Facility: All (EM and NNSA)

Best Practice Title: Flexible Packaging: Effective Design, Selection, and Use for Management of Low-Level Radioactive Waste (LLW) and Components

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Brief Description of Best Practice: When properly selected and used, flexible packaging (sometimes referred to as 'super-sacks' or SCO wraps) can provide an effective alternative to traditional rigid steel or wooden boxes for radioactive waste storage, transport and disposal.

Why the best practice was used: Flexible packaging provides an economical alternative to the use of rigid packaging that is compliant with transportation regulations and disposal site waste acceptance criteria. The packaging itself is of lower cost than the rigid alternative and mobilization costs for flexible packaging are negligible in comparison to those for rigid packaging. Typically, costs for the flexible packaging are roughly equal to the mobilization cost for an intermodal container and the daily rent of $11-$15 per day, and the cost of an inbound survey is avoided. Costs for flexible packaging are typically less than 25% the cost of a metal B-25 container, and mobilization/delivery costs of the flexible packaging are negligible in comparison. However, the considerations for the design, selection, and use of flexible packaging can be different from those considerations for rigid packaging. Thoughtful evaluation of packaging design and use factors is an important aspect of waste management best practice, and is necessary to assure the success of individual waste disposal campaigns. Proper selection of packaging materials should be based on the following criteria:

- Exterior fabric (weight, strength, finish);
- Liner (puncture strength, permeability);
- Lifting Straps (tensile strength); and
- Thread (compatibility with fabrics).

What are the benefits of the best practice: Flexible packaging has been in use for the packaging and transport of DOE and commercial waste for 15+ years, and has been demonstrated to be effective for this purpose. Users of this technology who follow best practices for design, selection, and use will benefit from the proven performance of this technology. The primary benefits include lower purchase cost, ease of use, reduced procurement time, and simplified logistics.

What problems/issues were associated with the best practice: End users are prone to use flexible packaging in lieu of rigid packaging without fully considering adjustments to waste management procedures that may be necessary to reflect the unique performance characteristics of each packaging type. As with any packaging, it is important to match the performance of flexible packaging to be compatible with the materials being shipped and the mode of transport. When using flexible packaging, waste managers must consider: 1) the physical and chemical profile/matrix of material being shipped; 2) equipment available to support package filling and loading onto transport vehicles; 3) transportation mode; 4) DOT
design and certification requirements for packaging material; 5) pre-shipment handling and storage practices; and 6) manufacturer's instructions and recommendations for use.

Flexible packaging is readily applicable to flowable, soil-like materials. Additional liners (generally a “pad” or liner of non-woven geo-textile fabric may be needed if the waste includes debris or sharp-edged material. The available lifting equipment and mode of transportation may influence the choice of a package that is lifted with integral straps or the use of a package without lifting features that requires a pallet or similar accessory. One-piece packages of a bag-like construction are suitable for top loading bulk materials. Rigid objects may require a two-piece 'inverted shoebox' design where the object is easily loaded onto a shallow pan and then covered with a larger top piece. Non-woven water-resistant liners can also be used to provide additional containment assurance for higher moisture content materials; however, users must be aware that flexible packages are not designed to contain free liquids or withstand hydrostatic pressure of any kind.

Flexible packages have been demonstrated to meet both the DOT IP-1 packaging standard and the more rigorous IP-2 standard requiring drop and stack testing. The packages can also be certified to meet the requirements of 49 CFR 173 240(c) required for hazardous materials in packing groups II and III. The certification and test requirements for flexible packaging are identical to those for rigid packaging. Design and manufacture of DOT-rated packages requires a quality assurance program meeting the requirements of DOT 49 CFR 173-474, and an NQA-1 program is the generally accepted standard for demonstrating that the QA requirement is met.

How the success of the Best Practice was measured: The success of this Practice is demonstrated by the reduction in the need to repackage materials before shipment (i.e. to address incidental package failures/punctures, or external contamination due to improper storage). Success for this Practice may also be measured by a reduction in transportation incidents (non-compliant transportation), and a reduction in waste package rejection upon receipt at the disposal site (owing to contamination issues or visual inspection issues).

End users accustomed to rigid packages must be aware that flexible packages are subject to UV degradation after extended periods of exposure during outdoor storage. Tarps or other secondary covers can be used to address this issue. Also, unlike rigid packages that typically sit on fork pockets or ISO corners, the entire bottom surface of a flexible package contacts the surface on which it is stored or transported. Care must be taken that this surface does not promote cross contamination and does not accumulate water. Like rigid packages, flexible packages must be properly closed and secured in accordance with the manufacturer's instructions, so that rainwater has no intrusion path into the packaged waste.

Description of process experience using the Best Practice: Consistent application of these principles for proper design, selection, and use of flexible packaging has provided many DOE sites with incident-free performance with this type of packaging. Their application has also been demonstrated as an effective corrective action remedy for sites and shipping campaigns where non-conformances have occurred. Soft-sided packaging has proven to be a cost-effective and reliable alternative to traditional wood and metal packaging in a wide variety of LLW transportation and disposal situations, as demonstrated on the following projects:
EFCOG Best Practice #136

- Savannah River DUO Drum Project (SRNS) – 2,400 IP-1 4-drum overpacks (SPS) to Nevada national Security Site (NNSS) with no issues;
- Berkeley Bevatron D&D (PermaFix, EnergySolutions) – over 1,200 9-ycd IP-1 bags (SPS) to NNSS with no issues;
- Argonne Bldg. 330 D&D (EnergX) – over 1,300 9-ycd IP-1 bags (SPS) to NNSS with no issues;
- Los Alamos remediation (EnergySolutions) – over 1,500 9-ycd IP-1 bags (PACTEC) to Clive with no issues;
- B&W Y-12 – 2,000 bags (PACTEC) to Oak Ridge onsite disposal cell with no issues;
- NNSS Environmental Restoration projects – 835 bags (PACTEC) and 200 burrito bags to Area 5 disposal site with no issues; and
- West Valley Demonstration Project – 3,100 IP-2 6-drum overpacks (MHF) shipped in rail gondola cars and transferred to trucks to NNSS with no issues.

Conclusion/Summary: Based upon the summary review conducted by the EFCOG P&T Trailer Contamination & Supersack Integrity Team, the following basic observations led to the overall conclusion that soft-siding packaging is appropriate for use during LLW management and disposal –subject to the proper conditions of use and handling:

- There has been a successful history of soft-sided packaging use for over 15 years in LLW management applications;
- Multiple vendors and customer users have reported consistent satisfactory performance during multiple applications;
- Soft-sided packaging provides viable, cost-effective alternatives to use of wooden and metal containers;
- Packaging must be appropriate for the LLW content/media being managed under controlled environmental conditions;
- Compliance with manufacturer storage, handling, filling, lifting, and related instructions is essential to ensure proper packaging performance;
- Consistent training of site operations personnel to manufacturer requirements will ensure maximum packaging performance;
- Filled waste packages must be staged and stored properly to minimize water intrusion and structural integrity

References: EFCOG WMWG Report to EM-30 dated September 17, 2012, entitled “Evaluation of Recent Trailer Contamination and Supersack Integrity Issues”

Presentation by Al Beale to EFCOG WMWG Packaging & Transportation Subgroup Workshop on June 15, 2012 (included as Attachment O to above Report dated September 17, 2012)
October 4, 2012

Ms. Christine Gelles, Associate Deputy Assistant Secretary
Office of Waste Management,
Office of Environmental Management (EM-30)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

SUBJECT: Evaluation of Recent Trailer Contamination & Supersack Integrity Issues

Dear Ms. Gelles,

Attached is the Energy Facility Contractors Group (EFCOG) Waste Management Working Group’s team report of the results from our evaluation of recent trailer contamination and Supersack integrity issues related to shipments of low-level and mixed radioactive wastes from DOE sites for disposal. Also attached is a list of the team members who participated in this analysis. This team evaluation was conducted in response to the request you made during the December 2011 Low-level Waste Corporate Board meeting in Nashville, TN. Per your request, the primary objectives of the evaluation were to identify and critique recent incidents, to trend any observed cause and effect issues, and to provide recommendations regarding changes in DOE site operations that would mitigate the future occurrence of the same or similar incidents.

This review effort was performed by team members selected from EFCOG member companies based upon their technical and/or managerial experience and direct involvement with the incidents of interest (see attached list). Representatives from the affected DOE waste generating sites, waste disposal facilities (Nevada National Security Site and Clive Utah site), and private industry (soft-sided packaging vendors) participated in this effort. Also, this evaluation was conducted in cooperation and coordination with another ongoing EFCOG team evaluation involving the application of appropriate radiological limits for the release of contaminated property and equipment, including commercial transport vehicles, from DOE sites.

As a result of the evaluations conducted during this evaluation, several recommendations were developed to prevent or minimize the recurrence of similar incidents in the future, and these suggestions are included for review and consideration by DOE. The team members are prepared to support future efforts, if requested, by conducting additional reviews, providing assistance in implementing selected recommendations, or other actions on a complex-wide basis. Please share this report with other individuals and organizations, as appropriate, and advise me if follow-up actions are desired. Questions regarding this report should be directed to either me at wtgoldston@energysolutions.com or Team Lead, Sydney Gordon, at gordonsj@nv.doe.gov.

Sincerely,

W. T. Goldston, Chair
EFCOG Waste Management Working Group

Attachments
EFCOG Waste Management Working Group

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- Robert Black, Battelle Energy Alliance/Idaho
- Sydney Gordon, NSTec/NNSS (Team Lead)
- John McCoy, Fluor-B&W/Portsmouth
- Travis Myers, CH2M*Washington Group-Idaho
- Danny Nichols, Fluor-B&W/Portsmouth
- Jim Portsmouth, CHPRC/Hanford
- Dan Shrum, EnergySolutions-Clive
- Don Wadsworth, New World Environmental
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- Al Beale (Strategic Packaging Systems)
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- Trey Bullinger (PACTEC)
- Gus Chirgott (ICE Service Group)
- Rich Defeuter (CAST Transportation)
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- Steve O'Connor, EM-33
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Evaluation of Recent Trailer Contamination and Supersack Integrity Issues

by

EFCOG Waste Management Working Group

September 17, 2012

Preparer: 
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National Security Technologies, LLC

EFCOG Reviewer: 
G. H. Portsmouth Date: 9-19-2012
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B. Free Release Limits

C. Carl Gertz Letter

D. Summary of ES/Clive Incidents
E. PermaFix Corrective Action plan

F. LATA-Parallax Portsmouth Corrective Action Plan

G. Fluor-B&W Portsmouth Corrective Action Plan

H. Battelle Energy Alliance INL Corrective Action Plan

J. Los Alamos National Security Corrective Action Plan

K. George Henckel (LASO) Presentation

L. List of Soft-sided Packaging Vendors & Participants

M. Presentation by Tim Blythe at 2012 NNSS Generator Workshop

N. Letter from Al Beale, SPS

O. Presentation by Al Beale at 2012 CTMA Workshop

P. PACTEC Testing Summary

I. Statement of Issues and Executive Summary

1.1 Identification of Issues

Recent incidents involving receipt of contaminated transportation vehicles and waste packages at DOE sites have resulted in the retention of transport equipment for the purpose of decontamination to achieve the free-release levels specified in 10 CFR 835, Appendix D. This has resulted in delays for generator shipment campaigns and formal requests for corrective action. In addition, commercial transport trailers have been effectively taken out of service in order to complete decontamination activities - at both generator and disposal sites.

Recent incidents involving detection of radiological contamination on the exterior of soft-sided waste packages and trailers on which these packages were transported for disposal have raised potential concerns regarding the integrity of soft-sided packaging and its continued use for storing and/or transporting low-level and mixed wastes.

1.2 Executive Summary

During the period from FY 2009 through FY 2011, there were a total of 21 incidents involving radioactively-contaminated shipment trailers and nine (9) contaminated waste packages received at the Nevada National Security Site (NNSS) Area 5 Radioactive Waste Management Site (RWMS). During this time period, the EnergySolutions (ES)
Clive, UT, disposal facility had a total of 18 similar incidents involving trailer and package contamination issues.

As a result of the increased occurrence of such incidents, DOE Environmental Management Headquarters (EM/HQ) Waste Management organization (EM-30) requested that EFCOG Waste Management Working Group (WMWG) conduct a detailed review of these incidents and report back to EM-30 regarding the results of this review, including providing any recommendations formulated as a result of the evaluation of current site practices involving handling and management of radioactive material and waste shipments.

In recognition of the fact that trailer contamination incidents at the NNSS have caused some commercial equipment to be held (or required to be returned) for decontamination, resulting in significant project cost and schedule impacts, EM-30 also requested that WMWG conduct a parallel review of the current disparity between equipment free-release limits (for radiological contamination) specified by the US Department of Transportation (DOT) in 49 CFR 173-178 versus lower limits specified for DOE sites in 10 CFR 835, Appendix D.

The WMWG implemented these requests by identifying and forming two evaluation teams comprised of WMWG member company representatives:

- **Trailer Contamination and Supersack Integrity Team** – this team was formed under the leadership of Sydney Gordon (NNSS/NSTec) and contained representatives from Nevada (NNSS/NSTec), Idaho (CH2M*Washington Group and Battelle Energy Alliance), Los Alamos National Laboratory (LANS), Portsmouth (Fluor-B&W), EnergySolutions (Clive and Oak Ridge), Hanford (CHPRC, Cavanagh Services), New World Environmental, and sponsors from EM-33 and NNSA (NA-173). Substantial participation by and inputs from representative manufacturers of soft-sided packaging also contributed to the efforts of this Team. See Attachment A for a summary of Team members and subject matter experts.

- **DOE versus DOT Surface Contamination Limits Team** – this team was formed under the leadership of Jim Portsmouth and Mike Waters (Hanford) and contains representatives from NNSS (NSTec), Idaho (CH2M*Washington Group), Los Alamos National Laboratory (LANS), Portsmouth (Fluor-B&W), ES (Clive and Oak Ridge), and NNSA/NA-174, New World Environmental, DOE HSS-11, with sponsors from EM-33.

This report presents the observations and recommendations produced as a result of Trailer Contamination and Supersack Integrity Team’s inquiry. During the course of this evaluation, it became apparent that the primary factor leading to retention (and subsequent requirements for decontamination prior to release) of contaminated trailers at the NNSS is the inherent difference between the DOE and DOT radiological free-release limits for surface contamination. This apparent conflict of requirements is being evaluated by the DOE versus DOT Surface Contamination Limits Team in order to arrive
at what will become a mutually-acceptable resolution that minimizes or prevents future incidents of this type. A description of the relevant issues and requirements for the DOE versus DOT Surface Contamination Limits Team is summarized in the presentation made during the EFCOG WMWG Packaging and Transportation Subgroup Meeting held following the CTMA Workshop in Reno, NV (see Attachment B).

During the course of the Trailer Contamination & Supersack Integrity Team’s evaluation, a total of three formal meetings were held: the first was in conjunction with the EFCOG WMWG session during Waste Management 2012 (Phoenix, AZ, March 1, 2012); the second was in conjunction with the NNSS Generator Workshop (Las Vegas, NV, April 24, 2012); and the third was in conjunction with the Contractor Transportation Management Association (CTMA) Workshop (Reno, NV, June 15, 2012). Additional team communication was conducted by E-mail and telephone.

The primary observations made by the Trailer Contamination & Supersack Integrity Team include the following:

1. Recent trailer contamination incidents at the NNSS have resulted primarily from legacy radiological contamination (which exceeds the limits allowed by 10 CFR 835, Appendix D) on commercial trailers that were used to transport waste packages to the NNSS.
2. The NNSS Waste Acceptance Criteria specify that external contamination levels for waste packages and transport vehicles shall meet the limits specified in 10 CFR 835, Appendix D, and the NNSS is constrained from releasing any transport vehicles back into commercial use if the outgoing radiological surveys detect contamination levels above these limits.
3. No issues were observed with regard to release of radiological waste materials from packages and subsequent contamination of transport trailers being used to ship wastes to the NNSS for disposal.
4. No issues were observed at the NNSS involving the failure of soft-sided packaging used to transport radioactive wastes.
5. Legacy contamination observed during outgoing NNSS trailer surveys could not be identified uniquely with any DOE site and, in selected cases, the trailers were found to have been in use at multiple DOE sites prior to being retained for decontamination at NNSS.
6. The ES/Clive disposal facility has had two documented situations where external trailer contamination levels exceeded DOT free-release limits; however, neither shipment was from a DOE site. In such cases, ES/Clive performs all decontamination prior to the release of transport equipment.
7. Approximately one-third of the radiological contamination and container integrity issues (total of 18) at ES/Clive during the three-year period being reviewed were associated with DOE waste shipments, and approximately 30% (total of six issues) involved the integrity of Supersack packaging.
The primary conclusions developed by the Trailer Contamination and Supersack Integrity Team include the following:

1. The recent increase in trailer contamination incidents is due in large part to the application of lower DOE free-release standards to a population of transport equipment that has been used at multiple DOE sites and is subject to legacy contamination that was not detected and addressed at the time the equipment was released from those DOE sites.

2. In the event the DOE and DOT free-release limits can be brought into closer harmony, this will reduce not only the number of transport equipment holds at the NNSS but also the need for subsequent decontamination to meet a more stringent release standard – including avoidance of significant costs for retention of equipment and decontamination services.

3. Implementation of stricter and more extensive radiological surveys of transporter equipment prior to loading waste packages and prior to the release of waste shipments will identify in advance situations involving legacy contamination that may warrant future decontamination activity. This will also assist transporters in identifying equipment that may be at risk and determining the probable sources of any such contamination.

4. Soft-sided packaging has been used successfully for transporting low-level radioactive waste (LLW) over a period of 15+ years. When the proper type of packaging material is used for the waste matrix, storage and transport conditions, and the manufacturer’s use instructions are followed as a result of site-specific training, soft-sided packaging has proved to be a viable and cost-effective alternative for managing LLW.

5. Improper closure or storage of filled Supersacks without adequate use of absorbents or regard for weather protection may result in water intrusion to the waste package and subsequent release of fluid onto storage or transport equipment surfaces.

Based on observations and assessments, the Trailer Contamination and Supersack Integrity Team has developed the following recommendations in order to minimize future occurrences of similar issues at DOE sites. It is recommended that EM, working in coordination with NNSA and other Program Offices, implement these practices on a Complex-wide basis.

1. Develop and implement consistent performance standards for radiological surveys on radioactive material packaging and transport equipment when either enters or exits a DOE-controlled site. It is important that waste generators perform comprehensive surveys on empty transporter equipment prior to loading waste packages. Provide guidance to improve large area survey techniques to ensure that legacy or new contamination is identified, quantified, and documented in a timely manner. This should include specification of appropriate
survey techniques, equipment and operating procedures that will offer efficient and accurate results from one site/location to another.

2. Establish and promulgate a more consistent set of contamination limits that would apply to the release of radioactive material packaging or transport equipment from a DOE-controlled location. (This Recommendation is directly related to the efforts being undertaken by the DOE versus DOT Surface Contamination Limits Team. Actual contamination measurements and determination should be accomplished using the consistent performance standards established under Recommendation Number 1 above.

3. Establish and distribute a Lessons Learned guidance document that addresses the proper selection, handling, control, and protection of soft-sided packaging used for LLW management, storage and disposal applications.

4. Establish a reliable and consistent method for ensuring contractor oversight of Complex-wide radiological survey capabilities and the proper utilization of soft-sided packaging for LLW management activities. Program oversight is a prime contractor responsibility and the goal of having clear survey performance specifications will be to ensure consistency between DOE sites as far as contractor oversight and self-assessment. DOE O. 458.1 clearly indicates that "DOE Field Element Managers responsible for oversight of clearance processes must implement oversight duties to verify that the contractor assurance program is ensuring that the applicable radiological clearance requirements have been met".

II. Team Communications

During the Trailer Contamination and Supersack Integrity Team’s evaluation, a total of three formal meetings were held:

- the first was in conjunction with the EFCOG WMWG session during Waste Management 2012 (Phoenix, AZ, March 1, 2012) – this served as a kickoff meeting and initial discussion among team members of the goals and objectives for the evaluation to be conducted;
- the second was in conjunction with the NNSS Generator Workshop (Las Vegas, NV, April 24, 2012) – this included a presentation and discussion of the preliminary trailer contamination findings and a detailed description of soft-sided packaging manufacturing and usage; and
- the third was in conjunction with the Contractor Transportation Management Association Workshop (Reno, NV, June 15, 2012) – this discussion focused primarily on the summary results of the inquiry, the format and content for the Team report, and the development of recommendations for presentation to EM/HQ.

Additional team communications were conducted by E-mail and telephone. Background information and team member inputs were circulated for comment and
discussion, and a draft of this report was distributed for team review, comment, and concurrence.

III. NNSS Waste Acceptance and Free Release Requirements

Waste generators who are approved to ship to the NNSS for disposal must meet a strict set of requirements for waste acceptance (NNSS Waste Acceptance Criteria, DOE/NV—325-Rev. 9), applicable DOT requirements during actual transportation, and DOE free-release criteria (10CFR 835, Appendix D) prior to release of transporter vehicles and equipment following waste off-loading for burial. Waste shipments must be refused by NNSS if determined to be non-compliant for any reason. In addition, the NNSS WAC contains other requirements related to shipment scheduling, advance notifications, preferred route selection, criticality safety, special handling for higher-dose levels, packaging, and marking.

With regard to the free release of waste packages and transporter equipment (vehicles and trailers), the NNSS Radiological Control Manual (DOE/NV/25946--801, Revision 2) imposes the surface contamination restrictions contained in 10 CFR 835, Appendix D (see Attachment B for detailed requirements). These limits have been in place since 1998 and were communicated to waste generators in a letter from the Nevada Site Office Assistant Manager for Environmental Management, Carl Gertz, dated August 19, 1998 (see Attachment C). During the actual physical transport of radioactive wastes, commercial carriers are subject to the DOT requirements in 49 CFR 173.443/715/843 (see Attachment B for detailed requirements).

However, there is a disparity between the free release contamination limits specified in 10 CFR 835 versus those in 49 CFR 173 (see Attachment B for a comparison). The contamination limits in 10 CFR 835, Appendix D are more conservative than those in 49 CFR 173. This has led to situations at the NNSS where transporter equipment could not be released after waste unloading – even if it met 49 CFR 173 contamination limits – unless the equipment could be manifested as “rad empty” or decontaminated to a level meeting the 10 CFR 835, Appendix D limits.

IV. Description of Relevant Incidents (FY 2009 to FY 2011)

Prior to FY 2009, there were isolated and intermittent incidents at the NNSS involving radiological contamination on either waste packages or transport vehicles and, in most cases, the contamination was due to leaking/damaged packaging. In these instances, NNSS issued specific Corrective Action Requests and the waste generators took incident-specific action to correct the problems. There were only sporadic situations where NNSS was unable to release transport equipment due to external contamination, and NNSS personnel provided decontamination services.

During the period of study undertaken as part of the Trailer Contamination and Supersack Integrity Team evaluation (FY 2009 through FY 2011), the rate of such
contamination incidents increased substantially; however, the failure of waste packaging integrity was not apparent as the source of the contamination. In addition to the increased number of contaminated transport vehicles, the nature of the contamination also changed and it became more difficult to decontaminate the affected items.

As a result of the increased occurrence of such incidents, DOE Environmental Management Headquarters (EM/HQ) Waste Management (EM-30) requested that the EFCOG Waste Management Working Group (WMWG) conduct a detailed review of these incidents and report back to EM-30 regarding the results of this review, including providing any recommendations formulated as a result of the evaluation of current site practices involving handling and management of radioactive material and waste shipments. The WMWG identified and tasked the Trailer Contamination and Supersack Integrity Team (membership and affiliations are shown in Attachment A). These incidents are documented in the following section of this report – grouped in accordance with the waste site of origin.

From FY 2009 though FY 2011, there were a total of 21 incidents involving radiologically-contaminated shipment trailers and nine (9) contaminated waste packages received at the Nevada National Security Site (NNS) Area 5 Radioactive Waste Management Site (RWMS). During this time period, the EnergySolutions (ES) Clive, UT, disposal facility had a total of 18 similar incidents involving trailer and/or package contamination issues (see Attachment D for a summary of ES/Clive incidents and their internal assessment).

4.1 Incidents Involving Shipments from PermaFix Environmental Services

In October 2008, three shipments of mixed LLW debris grouted into nine boxes were received from the PermaFix Northwest facility in Washington (adjacent to the Hanford Reservation). Although no contamination was detected on the tractors or trailers, several waste packages were found to be contaminated with weapons-grade plutonium at levels exceeding the 10 CFR 835, Appendix D limits. All waste boxes were returned to PermaFix NW for evaluation.

PermaFix subsequently determined that the presence of external contamination was due to limited access to the underside of the boxes during the final radiological surveys prior to release for shipment. Corrective action taken by PermaFix included revision of site package handling procedures to permit greater access to the underside of boxes during final survey. No further contamination issues arose during this waste campaign. See Attachment E for detail regarding the PermaFix Corrective Action Plan.

4.2 Incidents Involving Shipments from LATA-Parallax Portsmouth
In December 2010, a total of 47 shipments containing uranium metal waste from the Portsmouth facility were shipped by LATA-Parallax as part of a larger shipment campaign. Two of these trailers failed to meet the NNSS free-release survey. Generator personnel travelled to the NNSS and verified that contamination was isolated to small areas near the centerline of the trailer flooring. These two trailers were returned to Portsmouth as “rad empty” for evaluation and corrective action.

LATA-Parallax determined that the root cause involved legacy contamination on the exterior of the waste boxes (which had been packaged at Fernald and stored at Portsmouth for some time) that had somehow been transferred to the trailer flooring. No excess contamination had been measured while the boxes were in lengthy storage. Corrective actions taken at Portsmouth included the following:

- Implementation of an engineered racking system to permit enhanced visual and radiological surveys of the container bottom surfaces;
- Enhanced oversight of both pre-loading and pre-shipment vehicle surveys; and
- Comprehensive re-survey of both loaded and empty trailers staged at Portsmouth which involved enhanced large area swipe surveys on all accessible areas of the boxes.

See Attachment F for detail regarding the LATA-Parallax Corrective Action Plan.

4.3 Incidents Involving Shipments from Fluor-B&W Portsmouth

In March 2011, a group of 35 shipments (involving the same type of waste boxes as those shipped by LATA-Parallax) were received from Fluor-B&W after the end of the contract transition from LATA-Parallax. Two trailers failed to meet the NNSS free-release criteria and they were returned to Portsmouth for evaluation. It was later determined that the contamination at issue was limited to a small (two foot square) area on each trailer floor within the loading footprint of the waste boxed that had been shipped. In addition, the re-survey of other trailers staged at Portsmouth for shipment resulted in identification of one additional case of similar external contamination.

As part of its corrective action process, Fluor-B&W evaluated multiple potential root causes — including vibration loss of material from the waste boxes during transit, legacy contamination on the boxes or trailers, and legacy particle contamination that was not detectable due to the type and rigor of release surveys conducted prior to shipment. No single factor was ruled out. In addition, Fluor-B&W utilized an independent Certified Health Physicist to conduct an assessment of site radiation control processes and procedures.
Corrective actions taken by Fluor-B&W at Portsmouth included the following:

- Revision of onsite survey procedures to include a 10% independent verification;
- Implementation of a tacky roller approach to enhance large area swipes on trailer floors and outer surfaces;
- Re-wrapping of remaining waste boxes with clear stretch wrap; and
- Specification that transporters provide “new” trailers (those not having been used previously on a DOE site) for transport of the remaining shipments.

Lessons learned as a result of the corrective action process included increased emphasis on transport trailer history and trending, introduction of independent oversight for radiological survey activities, and enhanced trailer bed surveys using large area floor monitors. See Attachment G for detail regarding the Fluor-B&W Corrective Action Plan.

4.4 Incidents Involving Shipments from Idaho National Laboratory

In August 2011, a shipment consisting of one cargo container and 10 boxes was received from Battelle Energy Alliance (BEA) at the NNSS. After unloading, the trailer was surveyed and contamination was detected above DOE free-release limits in the middle area of the wooden trailer bed. However, no external contamination was found on the waste packages. NNSS was requested to perform the decontamination services, which resulted in extensive activities – including removal of wood flooring and physical scouring of accessible metal surfaces.

During the corrective action planning process, BEA identified the following potential causal factors:

- Trailer release surveys were performed as spot surveys on less than 100% of the accessible load-bearing areas,
- No incoming survey was performed on the trailer upon arrival at the site and only a limited survey was conducted prior to waste loading, and
- Review of site procedures indicated that radiological survey guidance was in general not adequate to ensure consistency.

After completion of the corrective action planning process, BEA issued enhanced survey requirements (100% coverage of accessible areas) and revised applicable site procedures for radiation control and waste generator services functions. See Attachment H for detail regarding the BEA Corrective Action Plan.

4.5 Incidents Involving Shipments from Los Alamos National Laboratory
In September 2011, Los Alamos was shipping debris in Supersacks to NNSS as part of a large ARRA-funded campaign. Over 200 shipments containing more than 700 bags had been received without incident when trailers started to fail the NNSS free-release survey after being unloaded. However, no external contamination was observed on the bags that were off-loaded. A total of 13 flatbed trailers were subsequently held at NNSS for decontamination. Los Alamos personnel visited the NNSS after the second failure in order to evaluate the issue, and shipments were self-suspended in order to determine appropriate corrective action.

LANL subsequently made several shipments of Supersacks to ES/Clive and surface contamination was observed on three of the bags prior to disposal. The following details were provided with regard to those shipments:

- The bags were extensively surveyed at LANL before being loaded on the truck and were known to not have external contamination when loaded.
- One bag was placed on clean plastic on the trailer, another on clean plywood, and the third directly on the trailer which was extensively surveyed and known not to be contaminated.
- All three bags had surface contamination when they arrived at Clive. All three surfaces which were clean at the time of shipment were contaminated when they arrived at ES/Clive.

Causal analysis was conducted in accordance with LANL Procedure P322-1. The corrective action evaluation conducted by LANL identified the following causal factors:

- Packages were not stored in accordance with requirements in the NNSS WAC, Section 3.2.10 and Section 5.5 – although packages were stored in a secure location, they were stored outside without any additional protection from rain and snow;
- LANL personnel performed package closures in accordance with vendor instructions but did not consistently secure the weather protection flaps (after bags were filled) – improper closure was also noticed by NNSS Disposal Operations personnel during unloading activities;
- During periods of heavy rainfall, the plastic on which filled bags were staged inhibited water runoff and caused water to pool around the bottom of packages;
- Localized areas of standing water potentially penetrated the packages to create conditions that allowed radioactive contamination to migrate through the external bag surfaces during extended transport;
- Although contamination was detected on the outside of several packages received at ES/Clive, including discoloration along several package seams, no visual indications of package breaches were identified during inspection;
- Trailer surveys were limited by lack of physical access for survey personnel to the center portion of the trailer bed – resulting in unsurveyed areas along the centerline which could not be ruled out as having detectable contamination, and
- Procedural inconsistencies were noted with regard to radiological surveys of loaded shipments and no surveys were performed on empty trailers upon receipt at the loading area.

In response to these factors, LANL implemented the following corrective actions:

- All remaining and newly-filled waste packages (including unused bags) were relocated to secure areas with protection from adverse weather - including storage on pallets, inside covered facilities, or under tarpaulins;
- Waste Certification Official surveillance requirements were expanded to include evaluation of package storage adequacy;
- Detailed radiological surveys were implemented on packages and trailers prior to loading waste to verify that any exterior contamination is within limits allowed by NNSS;
- Enhanced 100% survey procedures were implemented for all accessible load surfaces (including trailer centerlines) prior to vehicle entry to a controlled area, package loading, and shipment release for transport; and
- LANL conducted and documented training of project operations personnel to the enhanced package storage and survey procedures.

See Attachment J for detail regarding the LANL Corrective Action Plan. Attachment K contains a copy of a presentation made at the NNSS Generator Workshop which summarizes the Lessons Learned as a result of the LANL trailer contamination incidents.

NNSS personnel performed decontamination services on the 13 trailers that failed free-release survey limits. In some cases, the decontamination activity required multiple and repeated steps in order to achieve final survey results. This resulted in additional costs and extensive delays to the ARRA-funded campaign. Los Alamos responded by deciding to provide onsite disposal for the remaining waste packages.

V. Assessment of Integrity for Soft-sided Packaging

In view of the potential for external contamination of soft-sided packages (which was evaluated by Los Alamos as a possible causal factor during development of their Corrective Action Plan), the Trailer Contamination and Supersack Integrity Team was requested to consider the inherent capabilities and limitations associated with soft-sided packaging. The Team reviewed the recent history for DOE site use of this type of packaging and also considered the potential for packaging failure as a contributing factor in the specific trailer contamination incidents described in Section
II, above. During this process, relevant material and production information was requested from several commercial vendors who specialize in providing soft-sided packaging that has been used for DOE LLW management and disposal applications – see Attachment L for a list of the firms and individuals who responded to the Trailer Contamination and Supersack Integrity Team’s requests for information regarding soft-sided packaging material, applications, performance, and testing.

5.1 Background and Description for Soft-sided Packaging

For the purposes of this inquiry, "soft-sided packaging" refers to a DOT-compliant container (e.g., bag, liner, Supersack, etc.) as defined in 49CFR173.410 & 411 and includes both IP-1 and IP-2 rated containers which are manufactured from polypropylene, polyethylene or similar materials and which range from five to nine cubic yards (135 to 243 cubic feet) in capacity.

Soft-sided packaging was introduced to the radioactive waste management industry over 15 years ago. Since then, many thousands of these packages have been sold and used in the United States in both commercial nuclear and government waste management applications. Soft-sided packaging is manufactured and supplied by multiple vendors, all of which have reported consistent successful results. Based upon the Trailer Contamination and Supersack Integrity Team’s review of available literature, there has not been a single documented case of soft-sided package failure during transport that has resulted in a release of radioactive material.

Soft-sided packaging is constructed from engineered plastics that repel and resist water intrusion under normal circumstances; however, these packages are not inherently water-proof. These packages have been shipped successfully in closed van trailers, flatbed trailers, and in the more demanding environment of railroad gondola cars. There storage requirements for waste boxes and metal drums apply equally to soft-sided packaging, with the addition of protection from long-term ultraviolet radiation exposure. For additional detail regarding the manufacture and past performance of soft-sided packaging, see the presentation made by Tim Blythe and Gus Chirgot at the 2012 NNSS Generator Workshop (in Attachment M), the letter received from Strategic Packaging Systems (in Attachment N), and the presentation made by Al Beale at the DOE Packaging Management Council meeting held during the June 2012 CTMA Workshop (in Attachment O).

5.2 Successful Utilization of Soft-sided Packaging

Soft-sided packaging has proved to be a cost-effective and reliable alternative to traditional wood and metal packaging in a wide variety of LLW transportation and disposal situations, as demonstrated on the following projects:

- Savannah River DUO Drum Project (SRNS) – 2,400 IP-1 4-drum overpacks (SPS) to NNSS with no issues;
- Berkeley Bevatron D&D (PermaFix, EnergySolutions) – over 1,200 9-yd IP-1 bags (SPS) to NNSS with no issues;

- Argonne Bldg 330 D&D (EnergX) – over 1,300 9-yd IP-1 bags (SPS) to NNSS with no issues;

- Los Alamos Remediation (EnergySolutions) – over 1,500 9-yd IP-1 bags (PACTEC) to Clive with no issues;

- SPRU Remediation (EnergySolutions) – over 3,000 9-yd IP-1 bags (PACTEC) to Clive with only one minor issue. [SPRU was storing the bags for a while onsite before shipping. The bags were freezing into a block and, when they picked the bags up, the straps were not straight vertically and they were pulled out away from the top of the bag. This was put a tremendous amount of stress on the stitching around the zipper, and it was the thread that was breaking. PACTEC worked with SPRU contractors and DOE to fix this problem and wrote a protocol which specified removal of the straps from the “belt loops” around the top of the bag before lifting. This fixed the problem. Even though some bags did come open because of the broken stitching, the duffle served as an interior closure and there was no release of material];

- B&W Y-12 – 2,000 bags (PACTEC) to Oak Ridge onsite disposal cell with no issues;

- NNSS Environmental Restoration Projects – 835 lift-liners (PACTEC) and 200 burrito bags to Area 5 disposal site with no issues; and

- West Valley Demonstration Project – 3,100 IP-2 6-drum overpacks (MHF) shipped in rail gondola cars and transloaded to trucks to NNSS with no issues.

5.3 Historical Use – Best Practices

Based upon industry inputs, the following Best Practices have been identified with regard to the proper use of soft-sided packaging:

- Use packaging appropriate for the waste matrix and content;
- Consider hydrostatic pressure effects on bags containing soil-like waste with moisture content > 25%;
- Incorporate light polyethylene liner and approved absorbent media to control moisture content;
- Adjust lifting straps for load shift or deformation, as required;
- Use common sense when loading/closing/lifting/storing flexible material;
- Do not stage or store filled bags in areas of poor water drainage or pooling;
- Provide protection from precipitation for both empty and filled bags to prevent water intrusion;
- Train user personnel to manufacturer's use/care instructions; and
- Monitor dust suppression during bag fill and closure operations to minimize water intrusion.

5.4 Recent Incidents at NNSS and Clive

Evaluation of recent incidents involving receipt of LANL debris wastes in Supersacks at both NNSS and ES/Clive resulted in the following observations:
- Over 200 shipments (containing more than 700 bags) were received at NNSS with no issues;
- A total of 13 trailers failed to meet DOE free-release survey limits and were subsequently decontaminated by NNSS;
- No external contamination was found on bags off-loaded at NNSS;
- Later shipments of Supersacks to ES/Clive had both trailer and bag contamination issues;
- LANL implemented effective corrective actions (see Attachment J for specific actions and Attachment K for Lessons Learned);
- All waste packages were relocated to a secure area with adequate weather protection;
- LANL performed enhanced surveys of incoming trailers and waste packages prior to loading – including a 100% survey on all accessible load-bearing surfaces; and
- LANL provided and documented additional package-specific training given to operations personnel - including detail on revised procedures.

5.5 Integrity Factors Identified and Examined

The Trailer Contamination and Supersack Integrity Team members examined a wide range of factors that would affect the integrity for soft-sided packaging, based upon past project experience. The following factors were identified as those being relevant to successful performance of the soft-sided packaging:
- Inadequate staging/storage of filled bags at generator site can result in packaging failure;
- Potential water intrusion or pressure release effects may result in external contamination or release of waste;
- Inadequate closure of filled bags (per manufacturer instructions) may result in water intrusion;
- Use adequate absorbent media and inner liner to address moisture content factors;
- Monitor moisture content to mitigate effects due to excessive dust suppression;
- Evaluate potential for lifting stress due to bag deformation (e.g., frozen water content or load shifting); and
• Utilize standardized testing for compliance with IP-1/IP-2 specifications – see Attachment P for an example of vendor testing results.

5.6 Conclusion – Integrity of Soft-sided Packaging

Based upon the summary review conducted by all participants, the following basic observations led to the overall conclusion that soft-sided packaging is appropriate for use during LLW management and disposal – subject to the proper conditions of use:

• There has been a successful history of soft-sided packaging use for over 15 years in LLW management applications;
• Multiple vendors and customer users have reported consistent satisfactory performance during multiple applications;
• Soft-sided packaging provides viable, cost-effective alternatives to use of wooden and metal containers;
• Packaging must be appropriate for the LLW content/media being managed under controlled environmental conditions;
• Compliance with manufacturer storage, handling, filling, lifting, and related instructions is essential to ensure proper packaging performance;
• Consistent training of site operations personnel to manufacturer requirements will ensure maximum packaging performance;
• Filled waste packages must be staged and stored properly to minimize water intrusion and structural integrity; and
• Use of appropriate and adequate absorbents and liners will minimize adverse effects associated with higher moisture content.

VI. Conclusions and Recommendations

The primary conclusions developed by the Trailer Contamination and Supersack Integrity Team include the following:

1. The recent increase in trailer contamination incidents is due in large part to the application of lower DOE free-release standards to a population of transport equipment that has been used at multiple DOE sites and is subject to legacy contamination that was not detected and addressed at the time the equipment was released from those DOE sites.
2. In the event the DOE and DOT free-release limits can be brought into harmony, this will reduce not only the number of transport equipment holds at the NNSS but also the need for subsequent decontamination to meet a more stringent release standard – including avoidance of significant costs for retention of equipment and decontamination.
3. Implementation of stricter and more extensive radiological surveys of transporter equipment prior to loading waste packages and prior to the release of waste shipments will identify in advance situations involving legacy
contamination that may warrant future decontamination activity. This will also assist transporters in identifying equipment that may be at risk and determining the probable sources of any such contamination.

4. Soft-sided packaging has been used successfully for transporting LLW over a 15+-year period with no reported releases of radioactive material. When the proper type of packaging material is used for the waste matrix, storage and transport conditions, and the manufacturer's use instructions are followed as a result of site-specific training, soft-sided packaging has proved to be a viable and cost-effective alternative for managing LLW.

5. Improper closure or storage of filled Supersacks without adequate use of absorbents or regard for weather protection may result in water intrusion to the waste package and subsequent release of fluid onto storage or transport equipment surfaces.

Based on observations and assessments, the Trailer Contamination and Supersack Integrity Team has developed the following recommendations in order to minimize future occurrences of similar issues at DOE sites. It is recommended that EM, working in coordination with NNSA and other Program Offices, implement these practices on a Complex-wide basis.

1. Develop and implement consistent performance standards for radiological surveys on radioactive material packaging and transport equipment when either entering or exiting a DOE-controlled site. It is important that waste generators perform comprehensive surveys on empty transporter equipment prior to loading waste packages. Provide guidance to improve large area survey techniques to ensure that legacy or new contamination is identified, quantified, and documented in a timely manner. This should include specification of appropriate survey techniques, equipment and operating procedures that will ensure consistency of results from one site/location to another.

2. Establish a more consistent set of contamination limits that would apply to the release of radioactive material packaging or transport equipment from a DOE-controlled location. (This recommendation is directly related to the efforts being undertaken by the other WMWG Evaluation Team). Actual contamination measurements and determination should be accomplished using the consistent performance standards established under Recommendation Number 1 above.

3. Establish and distribute a Lessons Learned guidance document that addresses the proper selection, handling, control, and protection of soft-sided packaging used for LLW management, storage and disposal applications.

4. Establish a reliable and consistent method for ensuring contractor oversight of Complex-wide radiological survey capabilities and the proper utilization of soft-sided packaging for LLW management activities. Program oversight is a prime contractor responsibility and the goal of having clear survey performance specifications will be to ensure consistency between DOE sites.
as far as contractor oversight and self-assessment. DOE O. 458.1 clearly indicates that “DOE Field Element Managers responsible for oversight of clearance processes must implement oversight duties to verify that the contractor assurance program is ensuring that the applicable radiological clearance requirements have been met”.