

## The 1105-SD for Transport of Shielded Devices and Sources

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### ABSTRACT

The 1105-SD radioactive material transportation package is a new addition to the publicly available fleet of RAM transport packagings. Essentially identical to National Nuclear Security Administration's well-known 435-B packaging, it comes with a ready-made track record for reliability and ease of use. It offers leaktight containment for a shielded payload of up to approximately 2,115 kg [4,660 lb] and 200 W of decay heat from a number of isotopes. Relatively light in weight at 4,580 kg [10,100 lb] and small in size (2.1 m tall [83 inches] x 1.8 m diameter [70 inches]), it can be readily deployed in tight spaces. The range of payloads includes the Long Term Storage Shield (LTSS) for radioactive sources, as well as a family of shielded irradiation devices. A full set of auxiliary equipment, such as a shipping pallet and seal surface protectors, is available. An operating and maintenance manual has been prepared along with a full set of fabrication drawings and specifications. The 1105-SD is licensed by NRC under USA/9379/B(U)-96.

### INTRODUCTION

In 2009, Orano Federal Services LLC began the development of a Type B package for the National Nuclear Security Administration (NNSA)'s Offsite Source Recovery Project. The purpose of the package was to transport unwanted or abandoned sources in the Long Term Storage Shield (LTSS) or in intact medical or industrial irradiation devices. This package became known as the 435-B and was granted a NRC Certificate of Compliance in 2014. Since that time, NNSA has performed a number of successful source recoveries. The 435-B has proved its value in practice by its modest cost, light weight, and ease of use.

In order to offer these advantages to the general public, Orano Federal Services LLC has developed the 1105-SD. The 1105-SD is a virtual clone of the 435-B, and has the same licensing safety basis. The package has been designed, tested, and licensed to meet or exceed all of the applicable requirements of 10 CFR 71 [1] and SSR-6 [2]. The NRC has granted it Certificate of Compliance USA/9379/B(U)-96. The 1105-SD is shown in Figure 1.

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The 1105-SD can be used to transport sealed sources with up to 200 W of decay heat that are housed in either the LTSS or within an approved shielded irradiation device. The sources are not required to be in special form since the package offers leak tight containment. The beta and

gamma sources currently approved for transport in the 1105-SD are shown in Table 1. Americium and small plutonium and alpha,n sources may be accommodated as shown in Table 2. The quantities of fissile plutonium isotopes are small enough to be fissile exempt, and the package is currently without a criticality analysis. However fissile payloads could be certified by amendment.

The LTSS is a shielded storage container for sources which weighs approximately 2,115 kg [4,660 lb]. It is transported in the 1105-SD using an aluminum lodgment structure. Other shielded containers or large shielded devices up to this weight could be accommodated in similar-style lodgments.

Shielded irradiation devices include a mechanism to expose the radiation source, shielding material, a steel shell enclosure, and a means to lock the source in the shielded position. Devices may weigh up to 1,587 kg [3,500 lb] and are placed into an Inner Container within the 1105-SD for transport which has internal dimensions of 914 mm [36 inches] in diameter and 1,346 mm [53 inches] tall. The Inner Container is a standard component of the package.

**Table 1 – 1105-SD Approved Gamma and Beta Sources**

<b>Nuclide</b>	<b>Maximum Activity</b>
Co-60	12,970 Ci
Cs-137	14,000 Ci
Sr-90	1,000 Ci
Ir-192	200 Ci
Se-75	80 Ci

**Table 2 – 1105-SD Approved Transuranic and Neutron Sources**

<b>Nuclide</b>	<b>Maximum Activity</b>
Am-241 (no Be)	1000 Ci
Am-241Be	6.6 Ci
Pu-238 (no Be)	75 g Pu
Pu-239 (no Be)	15 g Pu
Pu-239Be	15 g Pu

## **PACKAGE DESCRIPTION**

The payload cavity of the 1105-SD is 1,105 mm [43.5 inches] in diameter and 1,532 mm [60.3 inches] tall. At each end of the cavity is an internal energy-absorbing structure designed to reduce structural loads on the payload in the hypothetical accident condition (HAC) impact case. The lower end of the package features an impact limiter made from polyurethane foam encased in a thin stainless steel shell. The impact limiter envelops and protects the package closure. The closure includes a bore-type elastomer containment O-ring seal and features 24, 32 mm [1-1/4-inch] diameter alloy steel bolts. A vent port and a seal test port are included in the closure flange. The 1105-SD has a 12.7-mm [0.5-inch] thick containment boundary with torispherical ends made from ASTM Type 304 stainless steel. Thin sheet metal thermal shields are attached to the external surfaces of the package to resist the absorption of hypothetical accident condition fire heat. A cross section of the package is shown in Figure 2.

The package consists of two primary components: the base and the bell, as shown in Figure 3. The base includes the lower torispherical head, the lower closure flange, the foam-filled impact limiter, and the lower internal impact absorber, on which the payload rests. (Note that the impact limiter is fixed to the base and is not removed during use, thus speeding operations.) The bell includes the side wall, the upper torispherical head, the thermal shields, the upper closure flange, the vent and seal test ports, and the upper impact absorber. The LTSS or other large payloads are transported in application-specific lodgment structures. General shielded devices weighing less than 1,587 kg [3,500 lb] are transported in the Inner Container. The package does not include a significant level of biological shielding; the shielding function is provided by the payload. The LTSS in its lodgment is shown in Figure 4 and the Inner Container in Figure 5.

The overall height of the 1105-SD is 2.1 m tall [83 inches] and the outer diameter of the impact limiter is 1.8 m [70 inches]. The gross weight of the package is 4,580 kg or 10,100 lb, which means that two or more packages can easily be carried on the same conveyance. The package is handled using a pallet, which also serves as the tiedown structure to the conveyance. A view of the 435-B, which is identical to the 1105-SD, is shown in Figure 6, during use at a recovery site. The empty weight of the package is approximately 2,240 kg [4,940 lb].

## **OPERATION**

The 1105-SD package is easy to use. The closure bolts, located at the bottom of 24 tube openings in the upper slanted surface at the lower end of the bell, are easily accessed without removing the impact limiter. The bolt tubes are covered by a thin weather cover. After the closure bolts are disengaged, they can be lifted out of the tubes using convenient cross-drilled holes in each bolt head. A single lift point at the top of the bell is then used to separate the bell from the base. The payload (either the lodgment of the LTSS or the Inner Container) is then lifted and removed from the base. The LTSS is accessed by separation of the lodgment upper half from the lower half (using 8 bolts), and the Inner Container lid is attached by only six bolts.

The vent port and seal test port are also accessed through tubes located in the slanted top at the lower end of the bell. For special form capsule payloads, the package does not require leakage rate testing. For non-special form payloads, a common mass spectrometer leakage detector is used with a helium atmosphere inside the package to achieve leak-tight containment as defined by ANSI N14.5 [3].

The light weight and small size means the 1105-SD can be used with relatively light-duty infrastructure or in tight places. The bell weighs 1,210 kg [2,670 lb] and a maximum payload, including lodgment or Inner Container, weighs 2,340 kg [5,160 lb]. The base remains in place on the pallet, which is moved by a fork lift truck.

A full set of operational and auxiliary equipment for the 1105-SD has been designed and proven in operation, including a detailed Operating and Maintenance manual. Due to the simplicity of package design, annual maintenance of the package is minimal. Other than annual replacement of the containment O-ring seal, maintenance is largely a matter of visual inspection of components during loading operations.

## LICENSING

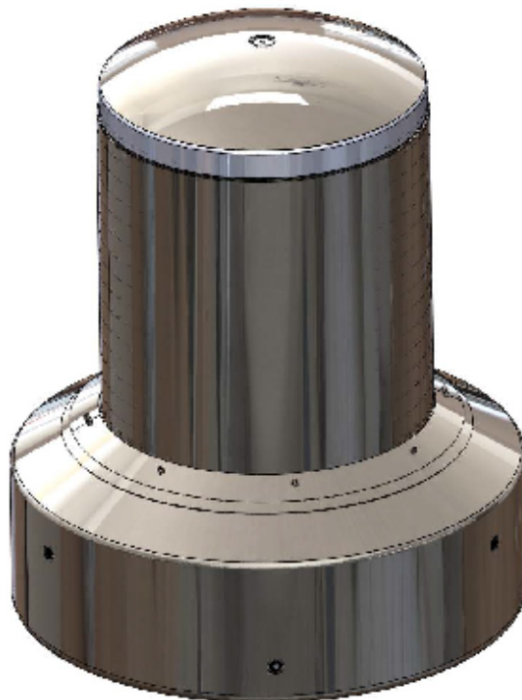
The 1105-SD was initially licensed as the 435-B package in 2014. The certification testing included use of three, full-scale test units, tested for normal conditions of transport (NCT) and HAC impact and puncture events. Multiple units were used in order to fully test all payload combinations and potentially worst-case impact and puncture orientations. Each test unit was leak-tight after the tests.

To ensure that the 1105-SD could be readily approved by competent authorities outside the U.S., a consideration of the requirements of IAEA SSR-6 was made. The only significant difference was found to be the initial temperature of the package during the HAC free drop event, which is  $-29\text{ }^{\circ}\text{C}$  [ $-20\text{ }^{\circ}\text{F}$ ] under 10 CFR 71 and  $-40\text{ }^{\circ}\text{C}$  [ $-40\text{ }^{\circ}\text{F}$ ] under SSR-6. Consequently, 9-m [30 ft] free drops were performed with an equivalent foam that simulated impact under the colder conditions required by SSR-6.

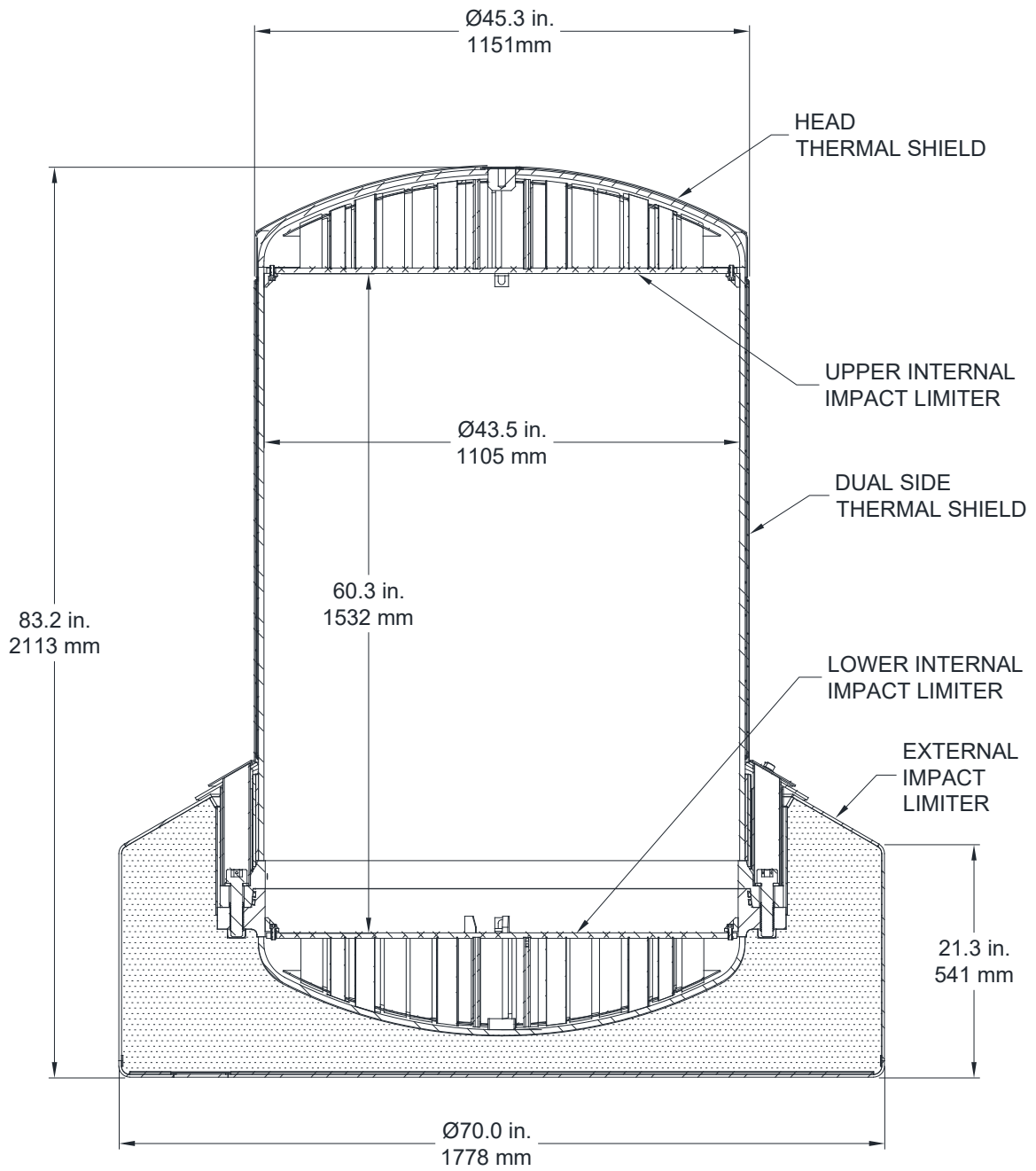
Of note, the certificates of compliance for the 435-B and the 1105-SD are completely independent.

## CONCLUSION

The 1105-SD radioactive material transportation package is a new addition to the publicly available fleet of RAM transport packagings. Essentially identical to NNSA's well-known 435-B packaging, it can transport sealed radioactive sources in a shielded container (the LTSS) or in shielded irradiation devices. Other shielded containers, or fissile payloads, could also be accommodated by license amendment. The 1105-SD is light enough and small enough to be easily deployed in congested areas. Operation is simple and does not require removal of the impact limiter for access to the closure.



**Figure 1 – 1105-SD Packaging**



**Figure 2 – Cross Section of the 1105-SD**

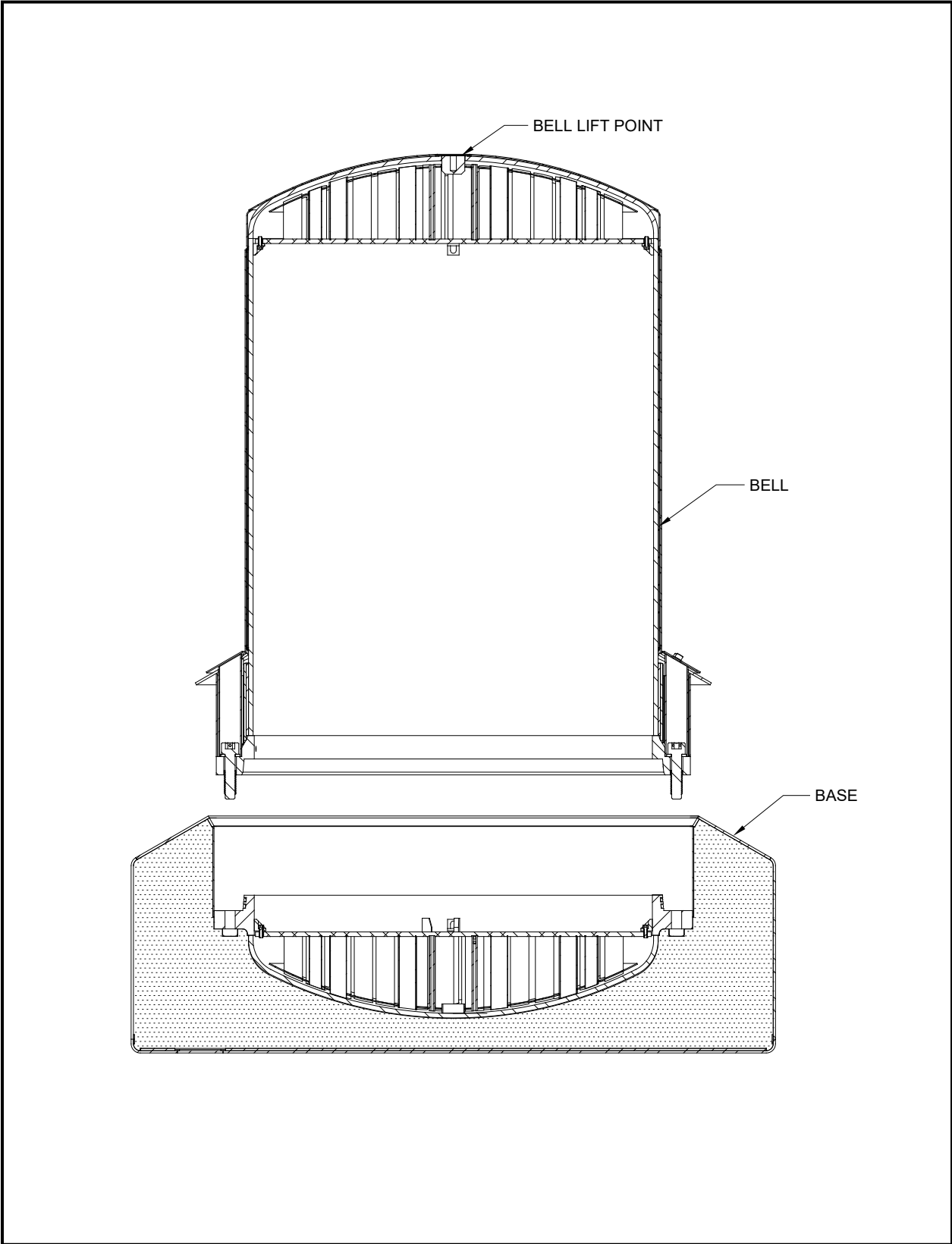
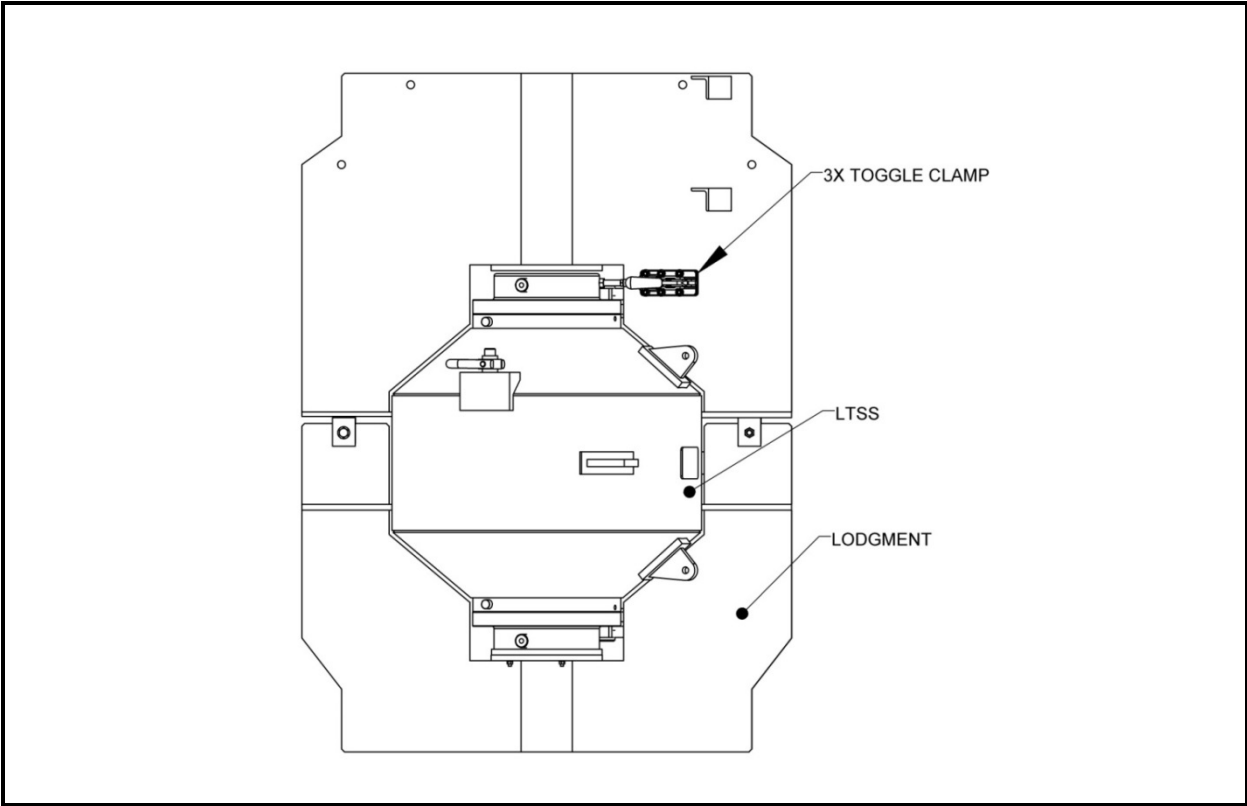
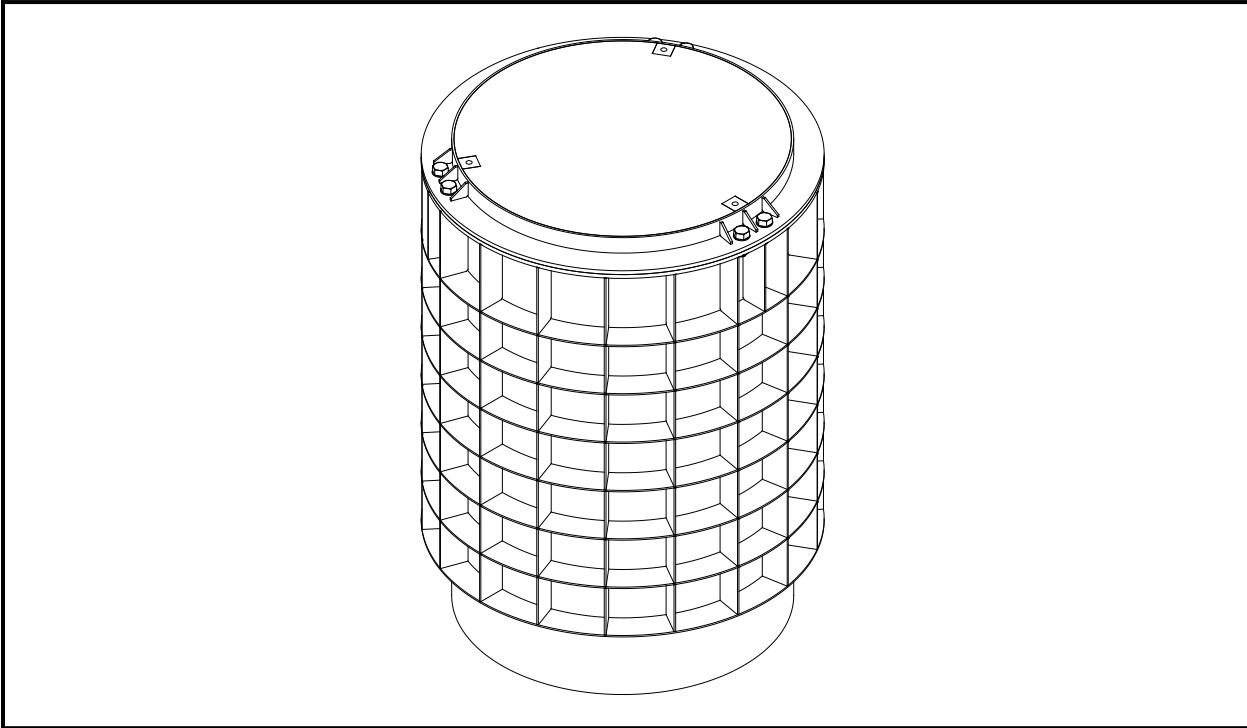


Figure 3 – 1105-SD Exploded View



**Figure 4 – LTSS and Lodgment**



**Figure 5 – Inner Container**



**Figure 6 – 435-B (Identical to 1105-SD) In Use, 2018**

## **REFERENCES**

1. Title 10, Code of Federal Regulations, Part 71 (10 CFR 71), *Packaging and Transportation of Radioactive Material*.
2. International Atomic Energy Agency, *Regulations for the Safe Transport of Radioactive Material*, SSR-6.
3. ANSI N14.5–2014, *American National Standard for Radioactive Materials – Leakage Tests on Packages for Shipment*, American National Standards Institute (ANSI), Inc.