

**Testing and Certification of the SAVY 4000 Nuclear Material Container for DOT Type A Liquid Transport – 15636**

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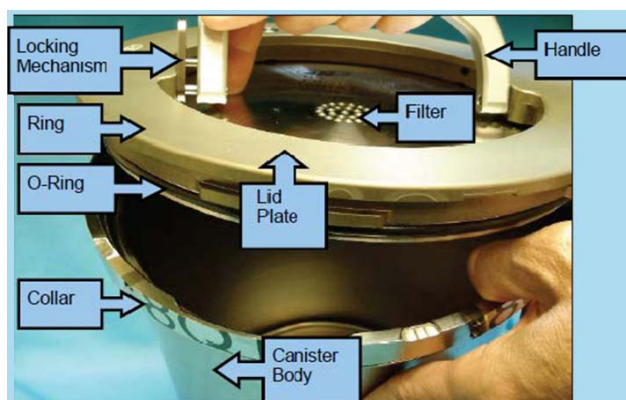
**ABSTRACT**

Los Alamos National Laboratory has contracted with Nuclear Filter Technology, Inc. to perform testing and certification of the SAVY 4000 container for DOT Type A liquid transport. The container was originally designed to meet DOE M441.1-1 requirements for safe storage of nuclear material, and it is currently being used for storage at Los Alamos National Laboratory, Livermore National Laboratory, Idaho National Laboratory and Nevada National Security Site. The SAVY 4000 container is manufactured from 316L stainless steel in a range of sizes from 1 quart to 10 gallon capacity, it can be opened and closed easily by hand, it is sealed with a Viton® O-Ring, and the filter retains particulates and resists liquid water entry while allowing hydrogen gas to escape. Finite element analysis has been used to guide the development of a testing regime that includes a 30 foot drop, bar penetration, vibration, water spray and stacking for the 5 quart capacity container. The results of the tests will be compared with the finite element analysis to validate the model. The validated model is being used to extend the Type A certification to the other container sizes. This poster will describe the results of the Type A liquid testing, the finite element analysis, and the benefits of broadening the use and versatility of the container.

**INTRODUCTION**

Container Design

- The SAVY-4000 container is composed of two primary sub-assemblies; the body and the lid.
- The body and lid are attached to one-another with a bayonet style closure.
- The lid has a built-in filter made of ceramic fibers that prevent hydrogen build-up and a water resistant membrane to resist water entry.
- The soft durometer Viton O-ring allows for a water and air tight seal.
- An aluminum handle is attached to the lid with stainless steel pins for manual handling and lifting.
- Holes in the collar allow water to drain off the lid and allow for the installation of a tamper indicating device (TID).
- The lid locks into place with a positive mechanical engagement made of aluminum and a stainless steel pin.
- The internal components that form the containment boundary are made of 316L stainless steel for corrosion resistance.



Currently the SAVY 4000 Nuclear Material Storage Container is being used in the Los Alamos National Laboratory plutonium facility PF-4 for storage purposes only. A need has arisen to extend the usability of the SAVY 4000 to allow for over the road transport. According to 49 CFR 178.350 the container must meet the following requirements in order to be a certified DOT Type A package for Class 7 Radioactive Materials:

<b>49 CFR 173 Design Requirements for DOT 7A Type A Packaging Containers</b>	
<b>178.350</b>	<b>Specification 7A; General Packaging, Type A</b>
(a)	Each packaging must meet all applicable requirements of subpart B of part 173 of this subchapter and be designed and constructed so that it meets the requirements of §§ 173.403, 173.410, 173.412, 173.415 and 173.465 of this subchapter for Type A packaging.
(b)	Each Specification 7A packaging must be marked on the outside "USA DOT 7A Type A."
(c)	Each Specification 7A packaging must comply with the marking requirements of § 178.3. In paragraph 178.3(a)(2), the term "packaging manufacturer" means the person certifying that the package meets all requirements of this section.
<b>173 Subpart B—Preparation of Hazardous Materials For Transportation</b>	
<b>173.24</b>	<b>General Requirements for Packaging's and Packages</b>
(a)	Applicability. Except as otherwise provided in this subchapter, the provisions of this section apply to—
(1)	Bulk and non-bulk packaging's;
(2)	New packaging's and packaging's which are reused; and
(b)	Each package used for the shipment of hazardous materials under this subchapter shall be designed, constructed, maintained, filled, its contents so limited, and closed, so that under conditions normally incident to transportation—

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(1)	Except as otherwise provided in this subchapter, there will be no identifiable (without the use of instruments) release of hazardous materials to the environment;
(2)	The effectiveness of the package will not be substantially reduced; for example, impact resistance, strength, packaging compatibility, etc. must be maintained for the minimum and maximum temperatures, changes in humidity and pressure, and shocks, loadings and vibrations, normally encountered during transportation;
(3)	There will be no mixture of gases or vapors in the package which could, through any credible spontaneous increase of heat or pressure, significantly reduce the effectiveness of the packaging;
(4)	There will be no hazardous material residue adhering to the outside of the package during transport.
(e)	Compatibility.
(1)	Even though certain packaging's are specified in this part, it is, nevertheless, the responsibility of the person offering a hazardous material for transportation to ensure that such packagings are compatible with their lading. This particularly applies to corrosivity, permeability, softening, premature aging and embrittlement.
(2)	Packaging materials and contents must be such that there will be no significant chemical or galvanic reaction between the materials and contents of the package.
(4)	Mixed contents. Hazardous materials may not be packed or mixed together in the same outer packaging with other hazardous or nonhazardous materials if such materials are capable of reacting dangerously with each other and causing—
(i)	Combustion or dangerous evolution of heat;
(ii)	Evolution of flammable, poisonous, or asphyxiant gases; or
(iii)	Formation of unstable or corrosive materials.
(f)	Closures.
(1)	Closures on packaging's shall be so designed and closed that under conditions (including the effects of temperature, pressure and vibration) normally incident to transportation—
(i)	Except as provided in paragraph (g) of this section, there is no identifiable release of hazardous materials to the environment from the opening to which the closure is applied; and
(ii)	The closure is leak-proof and secured against loosening. For air transport, stoppers, corks or other such friction closures must be held in place by positive means.
(2)	Except as otherwise provided in this subchapter, a closure (including gaskets or other closure components, if any) used on a specification packaging must conform to all applicable requirements of the specification and must be closed in accordance with information, as applicable, provided by the manufacturer's notification required by § 178.2 of this subchapter.
(g)	<i>Venting.</i> Venting of packaging's, to reduce internal pressure which may develop by the evolution of gas from the contents, is permitted only when—
(2)	Except as otherwise provided in this subchapter, the evolved gases are not poisonous, likely to create a flammable mixture with air or be an asphyxiant under normal conditions of transportation;
(3)	The packaging is designed so as to preclude an unintentional release of hazardous materials from the receptacle;



(h)	Outage and filling limits—
(1)	<i>General.</i> When filling packaging's and receptacles for liquids, sufficient ullage (outage) must be left to ensure that neither leakage nor permanent distortion of the packaging or receptacle will occur as a result of an expansion of the liquid caused by temperatures likely to be encountered during transportation. Requirements for outage and filling limits for non-bulk and bulk packaging's are specified in § 173.24a(d) and 173.24b(a), respectively.
<b>173.26</b>	<b>Quantity Limitations</b>
	When quantity limitations do not appear in the packaging requirements of this subchapter, the permitted gross weight or capacity authorized for a packaging is as shown in the packaging specification or standard in part 178 or 179, as applicable, of this subchapter.
<b>173.410</b>	<b>General design requirements.</b>
	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—
(a)	The package can be easily handled and properly secured in or on a conveyance during transport.
(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.
(c)	The external surface, as far as practicable, will be free from protruding features and will be easily decontaminated.
(d)	The outer layer of packaging will avoid, as far as practicable, pockets or crevices where water might collect.
(e)	Each feature that is added to the package will not reduce the safety of the package.
(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).
(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.
<b>173.412</b>	<b>Additional design requirements for Type A packages.</b>
	In addition to meeting the general design requirements prescribed in § 173.410, each Type A packaging must be designed so that—
(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.
(b)	The smallest external dimension of the package is not less than 10 centimeters (4 inches).

(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.
(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.
(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.
(f)	The containment system will retain its radioactive contents under the reduction of ambient pressure to 60 kPa (8.7 pounds per square inch).
(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.
(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—
(ii)	Have a containment system composed of primary inner and secondary outer containment components designed to enclose the liquid contents completely and ensure their retention within the secondary outer component in the event that the primary inner component leaks.
<b>173.415</b>	<b>Authorized Type A Packages</b>
	The following packages are authorized for shipment if they do not contain quantities exceeding A1 or A2 as appropriate:
(a)	DOT Specification 7A (see § 178.350 of this subchapter) Type A general packaging. Each offeror of a Specification 7A package must maintain on file for at least one year after the latest shipment, and shall provide to DOT on request, complete documentation of tests and an engineering evaluation or comparative data showing that the construction methods, packaging design, and materials of construction comply with that specification.
<b>178.3</b>	<b>Marking of Packagings</b>
(a)	Each packaging represented as manufactured to a DOT specification or a UN standard must be marked on a non-removable component of the packaging with specification markings conforming to the applicable specification, and with the following:
(1)	In an unobstructed area, with letters, and numerals identifying the standards or specification (e.g. UN 1A1, DOT 4B240ET, etc.).



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(2)	Unless otherwise specified in this part, the name and address or symbol of the packaging manufacturer or the person certifying compliance with a UN standard. Symbols, if used, must be registered with the Associate Administrator. Unless authorized in writing by the holder of the symbol, symbols must represent either the packaging manufacturer or the approval agency responsible for providing the most recent certification for the packaging through design certification testing or periodic retesting, as applicable. Duplicative symbols are not authorized.
(3)	The markings must be stamped, embossed, burned, printed or otherwise marked on the packaging to provide adequate accessibility, permanency, contrast, and legibility so as to be readily apparent and understood.
(4)	Unless otherwise specified, letters and numerals must be at least 12.0 mm (0.47 inches) in height except that for packagings of less than or equal to 30 L (7.9 gallons) capacity for liquids or 30 kg (66 pounds) capacity for solids the height must be at least 6.0 mm (0.2 inches). For packagings having a capacity of 5 L (1 gallon) or 5 kg (11 pounds) or less, letters and numerals must be of an appropriate size.
(d)	No person may mark or otherwise certify a packaging or container as meeting the requirements of a manufacturing special permit unless that person is the holder of or a party to that special permit, an agent of the holder or party for the purpose of marking or certification, or a third party tester.
<b>172.312</b>	<b>Liquid hazardous materials in non-bulk packaging's.</b>
(b)	Arrows for purposes other than indicating proper package orientation may not be displayed on a package containing a liquid hazardous material.
<b>173.461</b>	<b>Demonstration of Compliance with Tests</b>
(a)	Compliance with the design requirements in § 173.412 must be shown by any of the methods prescribed in this paragraph, or by a combination of these methods appropriate for the particular feature being evaluated:
(1)	Performance of tests with prototypes or samples of the specimens representing LSA-III, special form Class 7 (radioactive) material, or packaging, in which case the contents of the packaging for the test must simulate as closely as practicable the expected range of physical properties of the radioactive contents or packaging to be tested, must be prepared as normally presented for transport. The use of non-radioactive substitute contents is encouraged provided that the results of the testing take into account the radioactive characteristics of the contents for which the package is being tested;
(2)	Reference to a previous, satisfactory demonstration of compliance of a sufficiently similar nature;
(3)	Performance of tests with models of appropriate scale incorporating those features that are significant with respect to the item under investigation, when engineering experience has shown results of those tests to be suitable for design purposes. When a scale model is used, the need for adjusting certain test parameters, such as the penetrator diameter or the compressive load, must be taken into account; or
(4)	Calculations or reasoned evaluation, using reliable and conservative procedures and parameters.
(b)	With respect to the initial conditions for the tests under § 173.465 through 173.469, except for the water immersion tests, compliance must be based upon the assumption that the package is in equilibrium at an ambient temperature of 38 °C (100 °F).

Finite element models were used to determine a worst case orientation for the 30 foot drop and for the bar penetration test. FEA models also assisted in showing compliance of the majority of the design and performance requirements listed above. The results of the DOT Type A test conducted by Nuclear Filter

Technology are still pending. By gaining a certification for DOT Type A liquid transport the versatility of the SAVY 4000 would be dramatically broadened, which could serve a larger customer base.

## METHODS

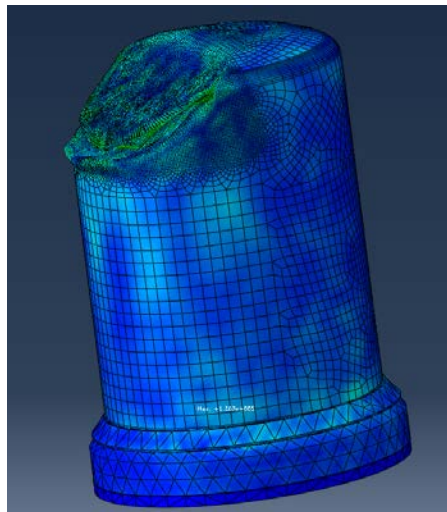
### Finite Element Analysis

#### Modeling

The software that was used is Abaqus 6.13 simulation software by Dassault Systemes, which is certified as meeting the Quality Assurance Requirements for Nuclear Power Plants and Fuel Reprocessing Plants. Finite element models were used in the preliminary analysis of the 5QT SAVY 4000 Transportation Package to help guide the physical tests that Nuclear Filtration Technology was contracted to conduct. Due to the complex geometries involved in the SAVY 4000 can design it was necessary to utilize numerical method technique, instead of obtaining an analytical solution. This technique breaks the problem being examined into small pieces that are more manageable. The information that is obtained from the first piece is then related to its neighboring piece. Finite element models require extensive computational power and can take days to solve.

#### Comparison to Physical Results

To extend the certification for DOT Type A to other SAVY 4000 sizes, the finite element models will need to be validated. In order to do this justification a comparison of the cans that had been dropped to the simulated deformation generated by the FEA models will need to be conducted. This assessment could be done through the use of 3 dimensional scanning. The method previously described would only give a qualitative compression where a quantitative compression would be more adequate in proving that the FEA models are a viable method for physical test replacement. The second more quantitative method that is being pursued is a digital image correlation technique. This technique works by tracking dots that have been painted on the outside surface of an undamaged object and extrapolating an internal stresses. Before more sizes can be certified this verification process will need to be completed.



**Figure 1.** Finite element simulation results showing deformation on the bottom corner with the center of gravity over point of impact.

## Test Plan

### Test Criteria

Los Alamos National Laboratory (LANL) contracted Nuclear Filtration Technology to test the SAVY 4000 for its ability to perform as a Department of Transportation (DOT) 7A Type A Package for Class 7

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Radioactive Material. LANL required that the following be completed:

1. Evaluation of the 5QT SAVY 4000 Transportation Package configuration against the applicable design requirements identified within 49 CFR 178.350,
2. Inspection and Evaluation of any associated design deficiencies applicable to the 5QT SAVY 4000 Transportation Package(s) being tested, and
3. Testing of the 5 QT SAVY 4000 Transportation Package configuration against the applicable performance requirements identified within 49 CFR 173.465

### Design Compliance

The following identifies the applicable design requirements for DOT 7A Type A Packaging Containers as it relates to the 5QT SAVY 4000 Transportation Package. The design compliance of the 5QT SAVY 4000 Transportation Package was evaluated based on the following package configuration as was defined by the LANL contract:

1. No more than 2.5 liters of liquid will be placed directly into a 3 Quart Slip-Lid Container.
  - a. For the purpose of the testing requirements defined within the 49 CFR 173, the liquid utilized was water mixed with fluorescent indicator.
  - b. Prior to replacement of the liquid mixture into the 3 Quart Slip-Lid container, the mixture was verified by NFT and LANL personnel (in a darkened area) to emit sufficient fluorescence in order to identify potential leaks after completion of the prescribed tests.
  - c. The Slip-Lid container was verified to be manufactured of 300 series stainless steel
2. PVC Tape (approximately two inches in width and of any color) was wrapped circumferentially along the 3 Quart Slip-Lid & Body interface. Approximately 2 wraps were applied to the container.
  - a. The first wrap was centered along the lid and body joint. The start and end of the PVC Tape overlapped itself slightly (approximately one to two inches)
  - b. The second wrap overlapped the initial wrap, but was offset (lower than the initial wrap) by approximately half the width of the tape. The start and end of this wrap was offset circumferentially from the initial wrap at a minimum of two inches. Additionally, the start and end of the PVC overlapped itself slightly (approximately one to two inches)
  - c. Each layer of PVC Tape was wrapped sufficiently tight to avoid wrinkles without degrading, tearing, or otherwise damaging the tape.
3. The tapped 3 Quart Slip-Lid Container was then placed upright into a 5 Quart SAVY 4000 Container (NFT Part Number: 201500000)
  - a. The 5 Quart SAVY 4000 Container was fabricated in accordance with current NFT drawings and specifications.
  - b. The 5 Quart SAVY 4000 Container was closed in accordance with the current revision of LANL TA-55 Nuclear Material Packaging Procedure, *TA-DOP-091*.

### Container Integrity & Deficiencies

Per the requirements of 49 CFR 173.462, the 5QT SAVY 4000 Transportation Packages subjected to the testing outlined in the Testing section below all packages were inspected prior to the commencement of testing. The inspections identified all non-conformances and defects associated with the packages. All associated deficiencies were documented and evaluated for their potential to affect the result of testing.

1. Inspection
  - a. Prior to testing, NFT Quality Control performed a detailed inspection of the 5QT SAVY 4000 Transportation Packages presented for DOT 7A Type A Packaging Testing.
2. Documentation Package Review
  - a. NFT Engineering performed a detailed review of the Documentation Packages associated with the 5QT SAVY 4000 containers presented for DOT 7A Type A Packaging Testing. This review identified all associated non-conformances.



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### Testing

In order for the 5QT SAVY 4000 Transportation Package to be qualified and certified as a DOT 7A Type A Package, it must successfully pass the test criteria outlined in 49 CFR 173.465 Type A Packaging Tests. Testing was performed in accordance with NFT's SOP-250, DOT Type 7A Packaging Testing Procedure. All results and associated documentation was recorded per the requirements of the procedure.

#### 1. Tests Conducted

##### a. Prerequisites to Testing

- i. As required by SOP-250, the Test Plan Submittal (Quality Form QF-250-1-1 within SOP-250), and Test Documentation Docket (Quality Form QF-250-2-1 within SOP-250) was completed and approved by the required personnel prior to the commencement of testing.

##### b. Water Spray Test

- i. The Water Spray Test was conducted in accordance with the requirements of SOP-250, Section 9.6.1. As required by 49 CFR 173.465(b), the Water Spray Rest preceded each of the tests identified in 49CFR 173.465 (Free Drop, Stacking, & Penetration) for the 5QT SAVY 4000 Transportation Package(s) tested. Acceptance was based on the acceptance criteria defined in the procedure. Results were recorded on the applicable test record in the procedure (Quality Form QF-250-6-1). In the event that a 5QT SAVY 4000 failed alternate test methods would have been utilized so long as they were documented and approved by all required personnel.

##### c. Free Drop Test

- i. The Free Drop Test was conducted in accordance with the requirements of SOP-250, Section 9.8. Additionally LANL requested that the 5QT SAVY 4000 Transportation Package be qualified for transport of fissile materials, therefore SOP-205, Section 9.8.5 applied and the package was subjected to the Preconditioning Free Drop Tests prior to the Free Drop Test height of 30 feet. As required by 49 CFR 173.465©, the orientation of the 5QT SAVY 4000 Transportation Package shall cause the maximum damage. The 5QT SAVY 4000 Transportation Package was initially oriented with the center of gravity over the corner of the 5QT SAVY 4000 bottom. This orientation was determined to cause maximum damage to the package and was agreed upon by NFT Engineering and LANS personnel. Acceptance was based on the acceptance criteria defined in the procedure (Quality Form QF-250-3-1). In the event that the 5QT SAVY 4000 container failed or adverse results occurred an alternate test method would be utilized and document and approved by all required personnel.

##### d. Stacking Test

- i. The Stacking Test was conducted in accordance with the requirements of SOP-250, Section 9.10. The compression weight was determined at the time of the 5QT SAVY 4000 Transportation Package preparation and was recorded on the test record as required by the procedure. Acceptance was based on the acceptance criteria defined in the procedure. Results were recorded on the applicable test record in the procedure (Quality Form QF-250-5-1). In the event of failure or adverse results an alternate test method would have been conducted so long as they were documented and approved by all required personnel.

##### e. Penetration Test

- i. The Penetration Test was conducted in accordance with the requirements of SOP-250, Section 9.11. The distance between the penetration bar and the impact location on the 5QT SAVY Transportation Package was 5.5 feet. As required by 49 CFR 173.465(e), the penetration bar impacted the package at its weakest point, so that it penetrated far enough, to hit the containment system. The impact location was determined to be the area of the 5QT SAVY 4000 body closest to the weld. The area of impact was as close to the 5QT SAVY 4000 body/collar weld as possible without interference of the collar. Therefore the impact location was approximately 0.625" bellow the 5QT SAVY 4000 collar. This impact location was agreed upon by NFT Engineering and

LANL personnel. Acceptance was based on the acceptance criteria defined in the procedure. Results were recorded on the applicable test record in the procedure (Quality Form QF-250-4-1). In the event of failure or adverse results an alternative method would have been utilized so long as the method was documented and approved by all required personnel.

f. Vibration Test

- i. The Vibration Test was conducted in accordance with the requirements of SOP-250, Section 9.12. Testing was conducted at CascadeTek, an approved supplier of testing services for NFT. The Vibration Test was witnessed and evaluated for conformance to this test plan, associate procedures and Purchase Order requirements by NFT Engineering and Quality Control. Acceptance was based on the acceptance criteria defined in the procedure. Results were recorded on the applicable test record in the procedure (Quality Form QF-250-7-1). In the event of failure or adverse results alternate test methods would have been utilized so long as those methods were documented and approved by all required personnel.

## CONCLUSIONS

The SAVY 4000 nuclear material storage container series was approved by the Department of Energy (DOE) for use at Los Alamos National Laboratory on April 16<sup>th</sup>, 2014. The container was designed to meet the requirements specified in the DOE M 441.1-1, *Nuclear Materials Packaging Manual*. Nuclear Filter Technology, Inc. in Golden, Colorado, designed, tested and currently manufactures the SAVY-4000 series with oversight from Los Alamos National Laboratory. The container series ranges in size from 1 quart to 10 gallons, with built-in filters, radiation shielding and ease-of-use features to minimize radiation exposure to workers. Additional DOE sites are making plans to use the SAVY-4000 series of containers including Lawrence Livermore National Laboratory, Pacific Northwest National Laboratory, Idaho National Laboratory and Savannah River Site, and approval by DOE paves the way for its approval at these sites. In order to limit the number of physical drop tests finite element analysis models were used to simulate DOT Type 7A drop tests. These models also added in determining the worst case drop orientation. All drop, vibration, penetration, and water entry tests have been completed through a contract with NFT Inc.



Figure 2. The full line of SAVY 4000 containers

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The previously described container meets the 49 CFR Packaging for Type A solids, with further design modifications needed to extend the certification to liquids. The only current limitation is that the container's filter arrangement does not allow liquids from entering but does allow liquids to exit. A design has been formulated but is pending a patent ownership review before it can be tested and released to the testing contractor.

### **REFERENCES**

1. Specification 7A; general packaging, Type A, 49 C.F.R. 178.350 (2014)
2. General requirements for packaging and packages, 49 C.F.R. 178.24 (2013)
3. Quantity limitations, 49 C.F.R. 173.26 (1990)
4. General design requirements, 49 C.F.R. 173.410 (2014)
5. Additional design requirements, 49 C.F.R. 173.412 (2014)
6. Authorized Type A packages, 49 C.F.R. 173.415
7. Marking of packagings, 49 C.F.R. 178.3 (2013)
8. Liquid hazardous materials in non-bulk packagings, 49 C.F.R. 172.312 (2013)
9. Demonstration of compliance with tests, 49 C.F.R. 173.461 (1998)