Fall Protection Procedures for Sealing Bulk Waste Shipments by Rail Cars at Formerly Utilized Sites Remedial Action Program (FUSRAP) Sites – 13509

J.D. Boyle*, E. Joseph Fort**, William Lorenz**, Andy Mills***
*U.S. Army Corps of Engineers – Buffalo District, Buffalo, New York 14207
**Cabrera Services (Cabrera) East Harford, CT 06108
***Shaw Environmental & Infrastructure, Inc. (Shaw) Baton Rouge, LA 70809

ABSTRACT

Railcars loaded with radioactive materials must be closed and fastened to comply with United States Department of Transportation (DOT) requirements before they shipped. Securing waste shipments in a manner that meets these regulations typically results in the use of a sealable railcar liner. Workers accessing the tops of the 2.74 m high railcars to seal and inspect liners for compliance prior to shipment may be exposed to a fall hazard. Relatively recent revisions to the Fall Protection requirements in the Safety and Health Requirements Manual (EM385-1-1, U.S. Army Corps of Engineers) have necessitated modifications to the fall protection systems previously employed for railcar loading at Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. In response these projects have developed site-specific procedures to protect workers and maintain compliance with the improved fall protection regulations.

INTRODUCTION

Transportation of bulk materials in open gondola railcars to disposal facilities is a cost-effective method of shipping waste chosen by remediation projects with access to rail spurs. With the exception of ores containing only naturally occurring radionuclides, transportation regulations require all unpackaged materials be transported in such a manner that under normal conditions of transport there will be no escape of the radioactive contents (49 CFR 173). To comply with this regulation, waste shipment preparers install a liner that can be sealed after the railcar is loaded (Refer to **Figures 1 - 2**). Once closed the liner provides a sealed, impermeable barrier that under normal conditions will prevent the release of materials from the railcar.

Figures 1 - 2: Lined railcar interior (left). Liner installation assisted by aerial lift (right).

The top edges of railcars are unprotected and exceed the height threshold identified by U.S. Army Corps of Engineer (USACE) and Occupational Safety and Health Administration (OSHA) fall protection regulation. Workers closing and sealing bulk liners on prepared waste shipments face the potential of falling from the tops of these gondolas. Two FUSRAP projects safely and efficiently manage railcar closure through the use of different techniques developed in response to each site's individual requirements and resources. The Maywood FUSRAP site has deployed a fall arrest system that allows workers to move about the top of railcars to seal shipments. The Linde FUSRAP Site Remediation project has instituted the use of an aerial lift to provide safe access to the elevated surface for this task. Additional methods to protect workers that eliminate the need to access the tops of railcars through the use of hard covers are also available.

DESCRIPTION OF APPLICABLE FALL PROTECTION REQUIREMENTS AND SYSTEMS FOR RAIL SHIPMENT PREPARATION

The fall protection height threshold for USACE administered FUSRAP projects is 1.8 m (6 feet) as outlined in Section 21 Fall Protection of the Safety and Health Requirements Manual (EM385-1-1, U.S. Army Corps of Engineers) and OSHA 29 CFR 1926 Subpart M. The unprotected edge of a railcar exceeds the 1.8 m (6 feet) limit. Prior to the 15 September 2008 revision of USACE regulations fall protection for workers accessing the tops of loaded railcars on most FUSRAP projects was achieved through training and the implementation of a Safety Monitoring System. Safety Monitoring Systems allow employees to work on elevated areas with unprotected edges when monitored by a designated individual whose sole function is to provide workers with a warning of the hazard.

In 2008, USACE regulations were revised to place administrative controls such as the Safety Monitoring System below elimination of fall hazards, preventative barriers, work platforms, and personal protective fall equipment on the hierarchy of fall protection controls (21.A.02 – EM385-1-1, USACE). FUSRAP Sites that formerly relied on administrative controls and those that began after the revision have shifted their approaches in a manner that provides worker protection, maintains compliance with safety requirements, and gives consideration to site-specific resources and limitations.

Fall Arrest System for Fall Prevention - FUSRAP Maywood Superfund Site:

The layout of the FUSRAP Maywood (New Jersey) Superfund Site allows for eight, 15.85 m (52 feet) long, low-wall gondolas to be loaded daily. A paved, 101 m (332 feet)-long bulkhead situated adjacent to the loadout spur and the soil and debris stockpile immediately opposite, provides a maintainable access for loading the railcars using a front end loader. Area constraints allow for six railcars to be loaded in-place; the loaded railcars are pushed further down the spur to allow an additional two railcars to be loaded.

Site-specific considerations at Maywood that influenced the identification and screening of alternative fall protection-compliant approaches included: fixed constraints on the existing spur and loadout area; spatial clearance requirements imposed by the railroad (refer to **Figure 3**);

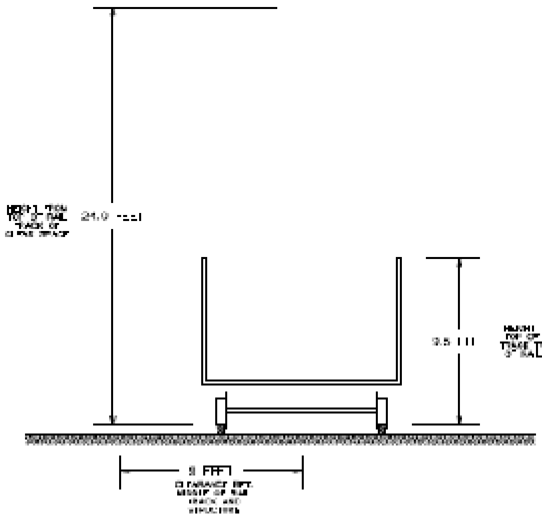

Figure 3 – Railroad Spatial Clearance Requirements

winter weather load out operation in the northeast; and the potential long-term capitalization of equipment that may be used for ten years or more. Alternative approaches that were screened out included:

1. Temporary, railcar-mounted centerline fall arrest – 1.8 m (6 feet), clamp-mounted posts located at opposite ends of the railcar, supporting a cable with self-retracting lanyards and two 76.2 cm (30 inch) perimeter cables that serve as a barrier;
2. Temporary, railcar-mounted perimeter railings – similar to the first alternative, but without the centerline fall arrest;
3. Portable scaffolding and associated fall arrest systems – requiring a paved ramp to deploy and relocate the unit for each car;
4. A built-up bulkhead that would diminish the elevation difference between the top of the loaded railcar and adjacent area to less than 1.8 m (6 feet);
5. Railcar hard lids – eliminating the need for workers to access the railcar load;
6. Rigid fall arrest system – Piers supporting either a rigid or cable-supported trolley with self-retracting lanyards.

A rigid fall arrest system was selected based on cost considerations; its cost recovery vs. alternatives was estimated to be approximately two years.

A design/build Request for Proposals was issued that required the system's design to support four workers on any one railcar and an additional two workers on an adjacent railcar at the same time. Construction of the new fall protection system was completed in March 2011; after providing initial worker training and rescue training, the system has been in nearly continuous and successful use without incident (refer to **Figure 4 – Rigid Fall Arrest System).**

Figure 4 – Rigid Fall Arrest System at Maywood, NJ

Aerial Lifts for Fall Prevention - Linde FUSRAP Site Remediation Project

The Linde FUSRAP Site Remediation project in Tonawanda NY addresses worker fall protection through the use of an aerial work platform. Elevated platforms allow workers to close railcar liners while protected from falls by guardrails and personal fall arrest systems. The choice to use an aerial lift was based on an evaluation of available fall protection systems, existing infrastructure, and the size, location, and configuration of the site's rail loading area.

At the Linde project railcars are loaded from a contained pad on the eastern portion of the property along the site's rail spur (Refer to **Figure 5**). The size of the loading facility is small allowing no more than two railcars in the loading position at any given time. This is an open area with no infrastructure to aid in the implementation of a preventative barrier system. The close proximity of the rail loading spur with a rail line immediately to the east prevents access to loaded railcars by equipment for the placement of hard lids (Refer to **Figures 6 and 7**). The installation of a fall arrest system would require partial disturbance and potential undermining of the adjacent rails and the underlying infrastructure. Additionally, the implementation of personal fall arrest systems do not address exposure to strain and sprain, cut, and impalement injuries associated with walking on the uneven surface of a waste and debris shipment (Refer to **Figure 8**). With these limitations identified the project chose the use of an articulated aerial lift to provide the necessary protection for workers performing this packaging activity.

Figure 5: Linde FUSRAP Site loading area.

Figures 6 - 7: Spatial constraints adjacent to the Linde FUSRAP Site loading area. Note proximity of additional rail lines to loading spur.

Figure 8: Strain and sprain, cut, and impalement hazards visible prior to liner closure.

Operating from the aerial lift, site employees are provided full lateral movement with access to all areas of the railcar while maintaining 100% fall protection. Workers are attached to an anchorage point within the basket with approved full body harness and lanyards (Refer to **Figure 9**). The lanyard length is short enough to prohibit exiting the aerial platform. Workers who must exit the lift basket during an emergency situation when all other options are exhausted will switch to retractable lanyards that are stowed in the lift basket as a secondary form of fall protection.

At the Linde FUSRAP Site Remediation Project workers access the platform of the aerial lift from the loading area while maneuvering its chassis in the adjacent clean area (Refer to **Figure 10**). This provides added safety and maintenance benefits. In the event of an unforeseen equipment failure, loss of platform controls, or incapacitation of basket occupants the ground controls can be accessed quickly by workers outside of the loading area. Fueling, maintenance, and minor repairs are also expedited with the engine compartment stationed in the clean area outside of the rail loading facility.

Figures 9 - 10: Liner closure from aerial lift (left). Lift chasis outside of the loading area (right).

Eliminating the Need for Fall Protection Systems:

The elimination of fall hazards is the first measure of control required by Section 21 Fall Protection in the Safety and Health Requirements Manual. This can be achieved through the use of rigid railcar covering systems available for shipments by railroad (Refer to **Figure 11**). Railcar covers are removed and reinstalled with cranes, forklifts, and loaders with fork attachments. When deployed the rigid lids are secured in place with locking clamps (Refer to **Figure 12**). Exposures to fall, strain/sprain, cut, and impalement injuries associated with working from the uneven surface of a waste and debris shipment are eliminated by removing the need for sealable liners.

Figures 11 - 12: Railcars with hard covers (left). Railcar cover locking clamp (right).

Projects considering the use of hard covers need to evaluate their specific loading area configuration, spatial constraints, and equipment resource lifting capacities. Railcar covers are equipped with lifting eyes that can be attached to a specialized lifting frame carried by equipment forks or lifting straps suspended from cranes (Refer to **Figures 13, 14, and 15**). When removing and reinstalling the hard covers with a forklift or loader with fork assembly and lid lifting frame, the area adjacent to the railcars must be wide enough to accommodate the turning radius required to access the side of the railcar. The accessible distance between the forklift or loader and the railcar also needs to be evaluated to insure that lids can be placed without encroaching on restricted portions of the loading area or exceeding the lifting capacity of the equipment in use. The distance between cranes in use and the railcars must also be examined to maximize the number that can be covered within a safe lifting configuration.

As noted above, the determination of the required lifting configuration is essential for an understanding of the benefits and limitations of the use of hard covers at a site specific level. The load that will be lifted by a crane is the weight of the railcar hard cover and the rigging used to lift it. Referring to the crane's load chart the operator can identify the safe maximum distance for railcar cover placement. This in turn will determine the number of cars that can be covered from the location of the crane and the allowable distance for a temporary hard cover staging area when removed. Because cranes are not as mobile as other equipment choices, fewer loads can be secured from a given location.

The mobility of loaders and forklifts lend themselves to efficient coverage on sites with larger loading facilities where multiple railcars can be loaded in a row. When using equipment requiring the lifting frame the load weight is equivalent to the combined weight of the railcar hard cover and the frame. Loader and most forklift operations can determine their specific lifting limits by simply examining the required lift height, load weight, and the equipment load chart. If non-all terrain lifting equipment is used the ground adjacent to the railcars need to be fairly level.

All terrain telescoping forklifts are the most versatile ground based means of deploying railcar covers. These vehicles can place lids from un-level surfaces at greater distances than loaders and conventional lifts. The load weight is again the sum of the frame and railcar cover weights. Calculation of the allowable range of operation and equipment configuration requires collection of the anticipated maximum boom/mast extension, minimum boom/mast angle, lift height, and forward reach. This information is then applied to the load chart of available all terrain telescoping forklifts to insure the appropriate choice of equipment.

Figure 13: Hard cover suspended from loader and lifting frame.

Figure 14 - 15: Placement with all-terrain forklift (left). Hard cover suspended from crane (right).

Railcar hard cover use does not come without costs. There are additional rail equipment and lifting frame rental fees involved. The available waste payload is decreased by approximately 1.5 tons or the weight of the cover per shipment. Crane rentals are also generally more expensive than those of loaders and forklifts which are often already available on remediation projects. Given these considerations it can be deduced that projects with larger loading facilities and quantities of waste to ship can more readily absorb the additional costs.

CONCLUSIONS

Each of the fall protection and the fall elimination methods examined here adequately protect workers from fall accidents. Each has its own application and niche to fill. Sites with the available space and configuration can readily eliminate fall hazards altogether through the use of railcar hard covers. To do this these projects have to be willing to absorb the additional costs by taking advantage of the efficiency produced by applying this method. Sites with greater spatial constraints can implement the use of aerial lifts or stationary fall arrest systems to provide 100% fall protection for workers sealing railcar liners.

United States Army Corps of Engineer administered FUSRAP projects shipping radiological waste by rail have several options when choosing a fall protection system to best protect workers. In developing a fall protection program these projects must take in consideration many factors. These include the hierarchy of fall protection controls; existing infrastructure; the size, location, and configuration of the site's rail loading area, the amount of waste that will be shipped, and the projected length of the project. By doing this sites will be able to identify the systems and processes that will most safely and efficiently achieve this goal at a site specific level.

REFERENCES

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