

## ATTACHMENT II-1-5

### MACROENCAPSULATION PLAN

#### 1. PURPOSE AND SCOPE.

This attachment outlines the requirements for macroencapsulation ("MACRO") at the Permittee's Facility. The requirements in this Attachment apply to MACRO operations.

#### 2. DEFINITIONS.

a. MACRO is defined as follows:

- i. MACRO for Radioactive Lead Solids Subcategory or radioactively contaminated cadmium-, mercury-, and silver-containing batteries (MACRO Vault): MACRO with surface coating materials such as polymeric organics (e.g. resins and plastics) or with a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media. MACRO for these subcategories specifically does not include any material that would be classified as a tank or container.
- ii. MACRO for Hazardous Debris (MACRO Capsule, or MACRO Vault): Macroencapsulation with surface coating materials such as polymeric organics (e.g. resins and plastics) or with a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media.

b. MACRO Capsule is defined as hazardous debris that has been macroencapsulated in a closed container.

c. MACRO Vault is defined as hazardous debris, radioactive lead solids waste, radioactively contaminated cadmium-, mercury-, or silver-containing batteries, or any combination of these wastes, that has been macroencapsulated by placing in an engineered vault, filling void spaces, and applying surface coating materials such as polymeric organics (e.g. resins and plastics) or with a jacket of inert inorganic materials to substantially reduce surface exposure to potential leaching media. MACRO Vaults may be constructed directly in the Mixed Waste Landfill Cell in accordance with the applicable requirements of this Attachment.

d. Engineered vault is a term applicable to the approval and construction of a MACRO Vault. An engineered vault has been evaluated and approved by the Director in accordance with the applicable requirements of this Attachment.

e. Secured is a term applicable to closure of MACRO Capsules. Secured is defined as meeting the criteria provided in Module III for a closed container, with the additional requirement that the closure mechanism be capable of withstanding the

effects of normal conditions of storage and transport without any deterioration in the effectiveness of the closure mechanism or in the effectiveness of the MACRO Capsule's ability to meet the acceptance criteria.

- f. Sealed is a term applicable to completion of MACRO Vaults. Sealed is defined as meeting the criteria provided in Module III for a closed container, with the additional requirement that the sealing materials be selected and applied so that precipitation or leachate is prevented from entering the MACRO Vault.

### 3. ACCEPTANCE CRITERIA

Waste managed as macroencapsulated waste shall meet the definition of MACRO. The following requirements apply to the specific elements of the MACRO definition:

- a. "Surface coating materials"
  - i. Polymeric organic encapsulating materials (e.g., resins and plastics) shall be used, provided that they are applied to the surface of the material being macroencapsulated.
  - ii. Materials that are not applied as coatings such as plastic "wraps" are not acceptable as surface coating materials.
- b. "Jacket of Inert Inorganic Materials"
  - i. Encapsulating materials shall be composed of metal or inorganic materials.
  - ii. The encapsulating jacket shall be chemically and physically stable and chemically inert with respect to the wastes and other materials it may contact within a Mixed Waste Landfill Cell.
  - iii. Metals or alloys that would be determined by DOT methods to be pyrophoric shall not be used.
  - iv. Reactive metals or alloys such as those of Group IA or IIA of the periodic table of the elements shall not be used.
  - v. As a macroencapsulant, metal jackets shall be in direct surface contact with the waste through lamination, welding, a pozzolanic material pour, a ceramic materials pour, and/or a molten metals pour.
  - vi. Other inert inorganic materials may be used as jackets. Such inorganic materials shall not be carbon-based compounds or substances.
  - vii. MACRO using non-metal inert inorganic materials may be held by a mold container only if the container is also not the MACRO jacket. Such non-

metal inert inorganic MACRO material:

- A. shall be largely monolithic
- B. shall not be susceptible to liquid penetration
- C. shall not be of a crumbly consistency or susceptible to deterioration such as crumbling, spalling, flaking or cracking.

c. "Substantially Reduce Surface Exposure to Potential Leaching Media"

*Note: Corrective action shall be taken for any macroencapsulated waste that does not meet these acceptance criteria.*

- i. Each object subject to the standard of MACRO shall be macroencapsulated meaning encapsulated within the MACRO Capsule or MACRO Vault.
- ii. The selected MACRO technology shall be applied so as to completely surround the waste, i.e., the coating or jacket shall be continuous and unbroken.
- iii. The MACRO Capsule or MACRO Vault shall be created to minimize interior voids or air pockets.
- iv. The encapsulating material shall have long-term integrity such that potential leaching media within a hazardous waste cell would not cause the encapsulating material to deteriorate.
- v. Waste shall not protrude through the surface of the MACRO Capsule or MACRO Vault.
- vi. A macroencapsulated waste shall have the MACRO material present and apparent upon surficial visual inspection at the point of disposal.
- vii. For MACRO Capsules containing hazardous debris, the MACRO container shall be a continuous and unbroken capsule with a secured lid or endcap. The capsule lid or endcap shall be secured to the capsule body using mechanical, adhesive, or welding methods.
- viii. Corrective action shall be required for any MACRO Form or MACRO Capsule that is found not to have structural integrity prior to disposal in a lift.
- ix. For MACRO Vaults, a minimum cover of 4 inches is required between the surface of the waste form and the exterior of the MACRO Vault.

- d. The Permittee may manage a waste as meeting MACRO when the waste does not meet the acceptance criteria above provided that:
  - i. the waste has a signed LDR certification from the generator for MACRO,  
and
  - ii. approval from the Director is received prior to management of such waste as meeting the MACRO requirements.

#### 4. VERIFICATION REQUIREMENT FOR MACROENCAPSULATED WASTES FROM OFF-SITE SOURCES

- a. Prior to receiving a shipment of macroencapsulated waste, the Permittee shall perform an assessment on the waste to ensure that it meets the criteria in this Attachment. Drawings, photographs, or both shall be included as illustrations in waste profiles for such waste. When shipments of such waste arrive on site, the Permittee shall ensure that the waste profile information is comparable to the incoming waste. This is completed by the verifying the integrity of the macroencapsulated waste and documenting verification in the Operating Record.
- b. The Permittee shall ensure that a LDR certification stating that the waste meets the requirements for MACRO accompanies off-site shipments of macroencapsulated waste. If a certification is not present with a shipment, then that discrepancy shall be reconciled in accordance with Attachment II-1, *Waste Analysis Plan*.
- c. For MACRO Capsules containing hazardous debris, the Permittee shall ensure that a certification of compatibility between the waste and the MACRO media accompanies the off-site shipment. If a certification is not present with a shipment, then that discrepancy shall be reconciled as required in accordance with Attachment II-1, *Waste Analysis Plan*.
- d. For MACRO Capsules containing hazardous debris, the Permittee shall meet the applicable requirements of Attachment II-1, *Waste Analysis Plan*.
- e. Prior to disposing an off-site waste as a macroencapsulated waste, the Permittee shall ensure that the waste meets the definition of MACRO and the acceptance criteria as outlined in this Attachment.
- f. MACRO Vaults shall not be accepted from off-site sources.

#### 5. WASTE MANAGEMENT FOR MACRO OPERATIONS

The following requirements apply to MACRO operations:

- a. General MACRO Requirements.

- i. For wastes that do not meet their applicable treatment standards, MACRO shall only be performed on
  - A. hazardous debris,
    - (1) Hazardous debris may have other non-debris material mixed with it as long as the waste is primarily debris, by container volume.
  - B. Waste in the D008 radioactive lead solids subcategory as defined in Utah Admin. Code R315-13-1, or
  - C. Radioactively contaminated cadmium-, mercury- and silver-containing batteries for wastes in the applicable subcategories of waste codes D006, D009, and D011 as defined in Utah Admin. Code R315-13-1.
- ii. The Permittee may macroencapsulate wastes that already meet all of their applicable treatment standards.
- iii. MACRO operations at the Facility shall involve one of the following approved technologies. MACRO shall be performed to meet the performance specifications outlined in the acceptance criteria in Condition 3. The following MACRO technologies are approved:
  - A. For hazardous debris: Placing wastes in an approved container, filling the container to minimize void spaces, and permanently sealing the container to create a MACRO Capsule.
  - B. For hazardous debris, radioactive lead solids, and/or radioactively contaminated cadmium-, mercury-, or silver-containing batteries: Encapsulation in a MACRO Vault in accordance with the applicable requirements of this Attachment.
- iv. Prior to acceptance of a MACRO Capsule technology, the Permittee shall compile documentation verifying the integrity, strength, and compatibility of the Capsule material. This information shall also be retained in the Operating Record. Specific performance criteria (or equivalent) that shall be met include:
  - A. Structural integrity. The MACRO Capsules shall be rated by the manufacturer as to the maximum weight capacity. The total weight of the MACRO Capsule at disposal shall be documented not to exceed this weight rating.
  - B. Chemical resistance. The MACRO Capsule shall be documented to resist changes in weight, volume, or mechanical properties

under conditions of chemical contact. Testing procedures and performance standards shall be comparable to those required for HDPE liners in landfills (e.g., ASTM D543 or National Sanitation Foundation criteria).

- C. **Waste Compatibility.** The MACRO Capsule shall be rated by the manufacturer as to materials and material concentrations that are incompatible with the capsule. Waste placed in the MACRO Capsule shall not contain concentrations of any incompatible materials sufficient to compromise the integrity of the MACRO Capsule.
  
- v. **MACRO Capsule operations shall take place within the Mixed Waste Storage Building, the Mixed Waste Operations Building or the Mixed Waste Treatment Building. Loading and lid securing operations for MACRO Capsules may take place on permitted storage pads or holding areas. In the case of loading operations on outdoor permitted storage pads or holding areas, the waste to be encapsulated within MACRO Capsules shall be contained within a closed container such as compacted debris in an 85-gallon overpack drum. Bulk waste shall not be loaded into MACRO Capsules on outdoor storage pads or holding areas.**
  
- b. **MACRO Operating Requirements**
  - i. **Container Management and Preparation for MACRO Operation:**
    - A. **Containers shall be used as the waste management units in which MACRO operations take place, unless otherwise specified in this Attachment.**
    - B. **Size Reduction for MACRO Operations. Where size reduction is necessary for waste that is to be macroencapsulated, the size reduction shall be accomplished in one of the following ways:**
      - (1) **Cutting, performed within secondary containment.**
      - (2) **Wastes may be shredded or separated in the Mixed Waste Treatment Building or the Mixed Waste Operations Building in preparation for MACRO and in accordance with the applicable provisions of this Permit.**
      - (3) **Wastes may be compacted using a drum crusher in appropriate secondary containment in preparation for MACRO and in accordance with the applicable provisions of this Permit.**
      - (4) **Waste may be compacted with heavy equipment, such as**

track hoe bucket, as needed for placement into a macro vault.

- C. Communication Requirement. Prior to constructing each MACRO Vault, the foreman or supervisor for the MACRO operation shall confer with those who will be involved with that MACRO to ensure that MACRO personnel have an understanding of the operational requirements and precautions. This pre-operational briefing shall be documented in the Operating Record.
- D. MACRO Capsules shall be stored and transported in accordance with Attachment III-1, *Container Management Plan*.

ii. MACRO Capsules

- A. A minimum of two people shall be present when loading and securing lids to MACRO Capsules.
- B. The manufacturer's maximum weight rating for the MACRO Capsule shall be documented in the Operating Record. Each MACRO Capsule shall be weighed after the lid is secured to ensure that this weight rating is not exceeded. Loaded weight shall be documented in the Operating Record.
- C. Waste may be loaded into the MACRO Capsule loose or in the shipping container with the lid removed.
- D. Following waste loading, voids that remain within the MACRO Capsule shall be filled with flowable material. Acceptable fill materials include, but are not limited to CLSM, molten LDPE, and dry sand. The fill material used and the inspection showing that voids are filled shall be documented in the Operating Record.
- E. The capsule lid or endcap shall be secured to the capsule body by mechanical, adhesive, or welding methods.

iii. MACRO Vaults

- A. For purposes of this Permit, MACRO Vaults consist of wastes approved for MACRO treatment encapsulated in a monolithic cement-based jacket of inert inorganic materials referred to as Macro Mix. The Macro Mix formulation is proprietary business information. Any change to the approved Macro Mix formulation shall receive Director approval prior to implementation.
- B. Unless approved by the Director, each MACRO Vault shall have a footprint no larger than 625 ft<sup>2</sup> and shall be less than 16 ft tall.

- (1) MACRO Vaults taller than 6 ft shall have the Macro Mix poured at a rate not to exceed 6 vertical feet per hour.
- (2) Larger MACRO Vaults exceeding 625 ft<sup>2</sup> x 16 ft tall shall receive Director approval prior to construction.
- (3) A minimum cover of 4 inches shall be maintained between the waste and any exposed MACRO Vault surface.
- (4) Primary containers and waste forms may be stacked or placed adjacent to each other, so long as MACRO Mix can flow into all voids and maintain minimum cover on all sides, top, and bottom.
- (5) A minimum 20 mil plastic liner shall be placed beneath each MACRO Vault that is to be poured on a soil or rock base.
- (6) One or more sides of existing MACRO Vaults or CLSM lifts may be used as forms for a new MACRO Vault, so long as the requirements of Condition 5.b.iii.B.(3) are met.
- (7) When using removable forms, form oil or vegetable-based oil shall be applied carefully so as to prevent puddling. Diesel fuel shall not be used as form oil in the cell.
- (8) MACRO Mix older than 3 hours since batching (measured as the time water is added to the MACRO Mix) shall not be poured.
- (9) Any pour surface within the MACRO Vault which has been exposed 3 hours or longer shall be considered a cold joint and shall be coated with an approved bonding agent prior to resuming the pour. If a cold joint is inaccessible, the MACRO Vault shall be re-treated unless prior Director approval is given.
- (10) Risers such as concrete parking curbs may be used to space the primary waste container or waste form up from the ground surface to ensure flowability. Risers shall be coated with a bonding agent prior to pouring the vault.
- (11) For MACRO Vaults that are to be poured on a soil or rock base a minimum 4" vault floor shall be poured. The MACRO Vault floor may be poured as a separate activity prior to setting the waste forms in place. A bonding agent shall be applied to the perimeter surface of the vault floor.

- (12) When constructing a MACRO vault on the top surface of existing MACRO vaults a floor will not be required as the 4” requirement will have already been met by the existing vault. However, a bonding agent shall be applied to the perimeter surface of the existing floor prior to construction and pouring of the vault.
- (13) Approved bonding agents include but are not limited to Concrevice® 1090 Liquid, Concrevice® Liquid LPL, and a silica fume bonding mixture.
  - (a) The silica fume bonding mixture consists of equal parts by weight of silica fume, sand, and water.
  - (b) The bonding material does not require curing.
- (14) The MACRO Vault shall be observed for a minimum of 30 minutes following pour completion for settlement that may compromise meeting the minimum cover requirement. If settlement is observed, additional MACRO Mix may be added.
- (15) MACRO Vault forms may be stripped after 12 hours of curing.
- (16) Curing controls shall be applied when ambient air temperatures are above 90°F or below 40°F any time during the initial cure period of one day.
  - (a) For temperatures below 40°F, the vault shall be covered so that temperature at the vault’s surface is at least 40°F. Temperature shall be monitored and documented at least once per day.
  - (b) For temperatures above 90°F, the vault shall be covered with plastic or moist fabric to retain moisture at the vault surface.
- C. A minimum of two people shall be present when loading waste into each MACRO Vault.
- D. Each MACRO Vault shall be considered a “large object” for waste placement purposes. Any MACRO Vault that is known or projected to exceed 100,000 pounds after MACRO Mix is poured shall be subjected to a Large Component Engineering Review in accordance with the LLRW and 11e.(2) CQA/QC Manual.
- E. Any precipitation that may accumulate in the MACRO Vault shall

be removed prior to waste or backfill placement.

- F. Waste with a pH of less than 2.0 shall be considered incompatible with MACRO Mix and shall be excluded from treatment in a MACRO Vault, unless neutralized to pH of at least 2.0 using other permitted treatment processes.
- G. Waste may be loaded into the MACRO Vault loose or in a container.
- H. More than one waste stream may be disposed in a single MACRO Vault if the wastes are compatible with each other and with the MACRO Vault.
- I. Care shall be taken to ensure that waste to be placed in the MACRO Vault does not contact waste emplaced in the Mixed Waste Landfill Cell.
- J. The MACRO Vault shall be protected against precipitation contacting the waste until void filling is complete.
- K. Containers holding waste for MACRO may have voids filled before transport to the MACRO Vault.
  - (1) If voids are filled before transport to the MACRO Vault, this activity shall take place within one of the following areas:
    - (a) the Mixed Waste Operations Building,
    - (b) the Mixed Waste Treatment Building, or
    - (c) the Mixed Waste Storage Building.
  - (2) Voids may be filled with MACRO Mix, CLSM, off spec concrete, structural foam, molten LDPE, dry sand, lime fines, or c-ash. Other materials may be used with Director approval.
  - (3) The fill material used and inspection that voids are filled shall be documented in the Operating Record.
- L. Voids within the MACRO Vault shall be filled within 24 hours of the first load of MACRO Mix being added to the MACRO Vault.
  - (1) If void filling has not yet begun, the waste shall be removed

from the MACRO Vault and placed into storage unless additional time is approved by the Director.

- (2) If void filling has begun, but the Permittee is not able to complete void filling on time, the Director shall be notified within 24 hours and the MACRO Vault shall be protected against precipitation contacting the waste.

M. MACRO Vault Inspections:

- (1) Visually inspect that voids are filled within all primary containers and waste forms.
- (2) Visually inspect that minimum cover is obtained on all sides and top and bottom of the MACRO Vault.
- (3) Review batch tickets for each load of MACRO Mix to ensure the mix design is within tolerance, as defined in the proprietary mix design documentation.
- (4) Observe the entire MACRO Mix pour to ensure that primary containers and waste forms do not shift so as to compromise minimum cover requirements.
- (5) Once the forms are removed, inspect the MACRO Vault surface for cracks, un-filled voids, etc.
  - (a) A structural crack is defined as 1/8 inch or greater; or a crack of any size that would affect the encapsulant's ability to remain in place in the vault. All other cracks are considered non-structural.
  - (b) Non-structural cracks shall be sealed in accordance with Attachment II-1-5, *Site Inspection Plan*, with a commercial concrete waterproofing product such as 'Aquella', 'Aquellux S', 'Silac', 'Hydrocast PVC', 'Leakmaster', or similar product.
  - (c) Structural cracks shall be reported to the Director within 24 hours of identification. Corrective actions for structural cracks shall receive Director approval prior to implementation.
- (6) Exposed MACRO Vault surfaces shall be inspected in accordance with Condition 4.j.ix, of Attachment II-3, *Site Inspection Plan*, until the vault has been covered with CLSM, another vault, or fill material.

- iv. Recordkeeping.
  - A. For MACRO operations, the following information shall be kept in the Operating Record:
    - (1) Generator Number,
    - (2) Waste Stream Number,
    - (3) date and time of MACRO,
    - (4) quantities of waste encapsulated,
    - (5) operators initials,
    - (6) method of MACRO; i.e., MACRO Capsule or MACRO Vault, and
    - (7) location of MACRO Vault.
  - B. The Permittee shall place daily worksheets, inspections, operational parameters for MACRO used to meet concentration-based treatment standards, results of analytical verification of applicable concentration-based treatment standards, and related documents for each MACRO waste stream in its Operating Record. MACRO records shall be maintained in the Operating Record for at least five years from the date of treatment.
  - C. Macroencapsulated waste shall be tracked in the Operating Record in accordance with Attachment III-2, *Waste Identification and Tracking Plan*.
  - D. A certification of treatment shall be signed for wastes that are macroencapsulated in accordance with Utah Admin. Code R315-13-1.
- c. Management Requirements for Disposal of macroencapsulated waste
  - i. MACRO Capsules shall be placed in the Mixed Waste Landfill Cell only after being approved for disposal.
  - ii. MACRO Capsules shall be disposed in such a manner as to not exceed the bearing capacity of the cell design under load. The Permittee shall document verification in the Operating Record.
  - iii. MACRO Capsules shall not be driven on by heavy equipment before placement in an approved lift.

- A. If this occurs to MACRO Capsules, an inspection of the entire capsule for cracks or other deformities shall be performed immediately. If cracks or other deformities are found, the Permittee shall follow the corrective action procedure for repairs of MACRO Capsules in Condition 5.d.ii.C.
- iv. If any MACRO Capsule in the Mixed Waste Landfill Cell does not meet the acceptance criteria in this Attachment, the following requirements apply:
  - A. The damaged MACRO Capsule shall be removed from the Mixed Waste Landfill Cell, labeled, dated, and placed in storage within 24 hours of discovery.
  - B. The Permittee shall receive Director approval prior to making any repairs to the capsule within the Mixed Waste Landfill Cell.
  - C. The corrective action requirements listed in Condition 5.d.ii.C. shall be implemented.
- d. Quality Control Requirements for macroencapsulated waste
  - i. Post-MACRO Inspection.
    - A. MACRO Capsules shall meet the acceptance criteria specified in this Attachment before the waste is placed in the Mixed Waste Landfill Cell for disposal.
    - B. The Permittee shall inspect all MACRO Capsules. The Permittee shall document the results of this inspection in an acceptance/rejection log.
    - C. The following information shall be kept in the Operating Record:
      - (1) date of inspection,
      - (2) Generator Number,
      - (3) Waste Stream Number,
      - (4) type of inspection, (primary or after corrective actions)
      - (5) inspector signature,
      - (6) pass/fail result,

- (7) specified cure times and whether cure times were met, and
  - (8) corrective action taken.
- D. MACRO Capsules shall be considered unacceptable for disposal if any surficial defect exceeds half the wall thickness of the MACRO Capsule. MACRO Capsules shall also be considered unacceptable for disposal if there is evidence of compromised container integrity, such as bulging capsule walls or lid.
- Note: A passive air pressure release valve or vent is not considered a surficial defect requiring repair.*
- E. Corrective action or contingency measures shall be taken for each MACRO Capsule that is found to be unsatisfactory by the Permittee or in any way does not meet the acceptance criteria in this Attachment.
- ii. MACRO Operation Contingencies and Corrective Action Requirements.
- A. Should incomplete MACRO occur, the object shall be repaired.
  - B. Repairs of MACRO Vaults. The following options are available for damaged MACRO Vaults:
    - (1) Damaged MACRO Vaults may be patched with MACRO Mix. Following curing, patched MACRO Vaults shall be visually inspected.
    - (2) Damaged MACRO Vaults may be reworked to remove the waste and place it in another MACRO Vault.
  - C. Repairs of MACRO Capsules. The following options are available for damaged MACRO Capsules:
    - (1) Damaged MACRO Capsules may be wholly encapsulated in another MACRO Capsule, or MACRO Vault in accordance with the requirements of this Attachment.
    - (2) Alternatively, the MACRO Capsule may be opened and the contents treated to meet land disposal restrictions. Treatment shall be conducted in accordance with applicable sections of this Permit. After it is emptied, the capsule shall be managed as an empty container in accordance with Attachment III-1, *Container Management Plan* and may be decontaminated for release or disposed in accordance with Module V, *Disposal in Landfills*.

- iii. Operation contingencies, corrective actions, and repairs shall be documented in the Operating Record.

END OF ATTACHMENT II-1-5