Closure Ring
- NNSA Weapon Quality Policy, NAP-24A