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Destructive Testing of an ES-3100 Shipping Container at the Savannah River National Laboratory

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Abstract

Destructive testing of an ES-3100 Shipping Container was completed by the Packaging Technology and Pressurized Systems organization within the Savannah River National Laboratory in order to qualify the ES-3100 as a candidate storage and transport package for applications at various facilities at the Savannah River Site. The testing consisted of the detonation of three explosive charges at separate locations on a single ES-3100. The locations for the placement were chosen based the design of the ES-3100 as well as the most likely places for the package to incur damage as a result of the detonation. The testing was completed at an offsite location which raised challenges as well as allowed for development of new partnerships for this testing and for potential future testing. The results of the testing, the methods used to complete the testing, and similar, potential future work will be discussed.

Background and Test Preparation

SRNL PT&PS was requested to perform explosive testing on an ES-3100 Shipping Package to determine if the package would be a candidate as a storage container. These tests followed ballistics testing performed in September 2013. The ballistics tests demonstrated the package's ability to experience a bullet impact while not allowing the penetration of a 3013 product container within the CV. This munitions testing was for a similar purpose in that these tests would demonstrate the ability of the ES-3100 Shipping Package to withstand the effects of the detonation of the explosive charge while the 3013 is not penetrated. Successful tests would allow the ES-3100 to be qualified for inclusion in facility Documented Safety Analysis (DSA) as a storage package.

The munitions tests were scheduled by SRNS personnel to be performed at the Government Training Institute (GTI) in Barnwell, SC. GTI is located outside of the boundaries of the Savannah River Site. In order to perform the tests the munitions and ES-3100 test package would have to be delivered to GTI. The munitions contain materials that are classified as DOT hazardous materials. Since they are hazardous, it was necessary to ship the munitions to GTI, i.e., they could not be hand carried to GTI by SRNL personnel. After considering various methods of transfer, it was decided that a commercial carrier capable of shipping hazardous materials of this type would be contracted to perform the shipment.

One ES-3100 package, Serial Number 61249, fabricated to the certified drawings, was assembled in a configuration that included the necessary content components for the test. This configuration, see Figure 1, included a Drum Body Subassembly, Containment Vessel, and two 3013 Containers. One of the 3013 containers, S000995, was modified to be leak-testable. The

other 3013, R602295, was not modified. The two 3013 containers were loaded into the test package, per Figure 1, with R602295 being on the bottom.

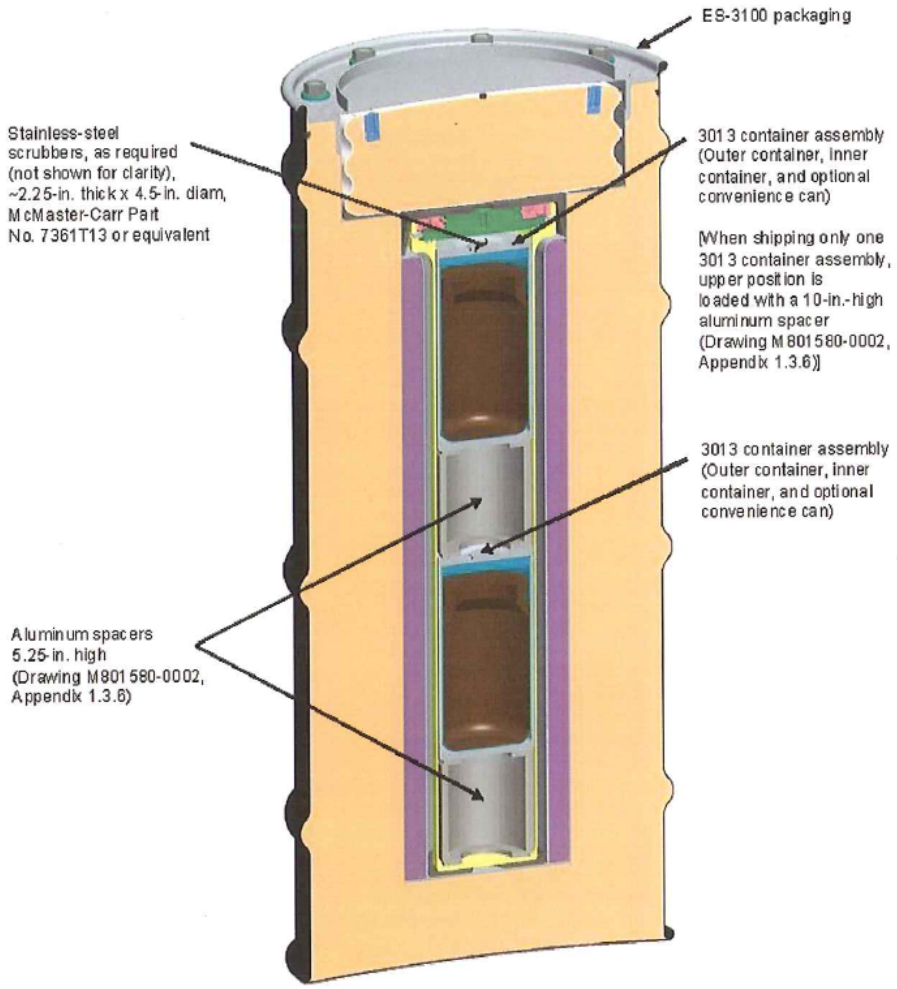

Figure 1 – The ES-3100 Tested Configuration

Testing

The assembled ES-3100 package was transferred to the test location on September 11, 2014. The package was set-up for the test by GTI personnel and the tests were performed as scheduled on September 16, 2014. The munitions were shipped to the GTI facility early on the day of the test.

Three explosive charges were placed onto the drum and tested successively. The first charge was centered under the bottom of the drum. A packed earth surface was used as the reflective surface for this test and is consistent with previous testing on similar, approved, storage packages. The second charge was placed on the top of the drum at the center of the drum lid.

The final explosive charge was placed about halfway down the package at the elevation of the top 3013 and affixed to the side of the drum.

The three charges were detonated in succession, see Figures 2 and 3, and the results were photographed to document the external damage. The package was then returned to SRNL for examination to determine if any internal damage had occurred and for leak testing of the 3013 container.

Figure 2 – The Impact Damage on the Bottom and Top of the ES-3100

Figure 3 – The Impact Damage on the Side of the ES-3100

Post-Test Examination

The package was transferred into the 723-A high pressure laboratory and examined on the afternoon of September 16.

The package was able to be opened by normal removal of the drum lid, and the containment vessel (CV) was opened while it was still inside of the drum. The 3013 containers were removed from the CV and the leak-testable 3013 was prepared for leak testing. The leak testing was completed on September 17, 2014. The 3013 containers appeared to have sustained no damage during the testing.

The leak-testable 3013 container, S000995, remained leaktight after the munitions tests. Figure 4 shows S000995 after the munitions and leak testing.

Aside from the obvious damage to the external portions of the package, there was no additional damage noticed on the internal or external of the package that would challenge the integrity of the CV or the containers within the CV. The drum lid was damaged when the top charge was detonated, and it was noticed, when the lid was removed, that the explosion caused the lid to breach. This breach, however, did not extend into the drum body and no deformation was noticed on the interior of the drum body. Additionally, it was noticed that the concrete-like materials inside the lid and the drum were rubbilized when the detonations took place. Thus there was considerable dust present. Although not a potential for further damage to the package, this did create an industrial hazard that was managed safely.

Figure 4 – 3013 S000995 Removed from the ES-3100

Conclusions

The ES-3100 was successfully tested and the 3013 remained leaktight after testing. This will allow the ES-3100 to be considered for inclusion as a storage package in the facility DSA. Performance of this testing at GTI allowed SRNL to develop a new partnership with a testing facility that can perform tests of this nature in the future. SRNL along with GTI has the knowledge base, ability, and now a suitable location to perform destructive tests on packagings to determine their ability to withstand impacts that could be caused by various impetuses.