Waste Minimization: Is It Cost Effective During Decommissioning and Decontamination?

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Presented by:
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Questions Often Asked

1) “Is there really a need to minimize waste during decommissioning?”

2) “How do I define the decommissioning process?”

3) What specific process steps do I need to address to get financial savings using waste minimization?

4) How clean does clean need to be?

5) “What is an example of applying waste minimization and how much was actually saved?”

6) “Are all the waste streams we examine always cost effective to minimize?”
Quick Answers

1) Yes, there is a need – environmental, cost of ownership, good business

2) Look at the definition of the site facility, systems and sub-systems

3) In four major process flow steps – many tasks and decisions to make in order to identify and capture savings

4) In simple terms…define the assets final disposition and verification sampling protocol needed

5) Fab closure example to follow

6) No, in some cases the total cost does not warrant applying waste minimization efforts
Disposition Options

- **Facility**
  1. Convert & upgrade
  2. Decommission & mothball
  3. Sell “as is”
  4. Upgrade & clean for another use
  5. Decommission & demolish for sale and redevelopment

- **Tool/Equipment**
  1. Sale and transfer for reuse (“as-is”, refurbish, or upgrade)
  2. Storage for future use
  3. Scrap or salvage
  4. Donation
  5. Disposal
Fab Closure Example - Background

- 40,000 sq. ft. semiconductor fab
- 15 years old
- Environmental closure cost ~ $1 Million
- Closure conducted in California under strict regulatory oversight
**Fab Closure Cost Table**

- **Key to Acronyms and Definitions**
  - **FRP** – Fiber Reinforced Polymer – various composition of fiberglass
  - **S/S** – Stainless Steel
  - **GALV** – Galvanized or Carbon steel
  - **Plastic** – PVC, Polypropylene, ABS, Polyethylene
  - **L** – Landfill disposal
  - **NH** – Non-hazardous waste by Federal, State, and Local Jurisdictions
  - **H** – Hazardous waste (RCRA, Non-RCRA, State-mandated, Client-mandated)
  - **R** – Recycled
  - **OF** – Offsite Facility not owned by company
  - **ON** – Onsite or internal reuse at the same or another company owned facility
  - **Auxiliary Tool Process Equipment** – vacuum pumps, abatement equipment, control equipment, etc
**Fab Closure Cost Table**

- **Cost Without Waste Minimization** includes:
  - Disposition as hazardous waste in a landfill or treatment facility

- **Cost With Waste Minimization** includes:
  - Recover waste to valuable asset applying effective cleaning techniques and defensible verification sampling & analysis protocol to show waste does not contain residual chemicals at unacceptable levels (as defined by Federal, State, Local regulations, DOT, and/or client-mandated requirements)
  - Reducing the volume of waste by onsite compression, treatment, and/or filtration methods
<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Construction Material</th>
<th>Disposition Options</th>
<th>Cost Without Waste Minimization ($)</th>
<th>Cost With Waste Minimization ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid Exhaust Duct</td>
<td>FRP</td>
<td>L-H, L-NH</td>
<td>25,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Acid Exhaust Duct</td>
<td>S/S</td>
<td>R-OF</td>
<td>25,000</td>
<td>2,500</td>
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<tr>
<td>Solvent Exhaust Duct</td>
<td>S/S or GALV</td>
<td>L-H, R-OF</td>
<td>10,000</td>
<td>15,500</td>
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<tr>
<td>Acid Supply &amp; Waste Piping</td>
<td>Plastic</td>
<td>L-NH, R-OF</td>
<td>5,000</td>
<td>500</td>
</tr>
<tr>
<td>Acid Supply &amp; Waste Piping (HF)</td>
<td>S/S</td>
<td>L-NH, R-OF</td>
<td>6,000</td>
<td>1,200</td>
</tr>
<tr>
<td>Solvent Supply &amp; Waste Piping</td>
<td>GALV</td>
<td>L-NH, R-OF</td>
<td>5,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Gas Piping</td>
<td>S/S</td>
<td>R-OF</td>
<td>5,000</td>
<td>500</td>
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<tr>
<td>Gas Cabinets</td>
<td>GALV</td>
<td>R-ON</td>
<td>12,000</td>
<td>1,500</td>
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<tr>
<td>Tool Exhaust Pipe</td>
<td>S/S</td>
<td>R-OF</td>
<td>10,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Tool Process Pipe</td>
<td>Plastic</td>
<td>L-H</td>
<td>10,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Auxiliary Tool Process Equipment</td>
<td>S/S, GALV, Plastic</td>
<td>L-NH, R-ON, R-OF</td>
<td>35,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Acid Waste Neutralization Tanks</td>
<td>Plastic</td>
<td>L-NH</td>
<td>4,000</td>
<td>1,200</td>
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<tr>
<td>HF Waste Treatment Tanks</td>
<td>Plastic</td>
<td>L-NH</td>
<td>5,200</td>
<td>2,500</td>
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<tr>
<td>Wastewater Corrosive Chemical Supply Tanks</td>
<td>Plastic, GALV</td>
<td>L-NH, R-OF</td>
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<tr>
<td>Solvent Waste Tanks</td>
<td>GALV, S/S</td>
<td>R-OF</td>
<td>4,300</td>
<td>1,000</td>
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<tr>
<td>Solvent Supply Tanks</td>
<td>S/S</td>
<td>R-OF</td>
<td>4,700</td>
<td>500</td>
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<tr>
<td>VOC Abatement System</td>
<td>GALV, S/S</td>
<td>R-ON</td>
<td>4,700</td>
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<tr>
<td>Acid Fume Scrubbers (6)</td>
<td>FRP</td>
<td>R-OF</td>
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<td>0</td>
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<tr>
<td>Acid Fume Scrubber Packing</td>
<td>Plastic</td>
<td>L-H</td>
<td>4,000</td>
<td>7,000</td>
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</tbody>
</table>

| Total Waste Min. Cost                     | $188,000              | $49,400             |
| Total Savings                             | $138,600              |
Decommissioning Process

- Site definitions and systems
- Decommissioning Process Flow

The “SYSTEMS”

SUPPLY SYSTEMS
- Air Handling System
- Bulk Chemicals
- Water Supply
- Bulk Gases
- Electrical Power
- Other Supply Systems

MANUFACTURING SYSTEMS
- Mfg System #1
- Mfg System #2
- Mfg System #3
- Mfg System #4
- Other Mfg Systems

WASTE SYSTEMS
- Waste Water Treatment
- Exhaust Abatement
- Solvent Storage
- Solid Waste
- Other Waste Systems

SUPPLIERS

PROCESS CHEMICALS/GASES & UTILITIES

WASTE DISPOSAL/DISCHARGE

Decommissioning Process Flow

Flow - 1
- Project Scope

Flow - 2
- Schedule Planning & Resourcing

Flow - 3
- Decommission all Systems, Sub-Systems, & Components

Flow - 4
- Disposition of all Systems, Sub-Systems, & Components plus Waste Handling
Some Definitions – Many Versions

- **Decommissioning**: The process of safely bringing down and disassociating a system, sub-system, or component

- **System**: An assemblage or combination of things or parts forming a complex or unitary whole to accomplish a specific process

- **Sub-system**: A secondary or subservient system; part of a system

- **Component**: An individual element in something larger (e.g. a sub-system or system)

- **Item**: A system, sub-system, or component

- **End-State**: The final appearance of the facility including the extent of decontamination required

- **Disposition**: What the end-state will be for systems, sub-systems, and components (e.g. move to another facility, store, salvage, waste, etc.)
The “Components of the Site Facility”

SUPPLY FACILITIES

MANUFACTURING FACILITIES

WASTE FACILITIES
The “SYSTEMS”

SUPPLY SYSTEMS

- Air Handling System
- Bulk Chemicals
- Water Supply
- Bulk Gases
- Electrical Power
- Other Supply Systems

PROCESS CHEMICALS/GASES & UTILITIES

MANUFACTURING SYSTEMS

WASTE SYSTEMS
The “SYSTEMS”

SUPPLY SYSTEMS
- Air Handling System
- Bulk Chemicals
- Water Supply
- Bulk Gases
- Electrical Power
- Other Supply Systems

PROCESS CHEMICALS/GASES & UTILITIES
- Mfg System #1
- Mfg System #2
- Mfg System #3
- Mfg System #4
- Other Mfg Systems

PROCESS WASTE
- Exhaust Abatement
- Solvent Storage
- Solid Waste
- Other Waste Systems

WASTE DISPOSAL/DISCHARGE

SUPPLIERS

- Corrosive storage and distribution for wastewater treatment
- HF storage and treatment
- Bottled high purity etchants, solvents, corrosives, photoresists
- Look at surplus inventory
The “SYSTEMS”

SUPPLIERS

- Bulk Chemicals
- Water Supply
- Bulk Gases
- Electrical Power
- Other Supply Systems

PROCESS CHEMICALS/GASES & UTILITIES

- Mfg System #1
- Mfg System #2
- Mfg System #3
- Mfg System #4
- Other Mfg Systems

PROCESS WASTE

- Waste Water Treatment
- Exhaust Abatement
- Solvent Storage
- Solid Waste
- Other Waste Systems

WASTE DISPOSAL/DISCHARGE

• Waste water storage and treatment tanks
• Pipe distribution system
• WWT vaults, pumps, control systems
• Look at selling tanks, pumps, controls in agricultural or plating industry
The “SYSTEMS”

SUPPLIERS

- S/S, FRP, galvanized, PVC, polypropylene duct
- Acid and solvent fume scrubbers
- Pumps and exhaust fans
- Look at recycling or selling scrubbers for plating, printed circuit, and biotech industries

PROCESSES & UTILITIES

SUPPLY SYSTEMS

- Water Supply
- Bulk Gases
- Electrical Power
- Other Supply Systems

MANUFACTURING SYSTEMS

- Mfg System #1
- Mfg System #2
- Mfg System #3
- Mfg System #4
- Other Mfg Systems

WASTE SYSTEMS

- Waste Water Treatment
- Exhaust Abatement
- Solvent Storage
- Solid Waste
- Other Waste Systems

WASTE DISPOSAL/DISCHARGE

RAW MATERIALS

PRODUCT

• S/S, FRP, galvanized, PVC, polypropylene duct
• Acid and solvent fume scrubbers
• Pumps and exhaust fans
• Look at recycling or selling scrubbers for plating, printed circuit, and biotech industries
The “SYSTEMS”

SUPPLY SYSTEMS
- Air Handling System
- Bulk Gases
- Electrical Power
- Other Supply Systems

MANUFACTURING SYSTEMS
- Mfg System #1
- Mfg System #2
- Mfg System #3
- Mfg System #4
- Other Mfg Systems

WASTE SYSTEMS
- Waste Water Treatment
- Exhaust Abatement
- Solvent Storage
- Solid Waste
- Other Waste Systems

RAW MATERIALS → WASTE MATERIALS → PRODUCT

SUPPLIERS

- Solvent waste storage tanks
- Solvent waste piping distribution system
  - Look at recycling solvent waste to fuel and asphalt recyclers
- Look at recycling S/S tanks

WASTE DISPOSAL/DISCHARGE
The “SYSTEMS”

SUPPLY SYSTEMS
- Air Handling System
- Bulk Chemicals
- Water Supply System
- Bulk Gases
- Electrical Power
- Other Supply Systems

MANUFACTURING SYSTEMS
- Mfg System #1
- Mfg System #2
- Other Mfg Systems

WASTE SYSTEMS
- Waste Water Treatment
- Exhaust Abatement
- Solvent Storage
- Solid Waste
- Other Waste Systems

SUPPLIERS

PROCESS WASTE
- Duct, piping, equipment parts, PPE, WWT sludges or filter cake, empty drums
- Look at volume reducing waste through compression and dewatering equipment

RAW MATERIALS

PRODUCT

WASTE DISPOSAL/DISCHARGE
Decommissioning Process Flow

**Flow - 1**
Project Scope

**Flow - 2**
Schedule Planning & Resourcing

**Flow - 3**
Decommission all Systems, Sub-Systems, & Components

**Flow - 4**
Disposition of all Systems, Sub-Systems, & Components plus Waste Handling
Decommissioning Process Flow - 1

Flow-1

Project Scope

Create Project Team

Determine end-use of facility

Conduct Site Audit

Develop Closure Plan

Define end-state of all items

Matrix all items by risk & final disposition

Develop Operations Plan

Verify that compliance issues are addressed
Decommissioning Process Flow - 1

Flow-1

Project Scope

Create Project Team

Determine end-use of facility

Conduct Site Audit

Develop Closure Plan

Include sufficient members to ensure both key relationships and coordination -- decision makers, influencers, support staff, suppliers, special service providers, etc.

Define end-state of all items

Matrix all items by risk & final disposition

Develop Operations Plan

Verify that compliance issues are addressed
Decommissioning Process Flow - 1

The final expected fate (disposition) of the facility. Examples include: converted for a similar use; converted for a new use; or demolished. This is key to waste minimization approaches you can employ.
Decommissioning Process Flow - 1

Flow-1

Project Scope

Generate a detailed list of all systems, sub-systems, and components. Locate and review all historical information for the site. This data is invaluable throughout all processes to have cost effective waste minimization. Identify materials and waste for sale, recycling, reuse, storage, etc.

Create Project Team

Determine end-use of facility

Conduct Site Audit

Develop Closure Plan

Define end-state of all items

Matrix all items by risk & final disposition

Develop Operations Plan

Verify that compliance issues are addressed
A Closure Plan should include the following information:

- Clear written goals for all involved stakeholders;
- A schedule and a methodology for modifying it;
- Facility information;
- Manufacturing utilities information;
- Process equipment information – identify waste generated to consider for waste min;
- Compliance summary;
- Decontamination protocols by item per intended disposition;
- Hazardous waste disposal procedures – locations & approach to focus on waste min;
- Identification and qualification of specialized service providers;
- Sampling, audit, and certification procedures to ensure safety and regulatory compliance. — Sample & analysis verification protocol key to moving waste from hazardous to non-hazardous to minimize waste.
Decommissioning Process Flow - 1

Flow-1

- Project Scope

  The final “fate” of the facility and all items within it, including the extent of decommissioning to take place. This analysis and decisions made determines waste minimization approaches and final dollar savings realized.

  - Create Project Team
  - Define end-state of all items
  - Matrix all items by risk & final disposition
  - Develop Operations Plan
  - Develop Closure Plan

  - Conduct Site Audit

  - Decommissioning Process Flow - 1

- Verify that compliance issues are addressed
**Decommissioning Process Flow - 1**

**Flow-1**

Matrix might include details for each system, sub-system, and component such as: disposition, release date, type of contaminants, owner, weight, length, location in facility, photos, etc. In defining and setting up matrix must be clear focus on waste minimization for each component.
**Decommissioning Process Flow - 1**

Operations plan contains all activities, schedule, communication links/channels, organization for all process flow steps. In defining and setting up operations plan must keep waste minimization in mind, how it is incorporated and will be tracked for each component.
Decommissioning Process Flow - 1

Flow-1

Project Scope

Create Project Team

Determine end-use of facility

Conduct Site Audit

Develop Closure Plan

Verify areas in matrix and plans where waste minimization is an objective of the compliance issues. Confirm waste minimization was tracked and followed up.

Define end-state of all items

Matrix all items by risk & final disposition

Develop Operations Plan

Verify that compliance issues are addressed
Decommissioning Process Flow - 2

Flow-2

Schedule Planning & Resourcing

Determine the expertise and services that will be needed from current site personnel BEFORE initiating layoffs. Identify who will be needed, for what, and for how long. Gather historical information on waste materials to maximize waste minimization.

Who will manage the project?

What is timeline and who controls?

How is project being funded?

What services will be required?

What site resources will be available?

What external services will be required?

How will resources be qualified & trained?

Issue an RFP or RFQ

Contractor Selection

Install a formal process for project management

Create a project GANT chart

Develop project plan per item

Define proper waste procedures

Prepare Site-Specific EHS Plan

Prepare Site-Specific EHS Plan

Issue an RFP or RFQ

Contractor Selection

Install a formal process for project management

Create a project GANT chart

Develop project plan per item

Define proper waste procedures
Who will manage the project?
What is timeline and who controls?
How is project being funded?
What services will be required?
What site resources will be available?
What external services will be required?
How will resources be qualified & trained?
Issue an RFP or RFQ
Contractor Selection
Install a formal process for project management
Create a project GANT chart
Develop project plan per item
Incorporate line item for waste material minimization, reuse, recycling, and other disposition options in plan.
Define proper waste procedures
Prepare Site-Specific EHS Plan
Create a Site-Specific EHS Plan
Develop project plan per item
This step includes waste identification, classification, characterization, decontamination, segregation, packaging, labeling, site selection, and volume reduction tasks that can render the waste saleable, reusable, recyclable. The dollar savings realized in waste minimization are maximized or lost in this step.
Decommissioning Process Flow - 2

Selected contractor develops a project-specific EHS plan which meets all applicable EHS regulatory requirements including the elements listed below:

- Hazard specific EHS training;
- Task specific demolition, decontamination procedures focused on waste minimization;
- Job hazard analysis (JHA) for all construction related tasks;
- Leading indicator programs; Setup indicators to initiate segregating materials & waste for recycling, reuse, volume reduction, disposal
- A housekeeping plan; Prevents unnecessary waste being disposed of rather than minimized
- A disciplinary action plan;
- Incident reporting and investigation;
- A return-to-work program;
- A new employee training program (buddy program); and
- A project readiness plan.
Decommissioning Process Flow - 3

Decommission all Systems, Sub-Systems, & Components

Flow - 3

Decommission each item per procedures

Perform in-place decon per item plan

Complete required documentation & affix labels

Review each item’s final status

Demolition as required per procedure
Decommissioning spans from pre-disconnect activities and drawing verifications to disconnecting tools from utilities and disassociating all items from other manufacturing systems. This task should be carefully planned and tracked to capture all the waste materials generated from the systems to obtain maximum waste minimization.
Decommissioning Process Flow - 3

Decontamination procedures and verification sampling & analysis protocol for each in-place tool, piece of equipment and facility area is paramount to performing this task; Clean, segregate, and size reduce exhaust duct, process pipe, and equipment parts for metals, plastic to reuse and recycle is critical to effectively minimizing waste.

Flow - 3

Decommission all Systems, Sub-Systems, & Components

Perform in-place decon per item plan

Complete required documentation & affix labels

Review each item’s final status

Demolition as required per procedure
Starting with original site audit matrix all waste must be documented and tracked throughout the whole decommissioning processes. Use color coded labels to identify requirements and materials that are reusable, size reducible, recyclable for achieving waste minimization objectives.
Decommissioning Process Flow - 3

Decommission all Systems, Sub-Systems, & Components

Review and check with the plans each system, subsystem and their components starting at beginning of process to the end of the items life cycle; Confirm each item that is to be handled during decommissioning and decontamination for waste minimization is in fact being executed properly.
Decommission all Systems, Sub-Systems, & Components

Flow - 3

Demolition activities include system, sub-system, or component disconnection, support cable pulling, tool move, and tool utility demolition back to point of facility interface. Segregate debris and materials during demo that are reusable and recyclable that can be waste minimized; Align waste streams and demo debris with matrix of risk and final disposition; Track to make sure it is handled properly;

Decommission each item per procedures

Complete required documentation & affix labels

Review each item's final status

Demolition as required per procedure
Decommissioning Process Flow - 4

Flow - 4

Disposition of all Systems, Sub-Systems, & Components plus Waste Handling

Reference the item disposition matrix

Coordinate with certified HazMat shipper

Prepare to ship all items

Prepare all wastes for proper shipping & disposal

Execute disposition plan

Sale and/or transfer for re-use

Storage for future use

Scrap or salvage

Donation

Disposal
Check and double-check disposition matrix developed during audit and planning steps to make sure waste minimization objectives are being executed fully.

Decommissioning Process Flow - 4

Reference the item disposition matrix

Coordinate with certified HazMat shipper

Prepare to ship all items

Prepare all wastes for proper shipping & disposal

Execute disposition plan

Sale and/or transfer for re-use

Storage for future use

Scrap or salvage

Donation

Disposal
Disposal of all Systems, Sub-Systems, & Components plus Waste Handling

Check DOT licenses, training records of employees, insurance coverage, and other client references before hiring shippers. Check scrap and recycling facility permits and capabilities to take advantage of reuse and recycling savings.

Reference the item disposition matrix

Coordinate with certified HazMat shipper

Prepare to ship all items

Prepare all wastes for proper shipping & disposal

Execute disposition plan

Sale and/or transfer for re-use

Storage for future use

Scrap or salvage

Donation

Disposal
Origin Services:
- Package item per spec to prevent against leakage or contamination.
- Coordinate removal and rigging (may include contracting disassembly of systems).
- Export packing and crating (for immediate shipment or storage).
- All risk cargo transit insurance, if required.
- Preparation of shipping and export documentation.
- Outbound shipment by air and/or sea.

Confirm all waste & recycled or reused materials are packaged to meet DOT & Int’l requirements/laws.
Decommissioning Process Flow - 4

- Profile waste or recyclable/scrap materials with facility
- Prepare manifests, shipping documents – generator sign paperwork
- Schedule disposal or recycling site receiving date
- Request certificate of destruction for waste incinerated

Audit final destination disposal or recycling facility. Check scrap and recycling facility permits and capabilities to take advantage of reuse and recycling savings.

Flow - 4

Disposition of all Systems, Sub-Systems, & Components plus Waste Handling

Reference the item disposition matrix

Coordinate with certified HazMat shipper

Prepare to ship all items

Prepare all wastes for proper shipping & disposal

Execute disposition plan

- Sale and/or transfer for re-use
- Storage for future use
- Scrap or salvage
- Donation
- Disposal
Disposition of all Systems, Sub-Systems, & Components plus Waste Handling

Preparation:
- Prepare to ship all items
- Prepare all wastes for proper shipping & disposal

Disposal:
- Sale and/or transfer for re-use
- Storage for future use
- Scrap or salvage
- Donation
- Disposal

Flow - 4

Destination Services:
- Assistance with and coordination of import permit documentation (as applicable).
- Import and customs clearance services at arrival port.
- Facilitation of import duty payments.
- Warehousing upon arrival, if required.
- Delivery to destination sites as required to meet production schedules.
- Coordination of delivery and/or rigging at destination site, as required.

Confirm any waste materials or equipment is recycled or reused to maximize waste minimization.
There is no single decontamination answer for an entire project. The degree of decontamination required is a function of the item’s intended disposition. Decontamination and sampling and analysis verification protocols should be designed based upon each item’s prior process exposure, intended disposition, and whether or not a return to process is required.
DECON developed wipe sampling verification protocol for facility closures.

Satisfies regulators for equipment or facility closure when compared to Federal, State, Local regulatory standards (Federal WET, TCLP; CA TTLC, STLC, etc.).

Formula used is based on determining chemical constituent concentration amount on surfaces with a discrete thickness and known density.

Final wipe sample result calculated is mg/kg or ppm.

Result compares to most regulatory standards for hazardous waste characterization.

Result provides verification that the surface has been decontaminated to the acceptable regulatory or company-standard chemical constituent concentration.
Decommissioning Process Flow - 4

- Include in transfer for reuse or sale of assets the transfer of ownership with acceptance of Decontamination Declaration Statement and backup information (analytical methods, data, and procedures performed, date performed, calculations converting wipe sample to kg/mg or ppm, comparison tables with cleanup criteria set to regulatory standards or client guidelines)
- Include list of previously used chemicals in system, subsystem, or facility area.

Savings from waste minimization in the sale/reuse process is dependent on following these steps.
• Purge, clean and cap systems, subsystems, and components
• Equipment systems, subsystems, and components that are decontaminated should have an attached Decontamination Declaration signed by previous owner, tool engineer responsible for tool, responsible EH&S manager, and the decon contractor’s responsible representative
• It is critical in terms of future waste minimization that records of this step be secured and accessible to owners
Clean systems, subsystems, and components as required by scrap or salvage firm receiving the materials, waste, or equipment and to satisfy transport laws and requirements.

Volume reduction of scrap and waste provides significant dollar savings in the waste minimization process.

Prepare all wastes for proper shipping & disposal

Dispose of all Systems, Sub-Systems, & Components plus Waste Handling

Execute disposition plan

Disposal

Donation

Scrap or salvage

Storage for future use

Sale and/or transfer for re-use
Deecommissioning Process Flow - 4

Make sure receiving organization obtains:
- Copy of final signed Decontamination Declaration Statement
- Verification sampling and analysis data, calculations, summary tables
- List of equipment, systems, subsystems, components, or facility areas that still have chemicals present
- Any tax benefits or other dollar savings obtained from this waste minimization option need to have detailed documentation

Flow - 4

Disposal of all Systems, Sub-Systems, & Components plus Waste Handling

Prepare all wastes for proper shipping & disposal

Execute disposition plan

Sale and/or transfer for re-use
Storage for future use
Scrap or salvage
Donation
Disposal

Refer to the item disposition matrix
Disposition of all Systems, Sub-Systems, & Components plus Waste Handling

- Characterize, profile, properly label and package hazardous and non-hazardous waste to permitted and licensed facilities only.
- Keep and store securely documentation of all waste disposal activities. In terms of waste minimization try to execute volume reduction and compression or treatment options before exercising this option if it is not cost prohibitive.

Flow - 4

- Coordinate with certified HazMat shipper
- Reference the item disposition matrix
- Prepare to ship all items
- Prepare all wastes for proper shipping & disposal
- Execute disposition plan

Disposition options:
- Sale and/or transfer for re-use
- Storage for future use
- Scrap or salvage
- Donation
- Disposal
Acknowledgments and References

- The industry professionals who have participated in the global series of SEMI Decommissioning Workshops

- The 40 members of the SEMI Decommissioning Task Force

For More Detailed Information

- Presentation slides
- **DECON Verification Wipe Sampling Protocol for Facility Closures**
- Other DECON facility and equipment decommissioning and decontamination procedures
- Leave your business card, or

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