300-296 Soil Remediation Project Operations Assessment for Soil Retrieval

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
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Approved for Public Release; Further Dissemination Unlimited
1.0 Purpose

This study was performed to establish a basis for the estimated time for completion of the operations of soil removal from beneath the 324 building B-Cell during the 300-296 project. This study examines the staging of empty bins into the airlock, loading of bins with soil excavated from under B-Cell, as well as performing other tasks necessary based upon the final disposition of the loaded soil bins. The disposition of loaded soil bins is to the Environmental Restoration Disposal Facility (ERDF) or positioning within an adjacent cell to be grouted. However, the estimated times for grouting of a filled cell or transport of a waste box to ERDF were beyond the scope of this study.

2.0 Background

The three-story 324 Building covers 9,476 m² (102,000 ft²) and includes one story below ground. The facility was completed in 1965 to support materials and chemical processing research and development activities at Hanford. Research operations at the facility ceased and stabilization cleanup activities began in 1996.

The 324 Building is being prepared for demolition, including stabilizing and preparing for the removal of the Radiochemical Engineering Complex (REC) cells. Contaminated grout was removed from the B-Cell sump and trench in support of demolition preparation. This grout removal revealed a visible breach in the stainless steel liner of the sump in the hot cell floor. Due to concerns about the possibility that B-Cell constituents had migrated through the breached liner, nonintrusive (closed-ended) characterization tubes were installed laterally into the soil column below B-Cell. Measurements inside the tubes confirmed the presence of radioactivity with gamma exposure rates up to approximately 13,000 R/hour. The peaks in the measured exposure rates approximately underlie the locations of the expansion joints in the B-Cell floor. It is believed that the leak from the B-Cell sump spread laterally along the felt liner between the floating B-Cell floor and the Cell foundation.

Figure 1 provides a rough depiction of the distribution of contaminated materials.

![Figure 1 – Sketch of Anticipated Contamination Area](image-url)
The selected approach for soil removal is to access the contaminated soil by first removing the existing debris and grout, then the concrete floor and stainless steel liner of B-Cell. The contaminated soil will be removed using remotely operated equipment. The previous project baseline planned to mix grout with the soil before loading into bins. Discussions with representatives of nuclear safety and waste transportation clarified that addition of grout to the soil during excavation was not required. Eliminating the addition of grout during soil excavation reduced the number of soil bins from approximately 862\(^1\) to 640. This study estimates the tasks and associated times for those tasks to process the soil bins used for removal of the soil.

3.0 Scope

The scope of the Operations Assessment for Soil Retrieval is to provide an estimate of the time required to process bins containing soil excavated from under the 324 Building B-Cell including staging empty bins, loading filled bins, and initial disposition of the bins. This document will also provide information regarding tasks that will affect soil bin operations but have not been specifically accounted for in the timeline provided. This estimate will be used in the overall project schedule along with the other critical path tasks.

4.0 Bases and Assumptions

Discussions were held with members of the 300-296 project team, and 324 Building operations and radiological control technicians to develop the assumptions, tasks, and estimated duration to complete each task for this study. Section 7.0 identified the personnel who contributed to this study.

4.1 Assumptions Applicable to Either Timeline Process

- Work will performed on the Hanford P/Q shifts.
- A fire surveillance will be used to allow the cell doors to remain open during non-working shifts.
- Soil bins have a 14.1 cubic foot capacity\(^2\) and will be filled to 90% of capacity, and no grout will be mixed with the soil during retrieval operations in B-Cell.
- Long reach bucket capacity attached to REA is 2.3 cubic feet\(^3\).
- 24 empty soil bins can be staged in Airlock.
- The Airlock door may remain open during Bin Staging process over changing of shifts.
- The Reverse Boom Hoist will be used to move empty soil bins over threshold into Airlock and the A/D Crane will be used to move them within the Airlock for staging prior to soil loading.
- The highest respiratory protection required for any manned entry into Airlock is a Powered Air Purifying Respirator (PAPR).
- The timelines provided do not account for equipment failure, routine maintenance, or other delays affecting operations.
- A-Cell will be used for staging filled soil bins after B-Cell debris has been loaded into the cell and grouting of the cell to the 10-ft. elevation has been completed. Relocation of debris from B-Cell into A-Cell and grouting of A-Cell are conducted prior to the start of soil excavation in B-Cell.

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\(^1\) AREVA submittal "Debris Tracking within the Radiochemical Engineering Complex (REC)", A-300-296-00131, Rev. 0; July 6, 2015

\(^2\) AREVA submittal "Debris Tracking within the Radiochemical Engineering Complex (REC)", A-300-296-00131, Rev. 0; July 6, 2015

\(^3\) Final Design Report Narrative for the Remote Excavator Arm Systems, KUR-1782-RPT-016, Rev. 0
Empty soil bins will be staged in the Cask Handling Area (CHA) concurrently with cell processes to support staging in the Airlock.

Grout will be available when needed to fill the void space in a waste box as part of soil bin disposition operations.

A-Cell and D-Cell doors will be opened and closed concurrently with other operational activities to avoid impact on operational timeline.

4.2 Assumptions - Bins to Waste Box

- Days 4 & 5 in the timeline will require flexible/staggered lunch breaks to allow processing of the waste box into and out of the airlock.
- Waste boxes will hold up to 12 filled soil bins with an average of 8 soil bins per waste box.
- Up to 24 filled soil bins can be staged in A-Cell to maximize waste box loading efficiency and shipment to ERDF.
- Waste box will be staged and prepped to be moved into the Airlock during ongoing processes in the REC to eliminate any delay in movement to Airlock when needed. Staging a waste box includes removing the box lid, installing the internal framing to position bins within the waste box, and wrapping the box in plastic.
- When a filled waste box is removed from the Airlock, the plastic wrapping is removed and placed into the Airlock. Plastic removal from the Airlock will be necessary after two waste boxes have been loaded and removed. This frequency may vary depending on amount of accumulation and need to meet fire loading and access requirements.
- The pre-job briefing required for entry into the Airlock will need at least 1.5 hours to perform and can be completed on the day shift prior to the Airlock entry with an abbreviated pre-job briefing being completed on the morning of the Airlock entry.

4.3 Assumptions – Bins to Hot Cells

Bins to A/C/D Cells was calculated assuming the maximum floor loading in each cell.

- The number of soil bins to be loaded into cells will be as follows:
  - A-Cell – 24 filled soil bins arrayed in a single layer
  - C-Cell – 56 filled soil bins arrayed in two layers
  - D-Cell – 128 filled soil bins arrayed in four layers
  - After each layer of bins is placed into a cell, grout is pumped into the cell to fill the void space between bins and provide a level surface for placing the next layer of bins or capping the layer of bins,
  - A total of 208 filled soil bins will be loaded and grouted into the cells.
- Filled soil bins can be loaded into a cell while another cell is being grouted.
- Adding grout in B-Cell for structural purposes (East wall, North wall) has not been included in this timeline.
- Day 7, second shift in the timeline will require flexible/staggered lunch breaks to complete tasks before end of shift.

5.0 Ideal Soil Retrieval Operations

Soil retrieval operations is expected to achieve a relatively routine evolution cycle after going through the learning curve. Despite extensive training, new complexities arise when processing radioactive material that are not anticipated during cold runs and training. The mock-up facility
will allow certain processes (soil retrieval and movement from B-Cell) to be practiced and refined. However, the mock-up facility was not designed and built to allow for practice of operations to be accomplished in the Airlock. These tasks include moving soil bins into and within the Airlock or to other cells, loading soil bins into a waste box, and grouting a waste box. Another factor impacting operations within the facility is the donning and doffing of Personal Protective Equipment (PPE) required for entry into the galleries, Airlock, and Cask Handling Area of the 324 Building. As the operation progresses, efficiencies and difficulties are likely to be identified which may impact the estimated operational timeline.

5.1 Activities Supporting Either Transport to ERDF or Grouting in Cells

Common to both transport of filled waste boxes to ERDF or placement of soil bins in a cell to be grouted is the empty bin staging in the Airlock and soil excavation tasks. Regardless of the final disposition of the soil bin, these operational activities are required to be accomplished.

Staging the empty soil bins into the airlock, soil loading into a bin, and movement to a cell are designed to be performed using remotely operated equipment without anyone entering the Airlock or any cell.

Staging the soil bins into the Airlock requires:

- Opening the Airlock door
- Moving the empty soil bins over the Airlock threshold using the Reverse Boom Hoist
- Moving the empty soil bins to appropriate staging locations within the Airlock using the A/D Airlock crane
- Closing the Airlock door

Soil Retrieval Preparation and Operations require the following:

- Opening the B-Cell door
- Opening of A-Cell and D-Cell doors (this will be accomplished concurrently with other retrieval activities).
- Lowering the transfer mechanism
- Operating the transfer cart to move it into the Airlock
- Using the A/D Airlock crane, move an empty soil bin from the staging location in the Airlock to the transfer mechanism cart
- Operating the transfer cart to move it into B-Cell
- Using the Upper Remote Excavator Arm (REA) to lift the soil bin and position close to the Lower REA soil retrieval location for filling
- Using the Lower REA to retrieve soil and fill soil bin
- Using the Upper REA to raise the filled soil bin and Master-Slave Manipulator to decontaminate outside of soil bin
- Moving filled soil bin to transfer cart with the Upper REA
- Operating transfer mechanism cart to move filled bin into Airlock
- Using the A/D Airlock crane to transfer filled bin from transfer cart to radiological assay table
- Performing radiological assay of filled soil bin
- Using the appropriate crane to move the assayed soil bin to designated cell (either for staging or as final disposition location)
Preparation for staging bins into Airlock will be required when all the empty bins have been used and additional soil bins are necessary to continue soil excavation operations. This process involves the following:

- Using the A/D Airlock crane to move an empty soil bin from the staging location in the Airlock to the transfer mechanism cart (if empty bin available)
- Operating the transfer cart to move it into B-Cell
- Folding the transfer mechanism into B-Cell
- Closing the B-Cell door
- Closing A-Cell and D-Cell doors (if open)

5.2 Activities unique to Bins being Transported to ERDF in Waste Box

In addition to the activities provided above that are common to either operation, there are some that will be unique to the transportation of filled waste bins to ERDF in a waste box. Some of these activities will require personnel entry into the Airlock which will require additional PPE and time associated with donning and doffing PPE.

The movement of the waste box into the Airlock involves the following:

- Opening the Airlock door
- Initial entry and Radiological Surveys of the Airlock (personnel entry)
- Installation of the rail segment over threshold to connect the CHA rail to the rail in the Airlock
- Moving the waste box and cart into the Airlock using the Reverse Boom Hoist (or tug system) and tying off plastic to allow removal of the outer layer as box is being brought out of Airlock.
- Removal of the rail segment from threshold area.
- Bagging and radiological survey of the rail end that went over the Airlock door threshold.
- Closing the Airlock door.

The tasks associated with loading a waste box with filled soil bins may vary slightly than provided below based upon the number and radiological dose rates associated with the bins being shipped. For example, the tasks below assume that a cribbing frame will be necessary to stabilize the bins within the box prior to grouting. This cribbing frame will be based on the configuration necessary to support shipping and will be inserted into the waste box prior to the box being put into the Airlock. The cribbing frame is removable and re-inserted into the waste box at the appropriate time to support soil bins. The waste box is designed to support several bin configurations based upon dose rates.

The loading of full soil bins into the waste box will involve the following activities:

- Removal of the cribbing frame from the waste box (if necessary)
- Moving filled soil bins from staging cell to waste box
- Inserting cribbing frame into the waste box (if necessary)
- Moving filled soil bins from staging cell to waste box
- Moving the grout line in the Airlock into position using the A/D crane along with using the MSM to provide support
- Placing grout into the waste box to cover the filled soil bins

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4 A rail system was previously used to move equipment and waste into and out of the Airlock but was removed. The 300-296 project will restore this rail system to facilitate waste box movement into and out of the Airlock.
• Flushing the grout line
• Allowing the grout to initially cure (estimated to be at least 3 hours)

The movement of the loaded waste box from the Airlock to the storage location prior to shipping will involve the following:

• Opening the Airlock door
• Installation of the rail segment over threshold to connect the CHA rail to the rail in the Airlock
• Remotely attaching Reverse Boom Hoist (or tug system) to the cart
• Moving the waste box out of Airlock including removal of outer plastic and radiological survey as box is moving through Airlock door
• Installation of lid on waste box
• Removal of the rail segment from threshold area.
• Bagging and radiological survey of the rail end that went over threshold.
• Closing Airlock door.
• Installation of the rigging on the waste box to allow movement from the cart to the loading dock
• The loaded waste box will be moved to a designated storage location until ready for shipment to ERDF.

6.0 Start-up and Maintenance Down Time Effects

Allowances must be made for start-up inefficiencies and unplanned outages, such as for equipment failures. However, these effects are beyond the scope of this study.

7.0 Contributors and Reviewers

The time estimation for soil retrieval tasks was completed with review and input from the following:

• April Wickersham – 324 Building Operations Manager
• Larry Sherman – 324 Nuclear Chemical Operator
• Bill Gowey – 324 Radiological Control Supervisor
• Tim Renz – 324 Lead Radiological Control Technician
• Dave Dodson – 324 Radiological Control Technician
• Gary Franz – 300-296 Nuclear Safety
• Michael W. Johnson – 300-296 Project Director
• Michael E. Johnson – 300-296 Senior Technical Advisor

8.0 Attachments

Attachment A: Soil Bins to Waste Box Diagram
Attachment B: Soil Bins to Cell Diagram
Attachment C: List of Tasks and Assigned Durations
Attachment A: Soil Bins to Waste Box Diagram
Bins to Waste Box

Assumptions:
- P/Q Shifts
- Fire surveillance on off-shifts to allow 8-Cell door to remain open until waste box put into airlock
- 430 bins will be shipped to ERDF based on 90% fill capacity of bins and no use of grout in bins
- 24 empty bins staged in airlock
- A-Cell will be used for staging soil bins after debris loaded into cell and grouted
- Up to 24 loaded bins staged in A-Cell for loading into waste boxes
- Grout of waste box time does not include cure time of grout as curing will occur during off shift
- Days 4 & 5 will require flexible/staggered lunch breaks
- Efficiencies in excavating middle of cell may be realized, but have not been analyzed in this study.
- Efficiencies may be realized if additional staged, filled bins can be loaded into boxes but was not analyzed at this time.
- Waste box prepped for move into airlock in parallel with soil retrieval tasks
- Airlock door open during Bin Staging over shift change
- Time for structural grouting not included in this timeline.
- One shift for plastic removal necessary after 2 waste boxes removed from Airlock
- Pre-job brief for Airlock entry estimated to be 1.5 hours and would be performed on day shift prior to entry with an abbreviated pre-job held the morning of entry.
- Opening and closing of A-Cell and D-Cell doors performed concurrently with other tasks

- Up to 12 soil bins/waste box – estimate an average of 8 bins/box; 54 waste boxes = 270 Days

* Days 2-3 can be repeated until empty bins needed to be staged in airlock

End of shift
11:30 PM
Attachment B

Soil Bins to Cell Diagram
Bins to A/C/D Cells

Assumptions:
- P/Q Shifts
- 24 empty waste bins can be staged in Airlock
- Fire surveillance on off-shifts to allow B-Cell door to remain open until waste box put into airlock
- A-Cell – 24 soil bins
- C-Cell – 56 soil bins
- D-Cell – 128 soil bins
- A-Cell will be used for staging soil bins after debris loaded into cell and grouted
- Bin loading into a cell loading can continue while a different cell is grouted
- Cell grouting is not included in this timeline.
- Airlock grouting is not included in this timeline.
- Day 7 second shift will require flexible/staggered lunch break to allow Airlock preparation for bin staging.
- Opening and closing of A-Cell and D-Cell doors performed concurrently with other tasks

- Total 208 bins = 61 days

End of shift 11:30 PM
Attachment C
Task List with Assigned Durations
<table>
<thead>
<tr>
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<th>Hours</th>
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<tbody>
<tr>
<td>PJB</td>
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<td>PJB - AL Open</td>
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<tr>
<td>PPE On</td>
<td>1.00</td>
</tr>
<tr>
<td>PPE</td>
<td>0.50</td>
</tr>
<tr>
<td>PPE AL On</td>
<td>2.00</td>
</tr>
<tr>
<td>PPE AL Off</td>
<td>2.50</td>
</tr>
<tr>
<td>Open/Stage</td>
<td>0.50</td>
</tr>
<tr>
<td>Position 6 empty waste bins (No Manned Entry)</td>
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<tr>
<td>Stage</td>
<td>2.00</td>
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<tr>
<td>Position 8 empty waste bins into Airlock. (No Manned Entry)</td>
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<tr>
<td>Stage/Close</td>
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<tr>
<td>Position 2 empty waste bins (No Manned Entry)</td>
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<tr>
<td>Close Airlock door</td>
<td>0.25</td>
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<tr>
<td>Lower Transfer Mechanism</td>
<td>0.50</td>
</tr>
<tr>
<td>Open B-Cell door</td>
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</tr>
<tr>
<td>Lower transfer mechanism</td>
<td>0.30</td>
</tr>
<tr>
<td>Remotely operate to move transfer cart into Airlock</td>
<td>0.10</td>
</tr>
<tr>
<td>Bin Fill/Disposition</td>
<td>Using A/D Cell Crane, place empty waste bin into Transfer Mechanism cart</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Remotely operate the cart on the Transfer Mechanism to move waste bin into B-Cell</td>
</tr>
<tr>
<td></td>
<td>Lift the waste bin from the Transfer Mechanism cart with the upper Remote Excavator Arm and position to receive soil</td>
</tr>
<tr>
<td></td>
<td>Load soil into the waste bin using the lower Remote Excavator Arm</td>
</tr>
<tr>
<td></td>
<td>Use MSM to spray bin for decontamination</td>
</tr>
<tr>
<td></td>
<td>Place the filled waste bin into the Transfer Mechanism cart using the upper Remote Excavator Arm</td>
</tr>
<tr>
<td></td>
<td>Remotely operate the cart on the Transfer Mechanism to move waste bin out of B-Cell into Airlock</td>
</tr>
<tr>
<td></td>
<td>Using A/D Cell Crane, move filled waste bin from Transfer Mechanism cart to Rad counter.</td>
</tr>
<tr>
<td></td>
<td>Rad count waste bin to determine disposition</td>
</tr>
<tr>
<td></td>
<td>Use crane to stage bin in A-Cell or to appropriate cell for final disposition</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PA (Prepare for Airlock Opening)</th>
<th>Using A/D Cell Crane, place empty waste bin into Transfer Mechanism cart</th>
<th>0.10</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Remotely operate the cart on the Transfer Mechanism to move waste bin into B-Cell</td>
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</tr>
<tr>
<td></td>
<td>Fold up transfer mechanism into B-cell</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Close B-Cell door</td>
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<td></td>
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<table>
<thead>
<tr>
<th>Open/Survey</th>
<th>Open Airlock door</th>
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<tr>
<td></td>
<td>Initial entry radiological surveys (Manned Entry into Airlock)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Install rail segment over airlock threshold</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Remove rail segment over airlock threshold</td>
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<tr>
<td></td>
<td>Close Airlock door</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>Radiological survey of rail</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.5</td>
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</table>

<table>
<thead>
<tr>
<th>Box in Airlock</th>
<th>Move waste box into Airlock.</th>
<th>1.00</th>
</tr>
</thead>
</table>

Page 13 of 14
<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
<th>Time (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bins to Box (A)</td>
<td>Removal of top frame from waste box</td>
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</tr>
<tr>
<td></td>
<td>1 Bin from staging area to waste box .25 hr X 4 bins</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Installation of frame in waste box</td>
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</tr>
<tr>
<td></td>
<td>2 Bin from staging area to waste box .25 hr X 4 bins</td>
<td>1</td>
</tr>
<tr>
<td>Grout waste box</td>
<td>Move grout line in place with A/D crane using MSM to steady for waste box grouting</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Grout waste box</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Flush grout line</td>
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</tr>
<tr>
<td></td>
<td>Waste box grout initial cure time (NOT INCLUDED ON TIME GRAPH)</td>
<td>3.00</td>
</tr>
<tr>
<td>Move full box out and install lid</td>
<td>Open Airlock door</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Install rail segment over airlock threshold</td>
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</tr>
<tr>
<td></td>
<td>Connect tugger to airlock cart</td>
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<tr>
<td></td>
<td>Move waste box into CHA including removal of plastic</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Place lid on waste box</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Radiological survey of box - contamination</td>
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<tr>
<td></td>
<td>Remove rail segment over airlock threshold</td>
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</tr>
<tr>
<td></td>
<td>Close Airlock door</td>
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</tr>
<tr>
<td></td>
<td>Radiological survey of rail</td>
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<td></td>
<td>4.95</td>
<td></td>
</tr>
<tr>
<td>Box to loading</td>
<td>Install rigging on waste box</td>
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</tr>
<tr>
<td>dock</td>
<td>Move full waste box from Airlock/CHA rail to loading dock</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Box to Storage</td>
<td>Move box to storage area using forklift</td>
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</tr>
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