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INCLUSION OF TREATMENT/PACKAGING PROCEDURES FOR PYROPHORIC MATERIAL INTO REMOVAL ACTION #9 - REMOVAL OF WASTE INVENTORIES

03/11/97

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DOE-FEMP EPAS
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PLAN

Department of Energy

Ohio Field Office
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

MAR 11 1997

DOE-0493-97

Mr. James Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

INCLUSION OF TREATMENT/PACKAGING PROCEDURES FOR PYROPHORIC MATERIAL INTO REMOVAL ACTION #9 - REMOVAL OF WASTE INVENTORIES

Enclosed are the Perma-Fix treatment/packaging procedures for potentially pyrophoric material stored at the Fernald Environmental Management Project (FEMP). The FEMP requests that these procedures be included in Removal Action #9 (RA #9), "Removal of Waste Inventories."

There are approximately 50 drums stored at the Fernald site containing uranium chips and turnings which may be pyrophoric. This waste stream consists of excess source material from the production of uranium metal, defined under Section 11 of the Atomic Energy Act (AEA). Section 1004 (27) of the Resource Conservation Recovery Act (RCRA) specifically excludes these materials as defined by the amended AEA from the definition of solid and hazardous wastes. However, this material is regulated as a solid, low level radioactive waste under ORC-3734.01 (J)(1) and (2).

The pyrophoric material, in its current form, does not meet the Nevada Test Site (NTS) Waste Acceptance Criteria (WAC); therefore, it will need to be deactivated. Treatment to deactivate the pyrophoric nature of the waste in order to meet the NTS WAC complies with the plan scope under RA #9. Deactivation of the uranium metal will be performed by mixing it with mineral oil and gypsum. The material will then be packaged in a safe configuration, in accordance with procedures for the Neutralization/Precipitation/Deactivation/Stabilization (NPDS) project. Perma-Fix Environmental Services, Inc. will perform the treatment/packaging work at the FEMP site prior to shipment to the NTS.

Recycled and Recyclable

If there are any questions concerning this matter, please contact Robert Danner at (513) 648-3139.

Sincerely,

Johnny Reising

Johnny W. Reising
Fernald Remedial Action
Project Manager

FEMP:Danner

Enclosure: As Stated

cc w/enc:

S. Fauver, EM-42/GTN
AR Coordinator/78
EDC, FDF/52-7

cc w/o enc:

R. Danner, DOE-FEMP
J. Sattler, DOE-FEMP
S. Beckman, FDF/65-2
D. Dilday, FDF/16-2
M. Thomas, FDF/16-2
T. Walsh, FDF/65-2

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Perma-Fix Environmental Services, Inc.

Process Operating Procedure

NPDS Project

Approval: Tim Kibbell

DEACTIVATION OF URANIUM TURNINGS

I. POLICY

PESI policy is to minimize the risk of personnel injury and radioactive exposure while efficiently performing deactivation/stabilization of uranium metal turnings for off-site disposal as low level radioactive waste (LLRW). The process goal of the deactivation/stabilization treatment is to produce a solid monolith inside a disposal container that is no longer potentially pyrophoric. This procedure establishes the guidance that PESI operators and subcontractor personnel must use when performing deactivation/stabilization of uranium metal turnings using the Perma-Fix Mixer.

II. DISCUSSION

Uranium metal reacts with oxygen in the air to produce uranium oxide which is a more chemically stable form. Uranium turnings are potentially pyrophoric in air due to their high surface area. Deactivation of uranium metal will be performed by inerting it in a grout formulated with portland cement, gypsum, and water. The metal surfaces will be saturated with mineral oil before the metals is submerged in the grout. This will help to prevent violent reactions between the water and the uranium metal. Unless otherwise authorized by Fluor Daniel, this procedure is to be used only for deactivation of metallic uranium wastes.

III. DEFINITIONS

Design Recipe - Prescribed dosages of one or more chemical reagents that have been shown by bench-scale testing to be effective in solidifying wastes having a specific waste profile.

Design Recipe Notice - An easy to read notice which is posted at each operator location, to communicate the currently applicable design recipe, raw waste profile and performance specifications to the operators.

Performance Specifications - A set of chemical and physical criteria which comprise minimum performance expectations for successful treatment of wastes fitting the raw waste profile using the design recipe.

Raw Waste Profile - A physical description of a waste category that is used to evaluate incoming waste batches for applicability of the design recipe.

White Metal Box (WMB) - A DOT strong, tight container built to FERMCO/NTS specifications and painted white. Approximate dimensions are 7 ft. × 4 ft. × 2 ft., giving a useful storage capacity of 40 cubic feet.

IV. REFERENCES

POP-CT-2.2, *Drum Opening, Inspection, and Liquid Adjustments, Process Stage 1*
POP-CT-2.8, *Chemical Treatment, Process Stage 4*
POP-CT-2.9, *Solidification Treatment, Process Stage 5*

V. PROCEDURE

This procedure is considered to be an addendum to POP-2.2, POP-2.8, and POP-2.9. The drum handling and mixing methods described in those three procedures are applicable to this procedure. This procedure describes the additional requirements and process steps which the operators must perform to minimize radiological and chemical hazards while performing deactivation/stabilization treatment of uranium metal turnings.

Uranium metal turnings will be deactivated by inerting in a grout formulated with portland cement, gypsum, and water. However, water and uranium metal can have a violent reaction which produces hydrogen gas. To prevent such a reaction, the uranium metal turnings will be saturated with mineral oil before it is mixed with the grout. The oil film will prevent a water/uranium reaction until the water is absorbed and chemically bound by the portland cement. The mineral oil will be absorbed and bound by the gypsum.

Since these materials are not regulated under RCRA, the design recipe will not include a precipitation step for toxic metals. The deactivation treatment will be performed in a WMB. The following procedural steps will be performed in deactivating uranium metal turnings.

Performer		Action
Safety Officer	1.	Will confirm the availability of 2 open drums of magnesium fluoride adjacent to the WMB, and that all combustible materials have been removed from the area within a radius of 10 feet from the WMB. Will notify (FDF Safety) so that they can have a representative present prior to opening containers or treating uranium

Performer		Action
Safety Officer (Cont'd)		metal turnings.
Mix Unit Operator	2.	Will prepare up to four drums of thin grout using water, portland cement, and gypsum, immediately before the treatment of uranium metal turnings begins. Also will have at least 5 charges each of dry gypsum plaster, and portland cement available.
Decant Operator	3.	Will open and inspect each drum of uranium turnings, and will immediately add mineral oil, as necessary to ensure that the uranium in the drum is saturated in mineral oil, before proceeding with treatment.
	4.	Will have one to two drums of grout mixture poured into the empty WMB.
	5.	Then will have a drum of oil-saturated uranium metal turnings poured into the grout layer in the WMB.
	6.	Using wooden or plastic tools (hoes or paddles), will hand mix the grout and uranium turnings to ensure that no air pockets remain in the mixed layer. May also bounce the box up and down with the lift truck.
		Warning: Use of metal tools may cause sparking at the surface of the uranium metal, resulting in ignition.
	7.	Will check the mixed layer to determine whether more gypsum plaster is needed to absorb and bind all of the mineral oil. If so, will add dry plaster to the box and mix with hoes or paddles.
	8.	Will have another one to two drums of grout poured into the WMB and then will add the next drum of uranium turnings and hand mix the layers again.
	9.	Repeats steps 4 through 8 until the WMB is full of a homogeneous mixture of uranium metal turnings and grout.

Note: There should be no visible metal turnings at the surface of the box. If necessary, add a thin layer of undisturbed grout on top of the waste.

10. Feels the side of the WMB to monitor for generation of high heat, also looks for smoldering, foaming, off-gassing, or other signs of combustion. Notifies FDF Fire Safety of any such signs via radio, phone or pull station.

VI. ATTACHMENTS

None

Perma-Fix Environmental Services, Inc.

Process Operating Procedure

NPDS Project

Approval: _____

DRUM OPENING, INSPECTION AND LIQUID ADJUSTMENTS PROCESS STAGE 1

I. POLICY

PESI policy is to minimize the risk of personnel injury while efficiently performing drum handling activities. Whenever possible, movement, lifting and dumping of drums will be performed using mechanical devices. This procedure establishes the guidance that PESI operators and subcontractor personnel must use when performing drum opening and inspection operations.

II. DISCUSSION

Drum opening and inspection takes place in several locations inside the project exclusion zone. Initial opening of original waste drums is performed by FERMCO personnel at the Drum Opening and Inspection Station (See Figure 1). A Perma-Fix Team member will inspect the waste in each drum, and record his/her observations in Section B of the Operations Log Sheet. Adjustments to the water content of the waste in the drum will be made by either adding or removing water as described in this procedure. When these activities have been completed, FERMCO personnel will replace the drum lid and clamp it in place with a lever-lock ring, and will move the sealed drum to a designated location in the Feed Drum Staging Area (See Figure 1). Inspected drums in the Feed Drum Staging Area will be staged in their Compatible Waste Groups (CWGs) to await log-in by FERMCO Materials Control and Accountability (MC&A).

The other locations where drum inspections may be performed are the infeed conveyor of the screen hopper hydraulic drum lift and at the mixer. Before a drum is lifted and dumped into the screen hopper, the lift operator will visually verify that the waste has the right water content. There should be no free water layer on top of the solids in the drum, but the waste should not be so dry and dusty as to put an excessive dust load on the HEPA filter systems. If the operator decides that water is needed he will add it to the drum prior to the lift. Whenever Perma-Fix Team personnel open a waste drum, it will be by removing the lever-lock ring, and then lifting or removing the drum lid.

In some operational situations, drums of granular or dusty materials may be taken to the mixer to be slurried with water. After slurrying, the drums can be dumped into the screen hopper with much less dust.

For reactive wastes (magnesium metal), contact with water could cause a serious fire. To prevent water contact, mineral oil will be used as a wetting agent as described in POP-CT-2.23, "Stabilization of Reactives."

III. DEFINITIONS

Compatible Waste Group (CWG) - A group of waste containers assembled from a single waste category that exhibit similar waste characteristics and are amenable to the same treatment method and reagent recipe. The total waste volume of a CWG will be adjusted to fill one White Metal Box (WMB) after all compatible solids, reagents and hydration water have been added.

Drum - A drum is a cylindrical metal container of 30, 55, 85, or 110-gallon holding capacity, with a removable lid. Multiple drums contained within larger drums may be encountered. Large drums which contain other smaller drums may also be referred to as Overpacks.

Drum Opening and Inspection Station - A partially-enclosed, ventilated area where waste drums are opened or deheaded (cut open). This area is covered with an impermeable floor covering and is equipped with a gravity roller conveyor, and a dust/fume collection system intake hood.

Feed Drum Staging Area - An open area near the Drum Opening and Inspection Station where original waste drums are grouped into compatible waste groups, and are staged prior to processing through the stabilization process.

Drum Grapple - A hydraulic device which mounts on the blades of a lift truck and allows a lift truck operator to approach, grapple, raise, and lower a drum, without leaving his seat.

Gravity Roller Conveyor - A system of rollers on a frame which supports a drum and allows easy lateral movement along the length of the frame.

Lift Truck - A propane-fueled internal combustion engine or electric-drive vehicle with hydraulic lift for the lifting and transporting of loaded pallets or containers. Lift trucks for this project will have a rated lifting capacity adequate for the anticipated load, plus at least a 25 percent safety factor. For the purposes of this procedure, lift trucks and hand stackers are considered to be functionally equivalent.

White Metal Box (WMB) - A DOT strong, tight container built to FERMCO/NTS specifications and painted white. Approximate dimensions are 7 ft. × 4 ft. × 2 ft., giving a useful storage capacity of 40 cubic feet.

IV. REFERENCES

None

V. PROCEDURE

A. Initial Drum Opening, Inspection and Water Adjustment

This procedure is for opening and inspecting waste drums that are in good condition, and can be opened by removing the lid retention ring and the lid. Severely deteriorated drums, bulging drums, or drums with severely corroded lid retention ring bolts may not be amenable to this procedure. In these cases, alternative means of drum opening may be required. In all initial drum opening and inspection activities performed by FERMCO personnel, FERMCO procedures will govern the work.

Performer	Action
PESI Drum Inspector	1. Receives the waste grouping lists from the PESI process supervisor and uses them to direct the work at the Drum Opening and Inspection Station. Records the beginning date and time of drum opening and inspection activities at the top of Section B of the Operations Log Sheet.
	2. Requests the FERMCO supervisor to provide the assistance of FERMCO hazardous waste technicians in: • Moving drums from the Incoming Waste Staging Area to the Drum Opening and Inspection Station. • Opening drums. • Adding/removing excess water/liquid. • Closing drums with lever-lock lids. **Note:** No more than 10 waste drums can be opened at any one time.

Performer	Action
PESI Drum Inspector (Cont'd)	3. Inspects the contents of each drum and records the size of the outer container and each inner container in the spaces provided in Section B of the Operations Log Sheet.
	4. Performs a visual inspection of the drum contents and records in Section B of the Operations Log Sheet whether the waste is dusty or has free liquid present. Also records whether water or mineral oil as appropriate was added or removed from the drum, and any other pertinent observations.
	5. Groups inspected waste containers to make up Compatible Waste Groups (CWGs) and supervises the movement of the CWG containers to a dedicated area in the Feed Drum Staging Area (See Figure 1).
	6. Secures the assistance of a FERMCO lift truck operator in moving all of the containers of a CWG to their dedicated staging location in the Feed Drum Staging Area, per agreements between FERMCO and PESI.
	7. Records the ending date and time of drum opening and inspection operations in Section B of the Operations Log Sheet. Places the Operations Log Sheet on top of the first drum in the CWG.

B. Confirmatory Drum Opening, Inspection and Liquid Adjustment

This procedure is for opening and inspecting original waste drums after they have been previously opened at the Drum Opening and Inspection Station. At any location where confirmatory drum opening and inspection take place the method of drum opening will be to first unlatch and remove the lever-lock ring, and then lift and remove the drum lid. The main location where this activity will be performed is on the infeed conveyor at the screen hopper hydraulic drum lift. However, this procedure may be used anywhere that a previously inspected drum requires reopening.

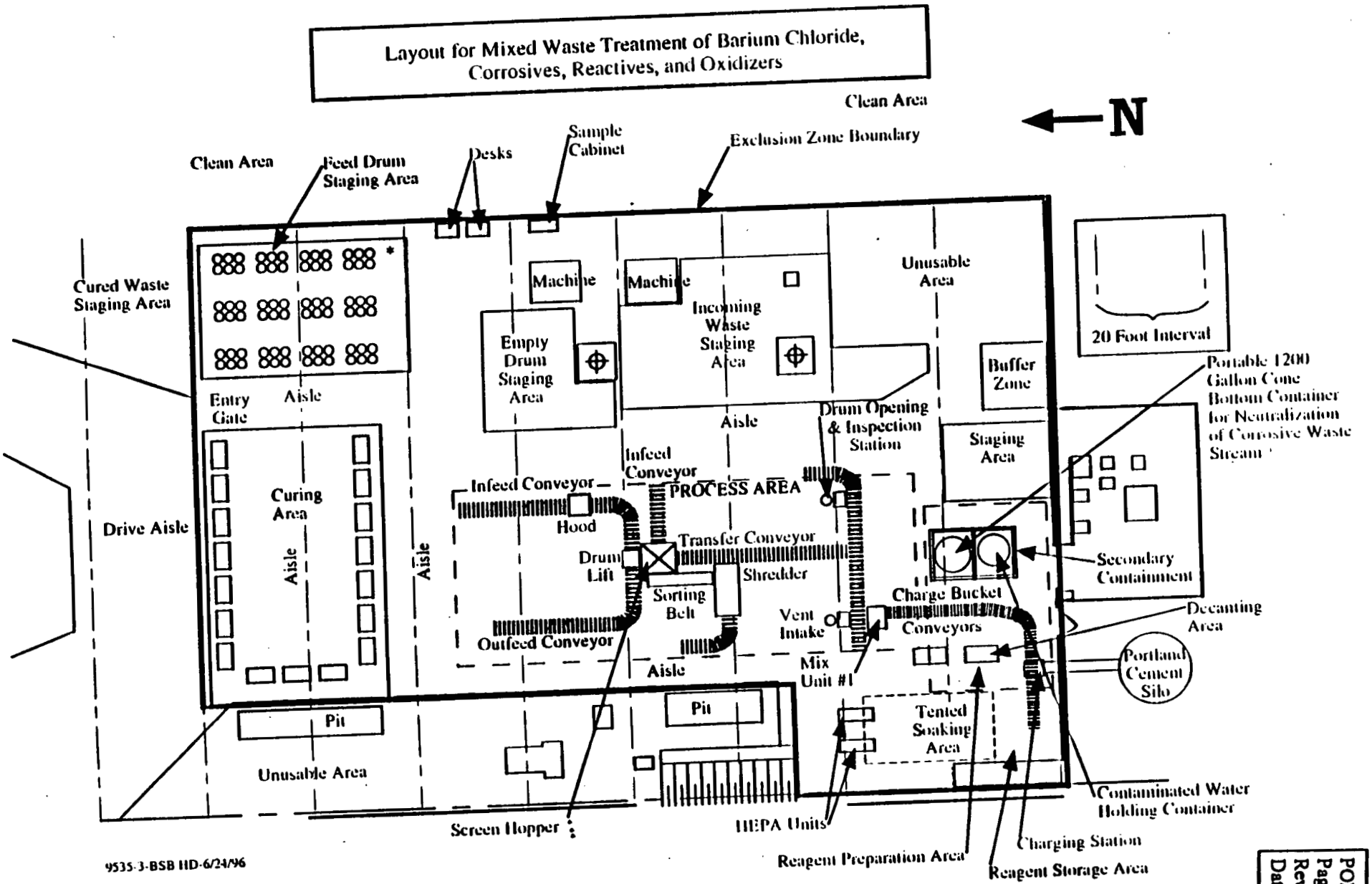
Performer	Action
Any PESI Team Member	1. Carefully loosens and removes the Lever-Lock ring, while guarding against hand or finger pinches.

Performer	Action
Any PESI Team Member (Cont'd)	2. Carefully lifts or removes the drum lid while guarding against potential sudden releases.
	3. Visually inspects the waste to ensure that dusty materials have been adequately wetted to prevent excessive dust emissions.
	4. Adds water or mineral oil (as appropriate) to the waste if materials still appear dusty, while guarding against adding too much wetting agent. **Note:** Free liquid layers on top of the waste solids are to be avoided.

VI. ATTACHMENTS

A. Figure 1 - Plant 6 Equipment Layout

B. Figure 2 - Waste Preparation Process



* Prepared Waste Drums Staged in CWGs

Mixed Waste Stabilization Project Layout Modified to Treat Barium Chloride and Other Waste Residues
Plant 6 Equipment Layout

Figure 1
Fernald Plant 6 Layout of Mobile Treatment Unit

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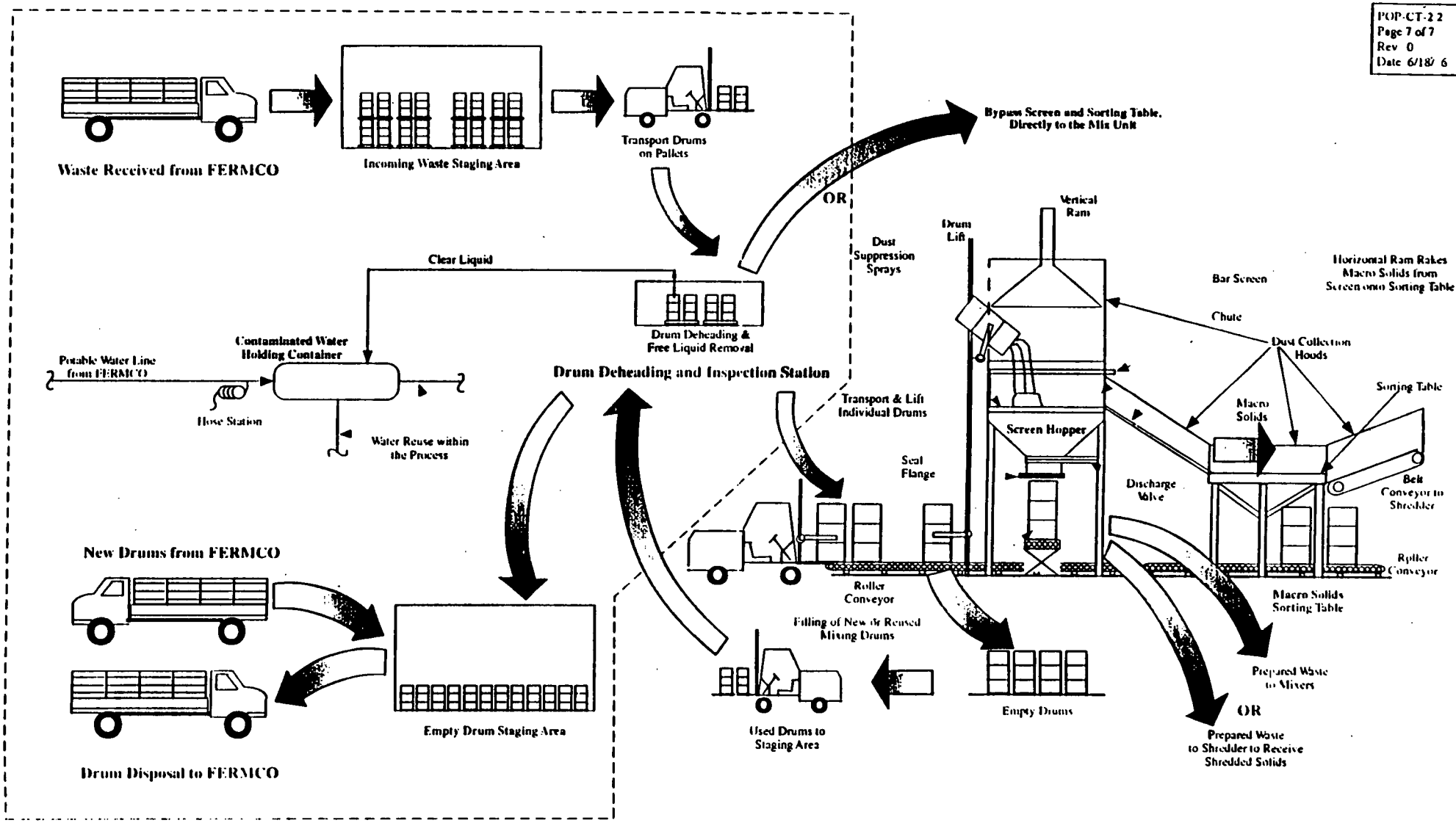


Figure 2
Waste Preparation Process

Perma-Fix Environmental Services, Inc.

Process Operating Procedure

NPDS Project

Approval: _____

CHEMICAL TREATMENT PROCESS STAGE 4

I. POLICY

PESI policy is to minimize the risk of personnel injury while efficiently performing chemical treatment of prepared waste or waste mixtures, prior to solidification treatment. The process goal of the chemical treatment activity is to chemically precipitate all toxic heavy metals and radionuclides so as to minimize their leachability from the final treated waste form. This procedure establishes the guidance that PESI operators and subcontractor personnel must use when performing chemical treatment using the Perma-Fix Mixer.

II. DISCUSSION

Chemical treatment by the Perma-Fix Process involves the precipitation of toxic heavy metals and radionuclides in a chemical form that has low water solubility compared to that of the untreated waste. The steps of the chemical treatment and the reagents used will vary somewhat with waste types. For standard treatment, sodium sulfide stabilization will effectively precipitate all heavy metals, except for barium and hexavalent chromium. For wastes expected to contain high concentrations of these metals, pretreatment with ferrous sulfate may be needed to reduce the leachability of these metals, before the other metals are put into their sulfide or hydroxide forms.

This procedure assumes that the treatment reagents are added at the mix units while mixing is performed. Reagents may be added at other locations only if those locations are equipped with fume/dust collection systems.

III. DEFINITIONS

Compatible Waste Group (CWG) - A group of waste containers assembled from a single waste category that exhibit similar waste characteristics and are amenable to the same treatment method and reagent recipe. The total waste volume of a CWG will be adjusted to fill one White Metal Box (WMB) after all compatible solids, reagents and hydration water have been added.

Chemical Treatment - A chemical reaction in which soluble metal ions are made essentially insoluble by a precipitation reaction.

Precipitation Reagent - A chemical compound which reacts with metal ions to form an insoluble precipitate. Precipitation reagents for this project include ferrous sulfate and sodium sulfide.

pH - A measure of the relative acidic or basic nature of a water, sludge or waste. The pH scale extends from 0 to 14, with 7 being the neutral point (neither acid nor base). A pH value between 0 and 7 is acidic with lower values indicating greater acidity. A pH value between 7 and 14 is basic with higher values indicating greater basicity.

pH Control Reagents - Chemical compounds which are added to water, sludge or waste to adjust its pH either up or down. To decrease pH, an acidic reagent is used. To increase pH a basic reagent is used. Commonly used acidic reagents include: sulfuric acid, hydrochloric acid, and sodium bisulfate. Commonly used basic reagents include: sodium hydroxide, lime, and sodium carbonate.

Sulfide Reaction End Point - The point of equivalency where enough sodium sulfide reagent has been added to exactly balance the sulfide demand exhibited by all of the precipitable metals in the waste.

Lead Acetate Paper Test - A colorimetric test using lead acetate saturated paper test strips to detect when the sulfide reaction end point has been attained. The lead acetate reacts with free sulfide to produce a stain varying in color from beige to black depending on the concentration of free sulfide present. A black color indicates a great excess of free sulfide, a beige to light brown color indicates only a slight excess of free sulfide. The test is performed after sodium sulfide has been added to the waste, completely dispersed, and reacted with the waste mass.

White Metal Box (WMB) - A DOT strong, tight container built to FERMCO/NTS specifications and painted white. Approximate dimensions are 7 ft. × 4 ft. × 2 ft., giving a useful storage capacity of 40 cubic feet.

IV. REFERENCES

1. POP-CT-2.5, *"Inspections and Tests"*
2. POP-CT-2.9, *"Solidification Treatment, Process Stage 5"*

V. PROCEDURE

A. Loading and Log-in of Waste for Chemical Treatment

Mixing drums containing prepared waste or waste/solids mixtures are transported to the mix unit on gravity roller conveyors. Figure 1 shows the locations of the mix unit in Plant 6, and Figure 2 provides a process schematic of the chemical treatment process. The mixing drums are grouped into Compatible Waste Groups (CWGs) sized to fill a WMB after treatment has been completed. The degree to which each mixing drum is filled with waste/solids is dictated by the Design Recipe. Each CWG is treated as a group, and no mixing drums from other CWGs are processed by the mix unit until the previous CWG has been completed.

The following procedures describe how each mixing drum is chemically treated prior to the addition of solidification reagents.

Performer	Action
PESI Screen Operator	1. Pushes mixing drums from a specific CWG along the roller conveyor from the Screen Hopper to the bottom of the shredder or to the Mix Unit.
PESI Shredder Operator	2. Pushes drums containing shredded solids (or shredded solids and prepared waste) along the roller conveyor from the shredder to the Mix Unit.
PESI Mix Unit Operator	3. Receives and stages 55-gallon drums from the Screening or Shredding Areas in CWGs, along the Transfer Roller Conveyor.
	4. Ensures that all mixing drums in a specific CWG have been chemically treated before initiating log-in and loading of the next CWG underneath the mixer.
	5. Logs in each waste container by recording the following information in the spaces provided in Section D of the Operations Log Sheet: Mixing Drum Inventory Number CWG Number Log-In Date and Time Material Description

Performer	Action
PESI Mix Unit	6. Moves prepared drums along the roller conveyor, one at a time, under the mixer and hydraulically clamps each drum in place. (For descriptions of treatment mixing refer to Sections B, C or D as appropriate).
	7. Adds slurry liquid (water or mineral oil as appropriate) and mixes to homogenize.
	8. For water slurried waste, uses pH indicator paper to check the initial pH of the prepared waste and records the result in the space provided in Section D of the Operations Log Sheet.

B. Chemical Precipitation of Barium and Hexavalent Chromium

If the Design Recipe Notice requires precipitation of hexavalent chromium and barium, the following procedure should be followed. This procedure considers chemical reduction of chromium and sulfate precipitation of barium to be a chemical treatment step which immediately precedes solidification treatment. In some cases the chromium reduction/barium precipitation step takes place and then the waste is allowed to react and soak overnight before the rest of the required treatment takes place.

Note: Data to be recorded on the Operations Log Sheet by the Mix Unit Operator recorded or at the time that treatment of each CWG is completed. In no case shall data recording be delayed past the completion of treatment for that CWG.

Performer	Action
PESI Mix Unit Operator	1. Using hydraulic controls, raises the mixer assembly high enough for the bottom of the impeller to clear the top of the mixing drum.
	2. Manually swings the Mix Unit arm over the drum, and hydraulically lowers the impeller into the waste, taking care not to puncture the sides of the drum.
	3. Using hydraulic controls drives the mixer in forward or reverse rotation at speeds up to 300 rpm to agitate the waste inside the mixing drum.

Performer	Action
PESI Mix Unit Operator (Cont'd)	4. Pivots the mixer support arm by hand, and uses the horizontal ram to move the mixer inside the mixing drum so as to ensure that all wastes and shredded solids in the drum are thoroughly mixed.
	5. Continues mixing until all lumps or irregularities inside the drum have been broken up and homogenized.
	6. If pH is above 6, adds sodium bisulfate until pH tests show less than 6. Records the adjusted pH in the spaces provided in Section D of the Operations Log Sheet.
	7. After waste color, consistency and texture are uniform throughout the mixing drum, adds the prescribed amount (See the Design Recipe Notice posted at each work station) of reducing agent (ferrous sulfate) and mixes thoroughly. Note: At this point, the design treatment recipe may require that the waste be reacted during a soaking period before proceeding with further treatment. If so, removes the mixer from the drum and moves the drum to the Soaking Area (See Figure 1). The assistance of a FERMCO Lift Truck Operator will be needed for movement of drums to the soaking area. If a soaking period is not required, proceeds directly to step 8 below.
	8. Performs extractions and comparison or spectrophotometer tests of representative samples to evaluate completeness of barium or chromium treatment testing methods as presented in Reference 1.
	9. When ferrous sulfate mixing is complete, records the amount of the reducing agent (ferrous sulfate) added in Section D of the Operations Log Sheet.
	10. Proceeds to Step C below.

C. pH Adjustment and Soaking of Chemically Treated Wastes

For wastes containing high concentrations of barium and hexavalent chromium, a soaking period may be required. Bench-scale tests have shown the production of hydrogen sulfide gas from sodium sulfide treatment of wastes to be insignificant as long as the pH of the waste is over 7.0. For purposes of ensuring a factor of safety, pH will be adjusted to at least 8.0 before sodium sulfide treatment begins. For wastes that have been demonstrated during the bench scale tests to release ammonia during the solidification treatment step, pH will be adjusted to 12.0 or higher, and these wastes will be allowed to soak overnight before further processing. The following are procedures for adjusting pH.

Performer		Action
PESI Mix Unit Operator	1.	Using hydraulic controls, drives the mixer in forward or reverse rotation at speeds up to 300 rpm to agitate the waste inside the mixing drum.
	2.	If pH is below the value prescribed in the design recipe (8.0 or 12.0), adds sodium hydroxide, portland cement, or lime until pH tests show a pH equal to or greater than the value prescribed. Records the final adjusted pH in the spaces provided in Section D of the Operations Log Sheet.
	3.	If the design recipe calls for soaking the waste in the drum overnight, removes the mixer from the drum and obtains the assistance of a FERMCO Lift Truck Operator in moving the drum to a designated soaking area. If soaking is not required, proceeds directly to step D below.

D. Chemical Treatment with Sodium Sulfide

If necessary, standard treatment with sodium sulfide will follow steps B and C above. Standard treatment of mixed wastes with sodium sulfide while mixing with the Perma-Fix Mixer is described as follows. The Mix Unit Operator is responsible for compliance with this procedure.

Note: Data to be recorded on the Operations Log Sheet by the Mix Unit Operator be recorded at the time that treatment of each CWG is completed.

Performer	Action
PESI Mix Unit Operator	1. If a soaking period took place, uses the methods described in Reference 1 to recheck the pH in each mixing drum, to ensure that pH is at least 8.0. If pH is below the required value, goes back to Section C above, to adjust pH.
	2. Using hydraulic controls, raises the mixer assembly high enough for the bottom of the impeller to clear the top of the mixing drum.
	3. Manually swings the Mix Unit arm over the drum, and hydraulically lowers the impeller into the waste, taking care not to puncture the sides of the drum, and then proceeds with mixing of the drum.
	4. Using hydraulic controls drives the mixer in forward or reverse rotation at speeds up to 300 rpm to agitate the waste inside the mixing drum.
	5. Pivots the mixer support arm by hand, and uses the horizontal ram to move the mixer inside the mixing drum so as to ensure that all wastes and shredded solids in the drum are thoroughly mixed.
	6. Continues mixing until all lumps or irregularities inside the drum have been broken up and homogenized.
	7. Adds the initial dose of sodium sulfide to the drum (See Design Recipe Notice posted at the work station) and mixes thoroughly, observing color and texture of the waste to make sure that all sulfide has been thoroughly dispersed and reacted with the waste. Mixing time will be for at least one minute after color and texture appear homogeneous.
	8. After waste color and texture are uniform throughout the mixing drum, performs lead-acetate paper test as described in Reference 1 to evaluate for the sulfide reaction end point. The end point is reached when the (CIV) of the paper strip matches the comparison chart between 6 and 10 on the CIV scale.
	9. If the CIV is less than 6, repeats steps 6, 7, and 8 with small incremental doses of additional sodium sulfide until the CIV is within the control range specified above.

Performer	Action
PESI Mix Unit Operator (Cont'd)	10. When mixing is complete and the CIV is within the control range, stops mixing operations, and records the total sulfide dose added, and acknowledges the final CIV result (CIV equals 6 or greater) in the spaces provided in Section D of the Operations Log Sheet.

E. Removal of Mixing Drum

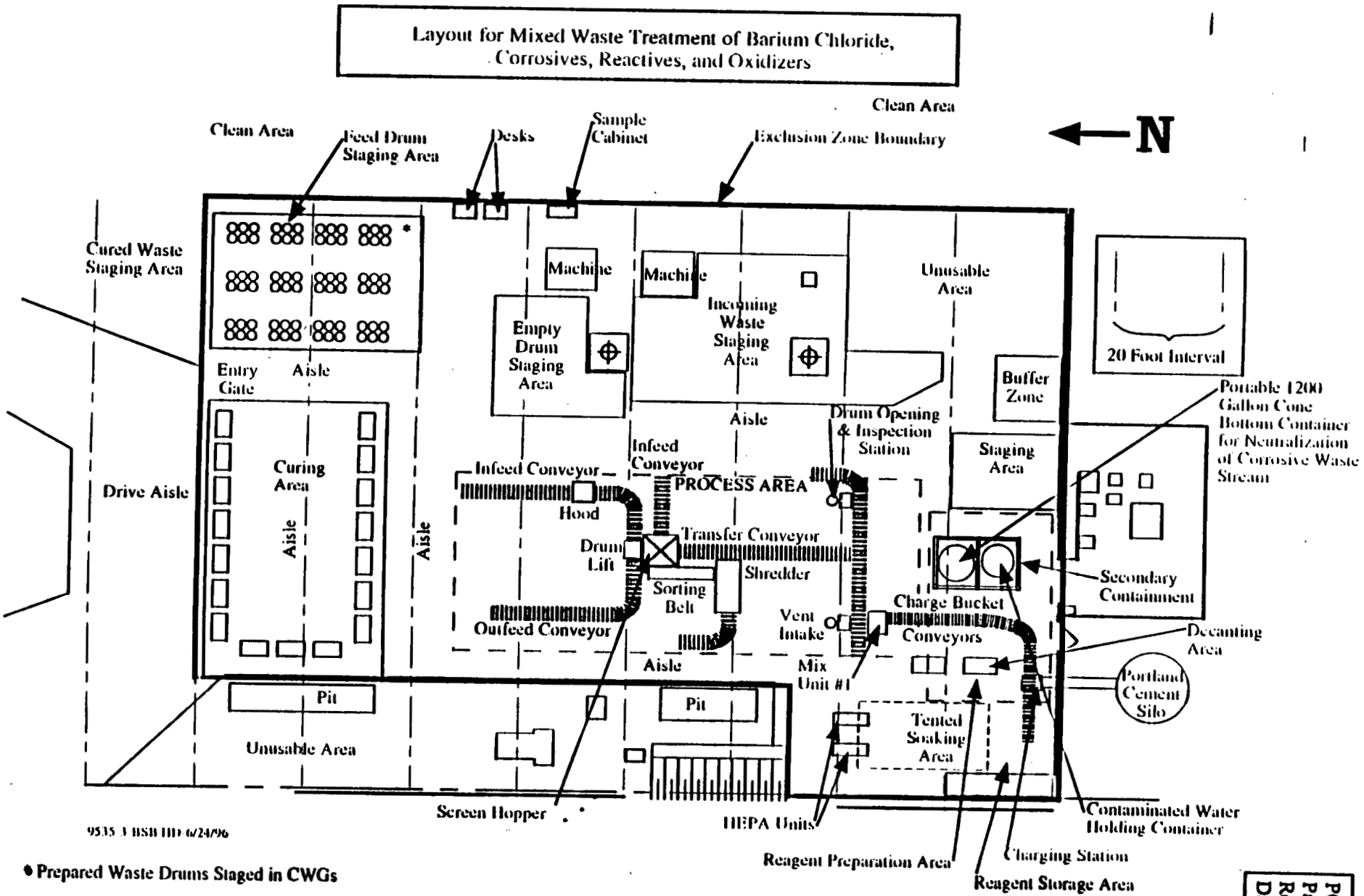
Although in most operating scenarios solidification treatment, Reference 2, will proceed immediately after the completion of chemical treatment by this procedure, it may be necessary to remove the mixing drum from underneath the mixer and move it to a staging or soaking area. This procedure describes the steps in removing the mixing drum from the Mix Unit.

Performer	Action
PESI Mix Unit Operator	1. Hydraulically raises the mixer until the bottom of the mixer shaft clears the top of the mixing drum.
	2. Shakes the miter up and down using the hydraulic control to shake waste off of the shaft and blades. If necessary, uses a spatula to scrape adhering waste from the shaft and blades of the mixer, allowing the waste to fall back into the drum.
	3. Manually pivots the mixer away from the mixing drum, releases the hydraulic clamp holding the drum, and pushes the drum down the outfeed roller conveyor.
	4. Obtains the assistance of a FERMCO Lift Truck Operator in lifting the finished mixing drum off the outfeed conveyor and transporting it to the designated staging or soaking area.

VI. ATTACHMENTS

A. Figure 1 - Plant 6 Equipment Layout

B. Figure 2 - Pretreatment Stabilization



Mixed Waste Stabilization Project Layout Modified to Treat Barium Chloride and Other Waste Residues
Plant 6 Equipment Layout

Figure 1
Fernald Plant 6 Layout of Mobile Treatment Unit

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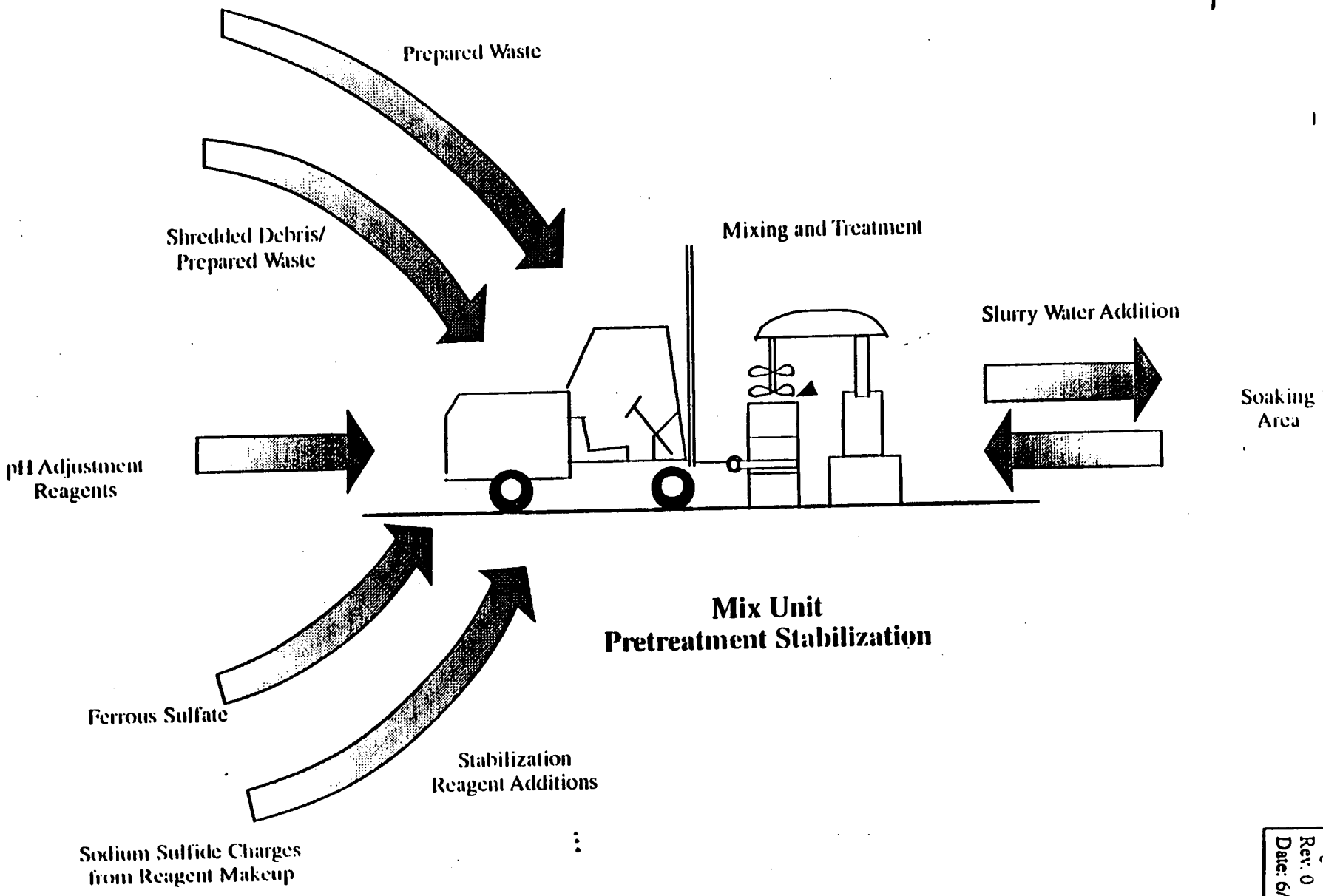

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Figure 2
Pretreatment Stabilization

Perma-Fix Environmental Services, Inc.

Process Operating Procedure

NPDS Project

Approval: _____

SOLIDIFICATION TREATMENT PROCESS STAGE 5

I. POLICY

PESI policy is to minimize the risk of personnel injury while efficiently performing solidification treatment of waste or waste/solids mixtures, to solidify them for off-site disposal. The process goal of the solidification treatment activity is to produce a treated waste that will absorb and chemically bind all free liquid, and provide a solid monolithr inside a disposal container. This procedure establishes the guidance that PESI operators and subcontractor personnel must use when performing solidification treatment using the Perma-Fix Mixer.

II. DISCUSSION

Solidification treatment by the Perma-Fix Process involves the addition of solidification reagents in accordance with a design recipe established through bench-scale recipe development tests. The design recipe is specific to the waste being treated, and cannot be used for other types of waste unless it has been proven to be effective for those wastes by bench-scale evaluations. The design recipe establishes the minimum dosage for each reagent and the performance specifications that the treated waste should meet. A Design Recipe Notice is posted at the Mix Unit Location to guide the operator in consistent application of the design recipe to wastes fitting the known waste profile. At the operator's discretion, additional reagent doses can be added to ensure that the performance specifications are met or exceeded.

III. DEFINITIONS

Compatible Waste Group (CWG) - A group of waste containers assembled from a single waste category that exhibit similar waste characteristics and are amenable to the same treatment method and reagent recipe. The total waste volume of a CWG will be adjusted to fill one White Metal Box (WMB) after all compatible solids, reagents and hydration water have been added.

Design Recipe - Prescribed dosages of one or more solidification reagents that have been shown by bench-scale testing to be effective in solidifying wastes having a specific waste profile.

Design Recipe Notice - An easy to read notice which is posted at the operator location, to communicate the currently applicable design recipe, raw waste profile and performance specifications to the operators.

Performance Specifications - A set of chemical and physical criteria which comprise minimum performance expectations for successful treatment of wastes fitting the raw waste profile using the design recipe.

Pozzolan - A solidification reagent that reacts with water and the waste matrix to cause crystallization of the pozzolan/waste mixture into a dry solid. Typical pozzolans include portland cement (Type I or II), class C fly ash, cement kiln dust, blast furnace slag, or a combination.

Raw Waste Profile - A physical description of a waste category that is used to evaluate incoming waste batches for applicability of the design recipe.

White Metal Box (WMB) - A DOT strong, tight container built to FERMCO/NTS specifications and painted white. Approximate dimensions are 7 ft. × 4 ft. × 2 ft., giving a useful storage capacity of 40 cubic feet.

IV. REFERENCES

1. POP-CT-2.8, *"Chemical Treatment Process, Stage 4"*

V. PROCEDURE

A. Loading and Log-in of Waste for Treatment

In most cases, solidification treatment with the design recipe will proceed immediately after the completion of the treatment step (Reference 1) and before the mixing drum is moved. In cases where chemically stabilized wastes must be allowed to soak for a period of time, it will be necessary for each mixing drum to be brought back from the soaking area, and placed under the mixer again. The following procedure governs the return of wastes from soaking or staging areas for additional treatment. Figure 1 shows the equipment layout of the processing area in the Plant 6 Building. Figure 2 is a schematic diagram of the solidification treatment process.

Performer	Action
PESI Mix Unit Operator	1. Obtains the assistance of a FERMCO Lift Truck Operator in performing the following actions, per agreements between FERMCO and Perma-Fix:

Performer	Action
PESI Mix Unit Operator (Cont'd)	a. Transporting mixing drums from a specific Compatible Waste Group (CWG) from the Soaking Area or Staging Area to the Mix Unit Location and staging them on the infeed conveyor, or as directed by the Mix Unit Operator. b. Transporting shredded solids drums from the same CWG from the soaking or staging area to the mix unit location and staging them on the infeed conveyor, or as directed by the Mix Unit Operator. 2. Receives individual mixing drums from the Soaking or Staging Area, in CWGs, ensuring that the appropriate Operations Log Sheet accompanies the waste container(s). 3. Receives shredded solids drums from the Lift Truck Operator and stages them with the mixing drums from the same CWG. 4. Moves each drum from a CWG on the infeed conveyor underneath the mixer and clamps it in place. 5. Ensures that all mixing drums in a specific CWG have been treated by the steps in Section B below, before initiating log-in and loading of the next CWG underneath the mixer.

B. Solidification Treatment According to the Design Recipe

Solidification Treatment will be performed according to a design recipe established by bench-scale testing of samples of the specific waste to be treated. The design recipe includes the minimum dosage established for each solidification reagent, and the performance criteria that the treated waste should exhibit after treatment. This information and the raw waste profile are communicated to the operators by posting a Design Recipe Notice (Attachment 3) at each work station. The procedures associated with solidification treatment and design recipe compliance are as follows.

Note: Data to be recorded on the Operations Log Sheet by the Mix Unit Operator may be recorded either immediately or at the time that treatment of each CWG is completed. In no case shall data recording be delayed past the completion of treatment for that CWG.

Performer	Action
Process Supervisor	1. Produces an easily readable Design Recipe Notice (See Attachment 3 for format) and posts this notice at the mix unit location. The design recipe portion of this notice must include the following information: a. The minimum dosages for each reagent included in the design recipe. b. The freeboard requirement for reagent displacement. c. The minimum mixing time required for blending of reagents with the waste matrix. d. Applicable performance specifications for properly treated waste at the time mixing ends. These specifications include: e. Acceptable Range for Slump Evaluation 2. Performs spot checks of mixer operations to ensure that the design recipe is followed as a minimum, and applicable performance specifications are met or exceeded.
Mix Unit Operator	3. Using hydraulic controls, raises the mixer assembly high enough for the bottom of the impeller to clear the top of the mixing drum. 4. Manually swings the mix unit arm over the drum, and hydraulically lowers the impeller into the waste, taking care not to puncture the sides of the drum, and then proceeds with mixing of the drum. 5. Using hydraulic controls drives the mixer in forward or reverse rotation at speeds up to 300 rpm to agitate the waste inside the mixing drum.

Performer	Action
Mix Unit Operator (Cont'd)	6. Pivots the mixer support arm by hand, and uses the horizontal ram to move the mixer inside the mixing drum so as to ensure that all wastes and solids in the drum are thoroughly mixed.
	7. Continues mixing until all lumps or irregularities inside the drum have been broken up and homogenized.
	8. Adds the initial doses of each solidification reagent specified in the design recipe to the drum and mixes thoroughly, observing color and texture of the waste to make sure that all reagents have been thoroughly dispersed and reacted with the waste. Mixing time will be as specified in the design recipe.
	9. After mixing performs a quick evaluation of slump by raising the mixer head out of the drum and observing the thickness of the waste lying on top of the mixer blades. Compares this thickness measurement with the acceptable range.
	10. Repeats steps 8 and 9 with additional charges of solidification reagent, if necessary to produce an acceptable slump and waste color and texture required by the Performance Specification of the Design Recipe Notice. Records the final slump value, the total reagent dose, and the ending time in the space provided in Section E of the Operations Log Sheet.
	11. If waste consistently requires more reagents to meet the performance specifications, notifies the Process Supervisor that an adjustment of the design recipe may be needed.

C. Removal of Mixing Drum

At the conclusion of solidification treatment, the mixing drum will be removed from underneath the mixer and taken to the Decanting Area. This procedure describes the steps in removing the mixing drum from the Mix Unit.

Performer	Action
Mix Unit Operator	1. Hydraulically raises the mixer until the bottom of the mixer shaft clears the top of the mixing drum.

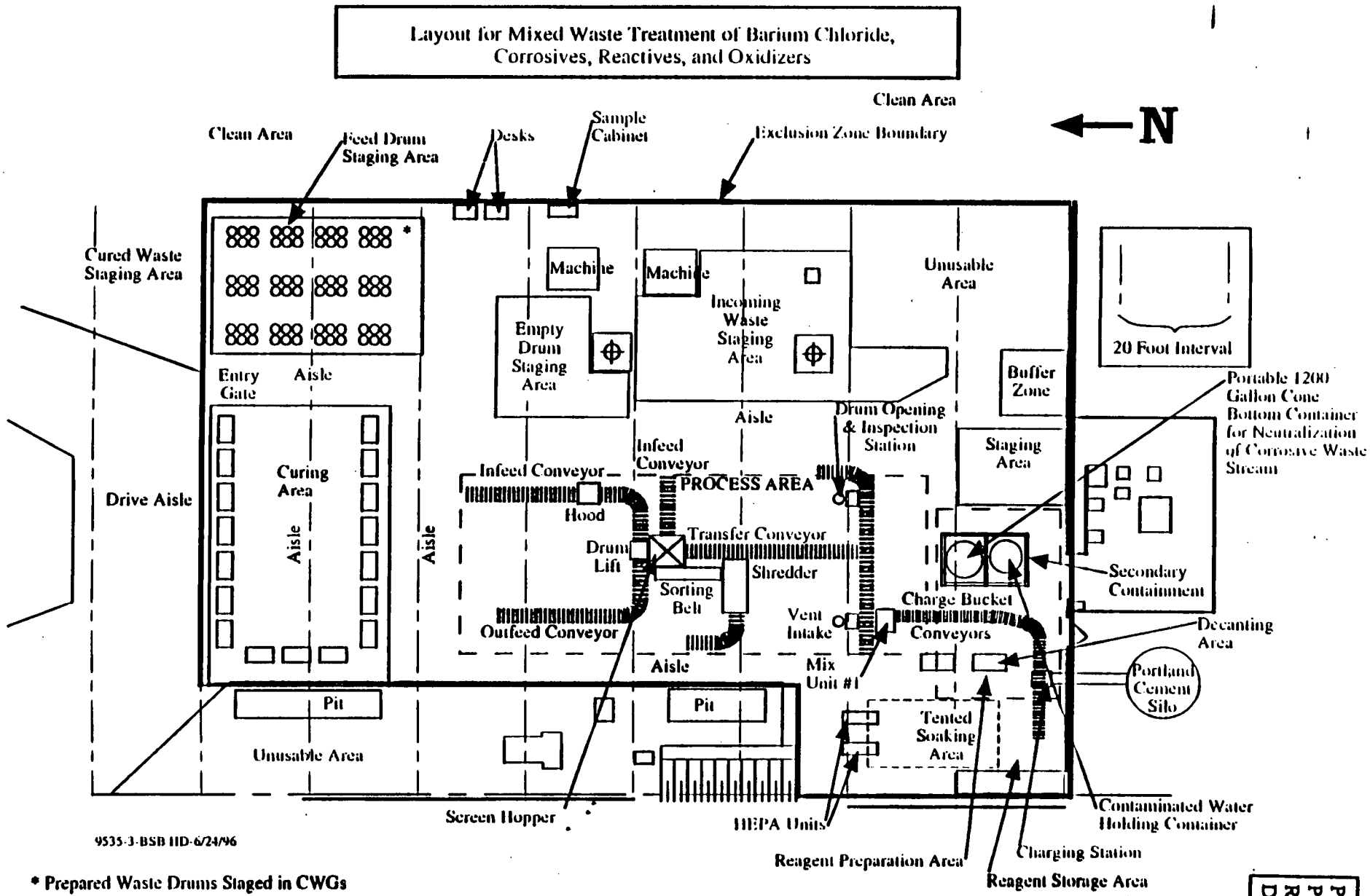
Performer	Action
Mix Unit Operator (Continued)	2. Shakes the mixer up and down using the hydraulic control to shake waste off the shaft and blades. If necessary, scrapes adhering waste from the shaft and blades of the mixer, allowing the waste to fall back into the drum.
	3. Manually pivots the mixer away from the mixing drum, releases the pneumatic clamp holding the mixing drum and pushes the finished mixing drum down the outfeed conveyor to be picked up by the FERMCO Lift Truck Operator.
	4. Guides the FERMCO Lift Truck Operator in grabbing, lifting, removing the mixing drum and staging it in a designated area.
	5. Obtains the assistance of a FERMCO Lift Truck Operator in transporting the finished mixing drums of a CWG to the Decanting and Curing Area (See Figure 1).

VI. ATTACHMENTS

A. Figure 1 - Plant 6 Equipment Layout

B. Figure 2 - Solidification Treatment

C. Figure 3 - Design Recipe Notice



Mixed Waste Stabilization Project Layout Modified to Treat Barium Chloride and Other Waste Residues
Plant 6 Equipment Layout

Figure 1
Fernald Plant 6 Layout of Mobile Treatment Unit

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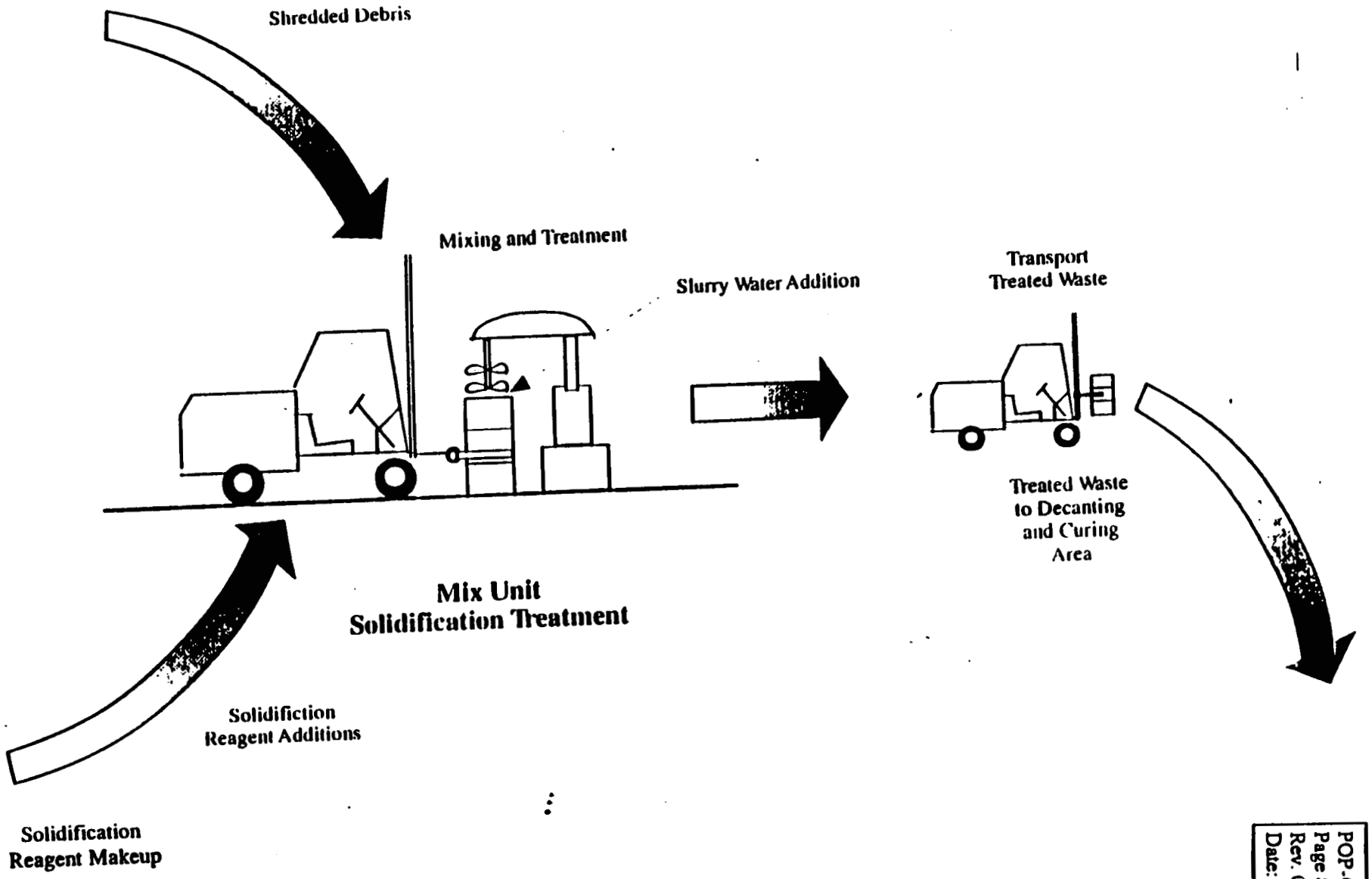

Figure 2
Solidification Treatment

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Figure 3

Design Recipe Notice

Waste Category Designation _____

Posting Date_____ Posting Time_____

Raw Waste Profile

Color_____
Texture_____

Free Water
Content _____

Macro Solids_____
_____
_____

pH_____

Freeboard _____ inches.

Prescribed Dosages

1. Adjust pH to _____,
with _____.

2. Stabilize Barium & Chromium
with _____ Gallons of _____%
Ferrous Sulfate, Mix _____ min.

3. Adjust pH to _____,
with_____.

4. Allow to Soak _____ hrs.

5. Stabilize all metals with
_____ Gallons of_____%
Sodium Sulfide, Mix _____ min.

6. Add solidification reagent
_____ lbs/gallons of Type ___
Portland Cement, Mix ____ min.

PERFORMANCE SPECIFICATIONS

Final Color of Treated Waste _____.

Final Texture of Treated Waste _____.

Lead Acetate Test Color Intensity Value, _____ minimum (CIV).

Blade Slump Range _____to_____ (inches).