SLUDGE DENSIFICATION AND WATER MANAGEMENT PROGRAM
SOLAR PONDS/PONDCRETE PROJECT
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SLUDGE DENSIFICATION AND WATER MANAGEMENT PROGRAM
SOLAR PONDS/PONDCRETE PROJECT

The intent of this draft document is to develop a sequence of operations for remediating the solar ponds. This document will establish the required planning and design criteria for equipment selections, general arrangements, and develop schedules for execution to support required completion of the work. Please note that the following proposal describes methods to process the waste that may require EG&G to negotiate with regulators for special waivers. HNUS recommends EG&G apply for permit waivers to minimize cost and improve schedule performance as identified within the Overview (Section 1.0). The potential regulatory issues are identified in Section 9.0 of this document.

1.0 Overview

HALLIBURTON NUS (HNUS) is proposing to perform all pondsludge, clarifier sludges and residual pond water solidification around the 207 Pond area. The balance of the waste forms under this contract will be processed on the 904 Pad using the Pondcrete/Saltcrete Waste Processing Train.Consideration was given to locating all waste processing on the 904 Pad. It was concluded by HNUS that locating the Pondsludge Process Unit around the 207 Pond area minimizes transportation and logistics problems transferring pondsludge and pond waters to the 904 Pad for processing. This was perceived to be a more significant problem than transferring the equipment to the 904 Pad after pondsludge processing.

Currently the two process trains under consideration (pondsludge/pondcrete) have similar pieces of equipment from the dewatering operation to the curing station. Utility requirements are also similar (power, air, holding tanks and cement conveying systems). This proposal calls for equipment required for pondsludge processing to be procured first and installed around the 207 Pond area for pondsludge processing. Upon completion of waste processing, most of the equipment will be water flushed, externally smear test tested- equipment skid and equipment components, dismantled and transfered to the 904 Pad for inclusion in the consolidated Pondcrete/Saltcrete Processing Train. The shared equipment is anticipated to include 2 Casting and Curing Stations, 2 Cement Mixers, Cement Tankage, Transportable Water Storage Tankage, and Air Supply Systems. HNUS is recommending procuring only one set of shared equipment and using on both pads to process the various waste included in this contract. This recommendation, if accepted, would also minimize the total amount of potentially contaminated equipment at the end of the project.

The scheduled completion for having the ponds "clean and dry" and processing the pondsludge waste is November 8, 1992.

HNUS recommends a Stage I Densification Program be approved which consolidates and pretreats the waste at a rate that would allow potentially two Pondsludge Processing units to be operated concurrent if the schedule requires. The process proposed is to mobilize one self contained belt press unit to dewater the sludges in 207 A & B . An air tight cement mixer and covered bin storage would be installed to process the dewatered sludge into a final certified waste form. HNUS is recommending commencing consolidation and initial dewatering (up to 30% solids) in late spring with a completion by October 1, 1992. Processing of sludges into final waste forms would be conducted during a later part of that period.

The low water ratio process train concept approved by EG&G on September 9, 1991 appears at this time to be done in one step. The Stage I Densification takes a dredged material consisting of 5-10% solids and dewaters the sludge to a 25-30% solids. A dry filter cake material is produced and conveyed into a storage bin where it will provide a surge capacity for the continuous cementing mixer producing a final certifiable waste form.Tests are currently scheduled to commence in the laboratory with bench scale equipment to evaluate the performance of various equipment units and chemical pre-conditioners to dewater the sludge. Once the processing rate of the pressure belt filter has been established the cement mixing train can be sized.This process is currently planned to produce 2-4 TPH of final waste form. Thus, we are anticipating that A & B can be processed within a 45 day processing day period. The final product will produce approximately 5 times less final waste volume that the current Statement of Work for Pond A & B. The cost savings based upon storage and container costs in Nevada is approximately $10 million for Ponds A & B.

Potential regulatory concerns which HNUS has related to the Water Management Program and the processing of pondsludge are addressed in Section 9 of this document.

2.0 Requirements

The following requirements/guidelines/regulatory understandings exist that govern the planning for this work:

1. The final waste form must be certifiable.

2. The primary concern is waste minimization of final waste volumes. The amount of waters solidified and percent solids of sludges solidified will greatly impact the final waste volumes.

3. The heater/soaker hoses and evaporation from the 374 & 910 Buildings will be used to evaporate pond water.

4. By November 8, 1992, all ponds must be clean and dry. After that date no materials may be stored in the ponds. Thus, the interceptor trench must be isolated from Pond 207 B-North.

5. Any empty pond can be used to store filtrate water prior to November 8, 1992. Any B Series Pond can hold A & B Pond filtrate. Pond water from A & B can be added to Pond 207 C.

6. Ponds 207 A & B may be commingled if HNUS can provide data from the Waste Characterization Report that shows that the composite is not significantly different than any of the stored waste in 207 A or B Series Ponds. These are included as appendix 1 .

3.0 Conditions Affecting Processing Options

1. At the scheduled start of Stage I Densification and Cementing the following conditions are anticipated to exist at the ponds:

   a. 207 A is empty.
   b. 207 B (one pond is empty).
   c. 207 C is ± 2 foot of water cover over the sludge will exist.

2. The Waste Characterization Report indicates that material (water and sludges) in 207 A & B ponds does not exceed TCLP requirements for metals. Sludges in 207 A, 207 B-North and Center exceed LDR limits for cadmium. The Waste Characterization Report indicates the material (water and sludges) in 207 C exceeds TCLP requirements for metals and LDR limits for cadmium, arsenic, chromium, nickel, and cyanide.

3. The 207 A & B Series Ponds appear to be similar in chemical characterization. There is no significant reason to indicate that ponds can not be combined. See appendix 1 .

4. Settling tests performed in the laboratory on 207 A & B indicate that settling was not an effective means to thicken the sludges based on an on-line process system. For the system to work on-line a thickener of 12,000 SF is required.Initial testing has reflected that gravity dewatering in conjunction with pressure belt filtering and a polyelectrolyte may produce a dense dry cake for cementing.

5. Laboratory analysis indicate that the sludges (A,B,&C) contain low level pathogens. These levels are below HNUS H & S prescribed limits requiring disinfection. Treatability studies reflect the unchlorinated sludges will not effectively gravity settle. Tests are currently underway to optimize gravity settling as a function of calcium hypochlorite addition for subsequent belt filter dewatering.

6. The integrity of the pond liners from best to worst is 207 B-South, 207 A, 207 B-North, and 207 B-Center per EG&G.

7. EG&G does not have heater soaker hoses in A Pond.

8. The entire contents of 207 C Pond (waters and sludges) will be processed without a dewatering step.

9. The process train for 207 C is simpler than for the balance of the pondsludge processing.

10. The heater soaker system and evaporators can evaporate a larger volume of water if evaporation can be scheduled for a longer period of time.

11. Filtrate waters will need to be returned to the pond area due to the projected volumes of water anticipated to be produced in the dewatering operation of Pond 207 A, B and Clarifier.

4.0 Sequencing of Operations

PONDS 207 A & B PONDS

The first step of the Phase One Sludge Densification Process is to consolidate the 207 A & B Ponds into one pond. Current inventory levels indicate that the A & B Series ponds contain less volume of water and sludges than the storage volume of any of the B series ponds.It may be more practical and advantageous to pump the entire contents of each pond one at a time into the sludge storage pond and decant the water back to a separate storage pond. Currently two methods for performing this work are recommended for EG&G consideration and are included as attachment 3. Either method would ultimately render as many as two ponds empty at the start of Stage 1 Sludge Densification and Cementing.

During the consolidation of the A & B ponds, process equipment will be assembled alongside the 207 Pond Area in preparation for densifying and cementing the A & B sludges. The equipment will be self contained and will provide it's own diesel powered
power supply.

The following sequence of processing of waste into final waste forms is anticipated:

1) Pond 207 C Sludge and Water

2) Clarifier Sludge

3) Pond 207 A & B Sludge (Consolidated)

4) Filtrate Residue from 207 A & B Processing

This sequence of processing afford the following benefits:

1) Pond 207 C does not require any off-line Stage I densification dewatering. A smaller list of equipment is required to process 207 C.

2) Affords the opportunity to do Stage I consolidation off-line from the Densification and Cementing processing.

3) Provides EG&G a longer period of time to evaporate waters than other sequence of operations considered.

   At the completion of Pondsludge processing it is intended that the systems will be water flushed, externally smear tested and dismantled.The cementing equipment and storage tankage will be prepared for transportation to the 904 Pad for installation in the Pondcrete/Saltcrete Process Train. The curing station will be cleaned and packaged for transportation to the 904 Pad for inclusion in the Pondcrete/Saltcrete Process Train.

POND 207C PROCESSING

Additional treatability studies are required to finalize the processing concept.

4.1 Description of Equipment Processing by Area

4.1.1 207 Pond Area

The 207 Pond Area will contain all equipment necessary to reclaim sludges and waters from the four (4) A & B solar ponds, perform screening of waste, perform the Stage I Densification and Cementing of sludges and provide adequate Storage Inventory of Pond Sludges and Pond Waters prior to waste processing.

A list of equipment to be placed within the 207 Pond area is included in Section 6.1 & 6.2.

4.1.2 788 Building

The area North of the 788 Building containing a concrete pad may be used for the 207 C Sludge Processing Train. It may be advantageous to process the 207 C contents adjacent to the pond to minimize any long distance transfer of the 207 C pond slurry.

The 788 Building can be used for storing wastes and containing a small geotechnical laboratory within the existing permacon to perform analysis identified within the Process Control Plan and prepare any samples for confirmation testing for shipment offsite which may be required. HNUS has evaluated this building and conclude the following:

1) Performance standards of Hepa filters and the existing Permacon within the 788 Building are unknown. These will need to be assessed to determine the best use of this space.

2) Ingress/Egress from the building is deemed to be poor to support waste processing at a 20 TPH output rate.

3) Building does not contain adequate size to support the curing station and inspection requirements currently required.

HNUS recommends using the 788 Building as a warehouse for storing full crates of low level waste produced in earlier processing campaigns. The full crates are currently stored on the 750 Pad. The 750 Pad can be used more effectively to store newly produced half crates of pondsludge waste. 788 Building can also be used to store metal containers of oversize material screened and separated in the processing of the 207 A & B .

4.1.3 750 Pad Area

The 750 Pad Area is currently not required to house any process equipment . The 750 Pad area may contain EG&G curing and inspection stations for certifying the waste produced from the 207 Ponds and the Clarifier

4.2 Water Management

All water management and evaporation efforts will be performed by EG&G. The primary system is considered to be the heater soaker hose contained in the B Series Ponds. Supplementary systems are the 374 & 910 Evaporator Buildings. The 374 Evaporators are scheduled to provide evaporation support for 207 A Pond and as a backup to the heater soaker system in the 207 B Series Ponds. The 910 Evaporators are not in service as of the date of this proposal but are scheduled to evaporate waters from the interceptor trench. This water is currently pumped to 207 B-North for long term storage. Three (3) 500,000 gallon storage tanks are being constructed to store water from the interceptor trench. Once the storage tanks are completed, interceptor trench water will not continue to be pumped to the 207 B-North pond. The current permit does not allow waters in the ponds to be pumped to the storage tank to assist in emptying the ponds to reach the required "clean & dry" ponds mandate of November 8, 1992.

During 1991, progress was made lowering the water level within all the ponds. Appendix 4 includes current inventories of waters within the 207 Series Ponds. Meetings held on November 22, 1991 reflected the following progress to be accomplished by the start of waste processing:

1) 207 A is empty

2) 207 B (one pond is empty)

3) 207 C is at the current water level

The two parties will have to coordinate the evaporation effort to maximize the benefits associated with lowering the liquid level within each pond.

The priority sequence recommended calls for the B Series Ponds to be given first priority. It is HNUS recommendation that the heater soaker hose system to be used for the B Pond Series. Any excess evaporator capacity from the 374 Building should be used to evaporate water from the 207 A Pond.

HNUS recommends that EG&G not continue to evaporate water from 207 C. The salts in the water appear to ~~be at~~ or near the saturation point. Continued evaporation techniques may continue to further concentrate the salts. The continued evaporation may prove to be counter productive since HNUS may have to dilute the waters with fresh water to process the wastes. Appendix 1 describes laboratory observations of the 207 C water crystal tests observed last week.

If EG&G is successful in repermitting the RCRA management units into one unit (A & B Series Ponds) the first priority for water evaporation should be Pond 207 A. 207 A would be used to deposit Stage I densified sludge from A and B Series Ponds. Pond 207 B-South would be used to store filtrate water from the Phase I sludge densification operations. The primary reasons for the recommendation are:

1) The most competent pond liners are the 207 A and 207 B-South.

2) Pond 207 A has a built in sump which would provide a convenient collection point for sludge reclaiming during Stage I Densification and Cementing.

5.0 Description of Waste Processing by Waste Form

5.1 Terminology

The following terminology will be used to describe the following activities associated with remediating the Solar Ponds.

Reclaim from Pond - A system for removing sludges and waters from a pond. System could include a suction dredge, vacuum truck, super sucker vacuum pump, or manual removal from the pond.

Size Reduction - Envisioned to be a disk pulverizer capable of reducing the grain size of all the materials to less than 10 mesh (2.4mm).

Chlorination/Oxidation - A process to disinfect the sludges of biological pathogens. Oxidation may be considered to destroy organic compounds identified to be above LDR restrictions.

Stage 1 Consolidation- The process of consolidating the sludges and waters currently contained in the 207 A & B Ponds.

discovered during sampling campaigns in August and November 1991. A similar device has been used in the past at Rocky Flats to clean the pond.

Once the hard crystals are broken into manageable pieces, a suction type pump will be designed with adequate velocity at the suction head to pick up three inch minus materials. The pump will discharge to a trash screen. At the completion of reclaiming sludges and waters from the pond, manual cleaning will be performed to remove any isolated crystallized areas which have been missed from the mechanical breakage process. Residual crystals will be loaded into trash boxes for processing on the 904 Pad.

Initially the pumped material which is run over the trash screen will be returned to the pond. The purpose is to "turn over" the material prior to preparing the material for processing. After all the material has been "turned over" the trash screen underflow pump will pump the slurry material to the disk pulverizer, located on a skid adjacent to the 207 C Pond which will grind all the material (in an open circuit) to a minus ten (10) mesh screen size. The underflow will be pumped to a series of Halliburton type (MX-5000) agitator holding tanks for final pretreatment. The pretreatment may consist of chlorination and/or lime addition as defined in the treatability studies.

The slurry in the agitator tanks may be considered as individual batches. Sample collection points exist in the tanks recirculating piping within the tanks for collecting samples for laboratory analysis as required within the treatability study.

The suspended slurry within the tankage will be pumped in a double contained pipeline to the 750 Pad for final cementing into the final waste form.

Method 2 - Heating Pond Waters to Remove Hard Crystals in the Ponds

The treatability study has currently indicated that temperature is not an adequate method to remove the crystals by putting the material into solution. Therefore, HNUS is not currently considering heat as a practical solution to removing the crystals in the pond.

5.3 Clarifier Sludge

5.3.1 Stage I Clarifier/Thickener Sludge Densification

The excess waters above the sludge in the clarifier will be removed by EG&G~~with a vacuum truck for transportation to the 374 Building for evaporation prior to Stage I Densification Processing.~~ HNUS will reclaim the sludges within the clarifier by using a super sucker pump or similar pumping devise to pump the majority of the sludge from the clarifier. The balance of the sludges will be removed by using the existing thickener underflow pump in conjunction with water spray from a low pressure pump to wash the settled sludges into the underflow pump. The sludges will be screened to remove material above 10 mesh prior to pumping to the self contained belt press filter. Filtrate from the dewatering step will be returned to a tanker truck supplied by EG&G for storage. Once all the sludges have been removed from the clarifier, EG&G will transport filtrate waters to the 374 Evaporators.

The dewatered sludges from the belt filters (~ 5,000 gallons) will be cemented.

A Block Flow Diagram (attachment # 2 & 3) is included depicting the initial dewatering step for the Thickener/Clarifier.

5.4 207 A Sludge Processing

5.4.1 Stage I Densification - 207 A

The initial consolidation step for 207 A will be performed in conjunction with the 207 B Series Ponds.Depending upon the method selected by EG&G the 207 A Pond would contain either consolidated sludge or filtrate water. If the RCRA management areas (A & B Ponds) cannot be combined into one unit, HNUS recommends that the initially dewatered sludge be placed in metals for interim storage and stored on the A Pond Berm. The quantity of sludges obtained in A Pond is believed to be minimal (20-100 cy) of material. Attachment # 4 & 5 reflects a Block Flow Diagram of the initial dewatering step envisioned for Pond 207 A. Filtrate from the dewatering would be returned to 207 A if required by regulatory limitations or tanker trucks.

5.5 Pond 207 A & B Sludge (Consolidated)

5.5.1 Stage I - Consolidation- 207 A & B Ponds

For the initial dewatering operation to work as envisioned one or more of the A or B Series Ponds must be emptied to provide an inventory storage area for consolidated sludge. A higher quality densification process can be attained if the average % solids can be increased during the reclaiming of the sludges from the storage pond . Both Productivity and the quality of the dewatered filter cake can be improved by increasing the sludge depth and the bulk density of the sludge through consolidation of the sludges. From the waste characterization report presented to EG&G, we conclude the following:

1. EG&G conducted earlier compatability studies and concluded that the ponds could be consolidated without any chemical reactions.

2. The bulk terminal density of the sludges varies within the ponds from 11% to 24%.

6.0 Stage I Densification

Stage I Densification will consist of the following activities:

1) Consolidating the B Series Ponds into one pond of sludge and one or more ponds of "clean" waters.

2) Screening of all sludges and trash to a ten (10) mesh minus size. Oversize would be deposited into metals and stored in the 788 building for subsequent processing at the 904 Pad area.

3) Segregation of oversize trash from the ponds into trash containers.

4) Disinfecting the sludges to remove the pathogens and improve the gravity settling characteristics of the sludge. This is currently planned to consist of introducing calcium hydrochloride into the collected dredge material (water & sludges) within a contact basin contained in the process train. In addition, lime will be used to adjust the pH of the material prior to belt filtering the sludge material.This may be performed during the same step of chlorininating the sludge.

5) Pre-conditioning the sludge - it is envisioned that the sludges will require preconditioning prior to dewatering. This could include the addition of lime to adjust the pH and the use of cationic polyelectrolytes to improve filterability.

6) Oxidation Step - This step will be required if the organic compounds require additional treatment. This will be determined in the treatability study.

7) Dewatering - The current plan is to consider a belt filter press capable of producing a filter cake upwards of 30% solids. The machine can receive a dilute solids (2-5%) input with little variance in output quality or quantity. Output percent solids anticipated in 25-30% solids. Filtrate waters containing residual free chlorine and water anticipated to be pH adjusted to 11.5 to 12 will be returned to a B Series Pond for additional evaporation efforts by EG&G. During emergency shutdowns or during periods when the belt filter produces off-spec material, the filter cake product will have to be returned to either the sludge pond or be collected in a metal container for storage and reprocessing at a later period. HNUS would recommend returning the filter cake to the sludge pond in lieu of interim storage of the product.

8) Cementing
   a. Teledyne Reco Mixer
   b. Cement Tankage and cement conveying equipment.

9) Casting Station
   a. Casting nozzle with shroud
   b. Casting conveyor

6.1 Equipment List - Stage I Densification and Cementing

Ponds 207 A & B

1) Consolidation (All Equipment by EG&G)
   a. Transfer Pumps supplied by EG&G
   b. Floating Pumps for pumping decant water to a filtrate storage pond
   c. Water Pumps for final pond cleanup.
   d. Sump w/Sump Pump
   e. 2200 gallon Vacuum Truck for removal of residues.

2) Reclaim System
   a. Super Sucker Pump or equivalent.

3) Segregation of Trash
   a. Trash Screen
   b. Sump w/Sump Pump
   c. Trash Boxes (Provided by EG&G)

3) Disinfecting the Sludge
   a. Contact Chamber

4) Preconditioning the Sludge
   a. Lime Addition System
   (May be worked in conjunction with Item 3)
   b. Polymer Addition System

5) Oxidation Step
   a. Oxidation System - 80 gpm input

7) Dewatering
   a. 1-2 Meter Belt Filter Housed in a Self Contained Trailer
   b. Filtrate Sump & Pump to Return Filtrate Water to a Storage Pond
   c. Dewatered Sludge (20-30% Solid) Sump & Pump to Return sludge to a Storage Pond

8) Storage
   a. Filter cake will be stored in a live bottom bin for transferring to the cement mixers

9) Cementing Equipment
   a. Teledyne Readco Mixer
   b. Cementing
      - Teledyne Reco Mixer
      - Cement Tankage and cement conveying equipment.
   c. Casting Station
      - Casting nozzle with shroud
      - Casting conveyor

10) Utilities
   a. Diesel Generators
   b. Air Compressor
   c. Fresh water supply.
   d. Pumps and piping system for flush water system and return to the sludge pond.

All equipment will be located around the 207 Pond area. See

Attachment # 6 & 7 for General Arrangement of Equipment and Piping Arrangement.

6.2 Equipment List - 207 C and Clarifier Sludge - Stage I Densification and Cementing

The Stage I Densification for 207 C will consist of only mixing the waters and sludges into a homogeneous mixture.

1) Consolidation
   a. Super Sucker Pump
   b. Trash Screen
   c. Sump w/Sump Pump
   d. In-Line Heater with Jet Nozzle

2) Pre-sizing
   a 36" Disk Pulverizer capable of grinding any oversize crystals fabricated on a skid
   b. Sump w/Sump Pump

3) Segregation of Trash
   a. Super Sucker Pump
   b. Trash Screen
   c. Sump w/Sump Pump
   d. Trash Boxes (Provided by EG&G)

4) Disinfecting the Sludge
   a. Contact Chamber

5) Preconditioning the Sludge
   a. Lime Addition System (May be worked in conjunction with Item 4)

6) Oxidation Step
   a. To be determined

7) Dewatering
   (Not applicable for Pond 207 C)

8) Storage

   Agitated Portable Tankage

   At the completion of Pondsludge processing it is intended that the systems will be water flushed, externally smear tested and dismantled, for transportation to the 904 Pad for installation in the Pondcrete/Saltcrete Process Train. The curing station will be cleaned and packaged for transportation to the 904 Pad for inclusion in the Pondcrete/Saltcrete Process Train.

9) Cementing
   a. Teledyne Reco Mixer
   b. Cement Tankage and cement conveying equipment.

10) Casting Station
   a. Casting nozzle with shroud
   b. Casting conveyor

Final waste form will be transported to the 750 area for curing and inspection once the material has taken it's initial set and can be transported as a solid material.

All equipment identified above will be located around the 788 Pad. See Attachment # 2 for general location and piping configuration.

6.3 Low Water Ratio System

The low water ratio system for densification of the sludges will be used to process the Pondsludges contained in Ponds 207 A & B Series Ponds, and the Clarifier Sludges.

The system will be contained along the 207 Pond area. All piping systems from the pond areas and filtrate returns to the ponds will be double contained piping systems. All waste will be cast into half crates. Any off-spec waste which has been cemented will be stored and reprocessed on the 904 Pad at the proper period.

The laboratory filtration tests indicate that material dewatered from the belt pressure filters will produce a dry filter cake. After cementing the product it should produce a solid material within a short period of time. The curing stations shown within the Material Handling Study were based on having the material cure for 48 hours prior to securing the plastic liner and installing the half crate lid.In addition, a higher processing rate was used than is currently being envisioned. This requirement may be reduced once the treatability study results are completed and engineering re-evaluates the requirements minimizing the floor space requirements for the curing station. HNUS does recommend storing the curing half crates in a heated tent during initial curing of the waste once the material can be transfered from the 207 pad Area.

6.4 High Water Ratio System (Pond 207 C)

A high water ratio system will be used to process 207 C Pond and any residual wastes remaining at the end of Pondsludge Waste Processing. These may include filtrate sludges remaining in 207 A & B Processing during the final cleaning of the filtrate water pond.

The high water ratio system is envisioned to be the same as the low water ratio system with the pressure belt filters being bypassed. General arrangements for equipment would be similar to those of the low water ratio unit.

Block Flow Diagrams reflecting the configuration of the equipment are shown as Attachment # 11, 12.

7.0 Stage I Cementing

Stage I Cementing will consist of all operations commencing with the reclaiming of Stage I densified waste from inventory from the live bottom bin and including all work required to cast the waste into the final waste form. The same equipment process train is envisioned for all pondsludge and clarifier waste.

8.0 Sludge Densification and Processing Responsibility Matrix

	EG&G	HNUS
Water Management		
. Evaporate Water using Heater Soaker Hoses	X	
. Transfer Water from Pond to Pond	X	
. Evaporate Filtrate Water	X	
. Transfer Waters to Evaporators	X	
. Transfer Residual Waters to 904 Pad for Makeup Water (Tanker Trucks)	X	
. Transfer 207 A & B Series Sludge into one pond location	X	

Stage I Densification

. Reclaim Sludge from Ponds		X
. Trash Box Stowage & Transportation	X	
. Disinfecting Sludge		X
. Final Clean-up - Each Pond	X	
. Stage I Densification - Dewatering		X
. Sludge Pond Management	X	
. Furnishing Temporary Power - 788 Area		X

Stage II

. Reclaim Sludge to 750 Pad		X
. Return Stage II Filtrate Water to Ponds		X
. Cement Sludges		X
. Final Clean-up - (All Ponds)	X	
. Casting and Stowage of Final Waste Form	X	
. Furnishing Power - 207 Area		X

9.0 Regulatory Issues

The proposed pondsludge processing scenario raises certain issues that require resolution based upon HNUS understandings of the existing permits affecting the pond areas. EG&G needs to advise HNUS as to the viability. The issues requiring clarification are the following:

1. Consolidate 207 A & B Ponds- D. Brenneman to Write

2. The laboratory analysis performed to date reflects that low levels of fecal coliform exist in the raw sludge. NVO-325 requires zero pathogens in the final waste form. It is anticipated that excess chlorine dosages will be required to kill the biomass to allow efficient dewatering properties. Filtrate waters from the Stage 1 Densification and Cementing Process will return filtrate water which contains free residual chlorine to the ponds.

3. To optimize the filterability of the sludges a preconditioning of the sludges will be required. This is anticipated to include the addition of lime to raise the pH of the sludges to 10.5 - 11.5 Thus, filtrate waters will be pH adjusted prior to returning to the pond areas.

4. During an emergency situation or during periods of producing off-spec material it needs to be determined if the materials within the Pondsludge Process Train can be returned to the consolidated sludge pond. Within 3 weeks HNUS should be able to define what chemical and physical changes have occured within each of the steps of the process.

The scheduled completion for having the ponds "clean and dry" and processing the contained waste is November 8, 1992. Every effort must be made to accomplish this goal. HNUS recommends actions to simplify the processing of these wastes. These include:

1) Re-permit the A Pond and B Pond Management Areas into one RCRA Permit Area.

2) Consider the A and B Pond Waste as one waste form.

The current restrictions placed by the management areas are not conducive to making decisions that minimize costs and protect the environment. The existing conditions of the pond liners is a consideration in determining the safest method to store sludges and pond waters. If repermitting is allowed, HNUS recommends that A & B Pond Sludges be consolidated and densified into Pond A and the pond waters and filtrate waste from A & B Series Pond be placed in Pond 207 B-South.

10.0 Schedule

The schedule for this work will be available for discussion on January 22 during the Project Control Meeting.

APPENDIX

Appendix 1 Compatability Study Ponds 207 A & B- R. Ninesteel

Appendix 2 Updated Tables for Cement Stabilization formulas and Estimated Volume of Waste Forms from the 207 A & B Pond Sludges- W. Henderson dated January 11,1992

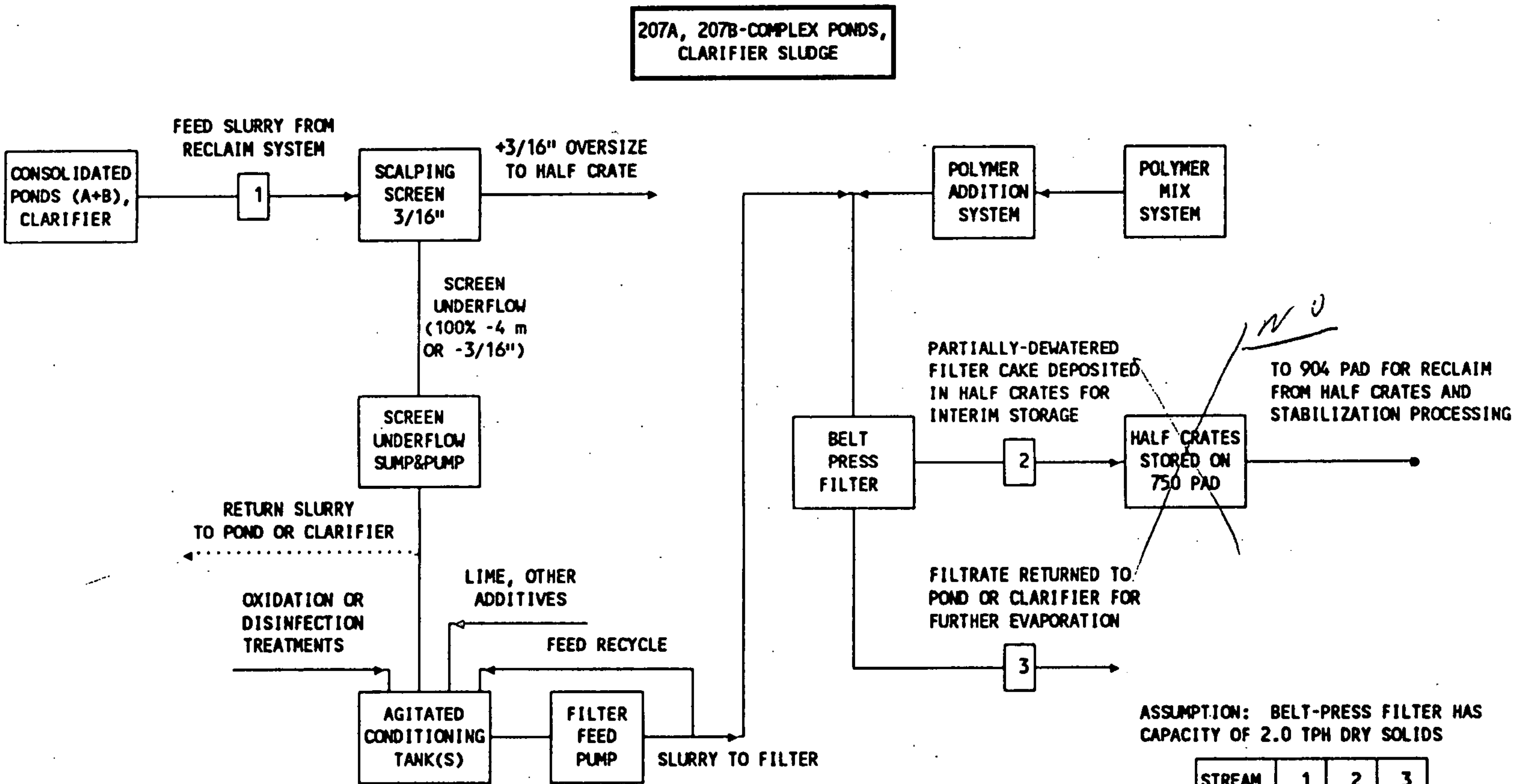
Appendix 3 Consolidation of Pond 207 A & B Methods.

Appendix 4 Inventories of Pond Water in the 207 Series Ponds

ATTACHMENT 1

PLAN A: STAGE I PREPROCESSING OF SLUDGE TO INTERIM STORAGE

EQUIPMENT REQUIREMENTS OR SUBCONTRACTOR SCOPE



ASSUMPTION: BELT-PRESS FILTER HAS CAPACITY OF 2.0 TPH DRY SOLIDS

STREAM	1	2	3
GPM	105	24.1	80.9
% SOLID	7.5	30.0	0.0
TPH SOL	2.0	2.0	0.0
TPH LIQ	24.7	4.7	20.0

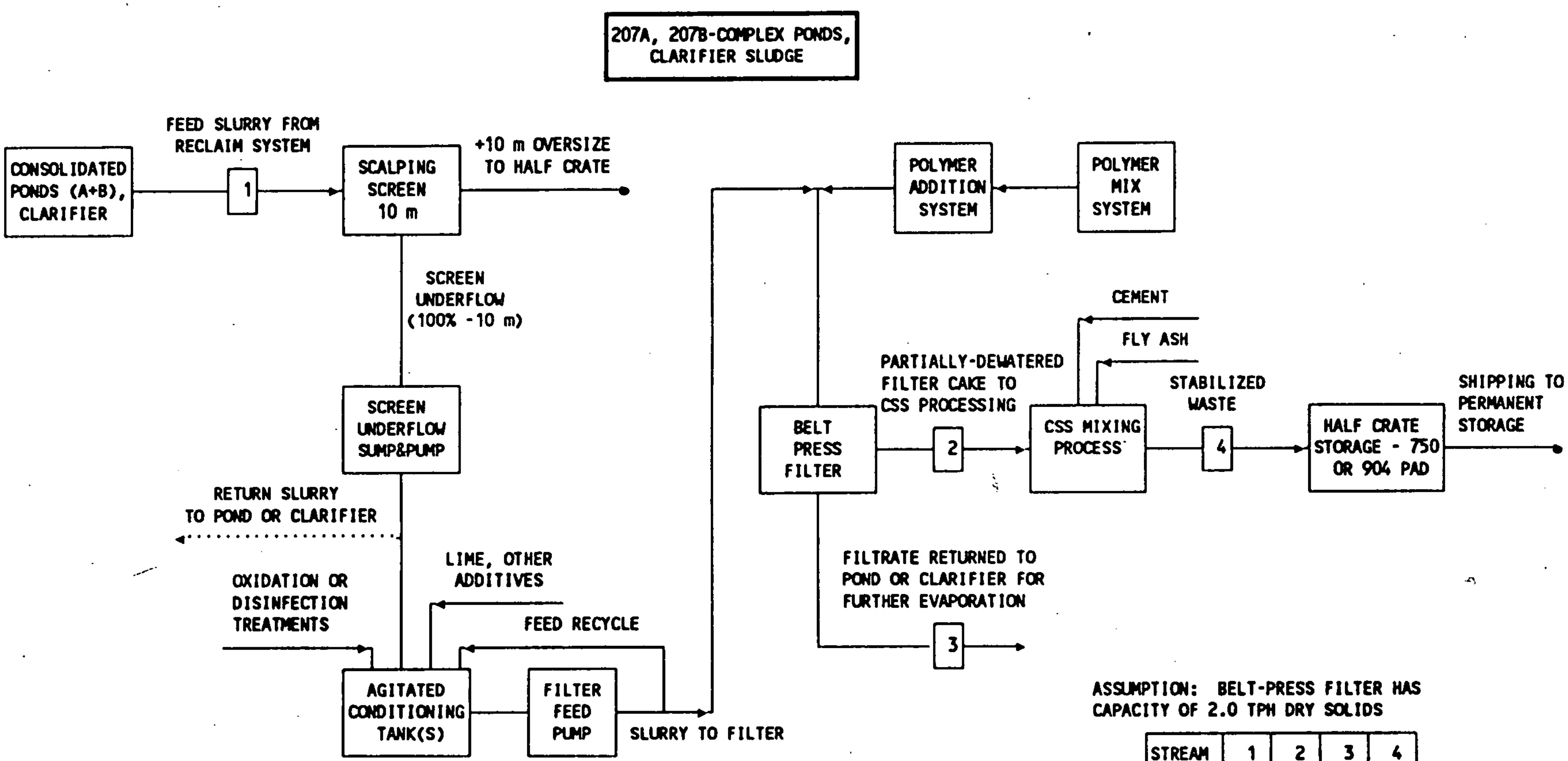
NOTE: ALL SLUDGES WILL REQUIRE SOME OXIDATIVE PRETREATMENT FOR DISINFECTION AND TO IMPROVE L/S SEPARATION. ONLY CLARIFIER SLUDGE WOULD NEED HIGHER-INTENSITY CHEMICAL OXIDATION TREATMENT.

*NOTE: EFFECTIVE S.G SOLIDS = 1.50

January 13, 1992

ATTACHMENT 1 B

PLAN B: RECLAIM, PARTIALLY DEWATER AND STABILIZE SLUDGE
EQUIPMENT REQUIREMENTS OR SUBCONTRACTOR SCOPE



NOTE: ALL SLUDGES WILL REQUIRE SOME OXIDATIVE PRETREATMENT FOR DISINFECTION AND TO IMPROVE L/S SEPARATION. ONLY CLARIFIER SLUDGES WOULD NEED HIGHER-INTENSITY CHEMICAL OXIDATION TREATMENT.

ASSUMPTION: BELT-PRESS FILTER HAS CAPACITY OF 2.0 TPH DRY SOLIDS

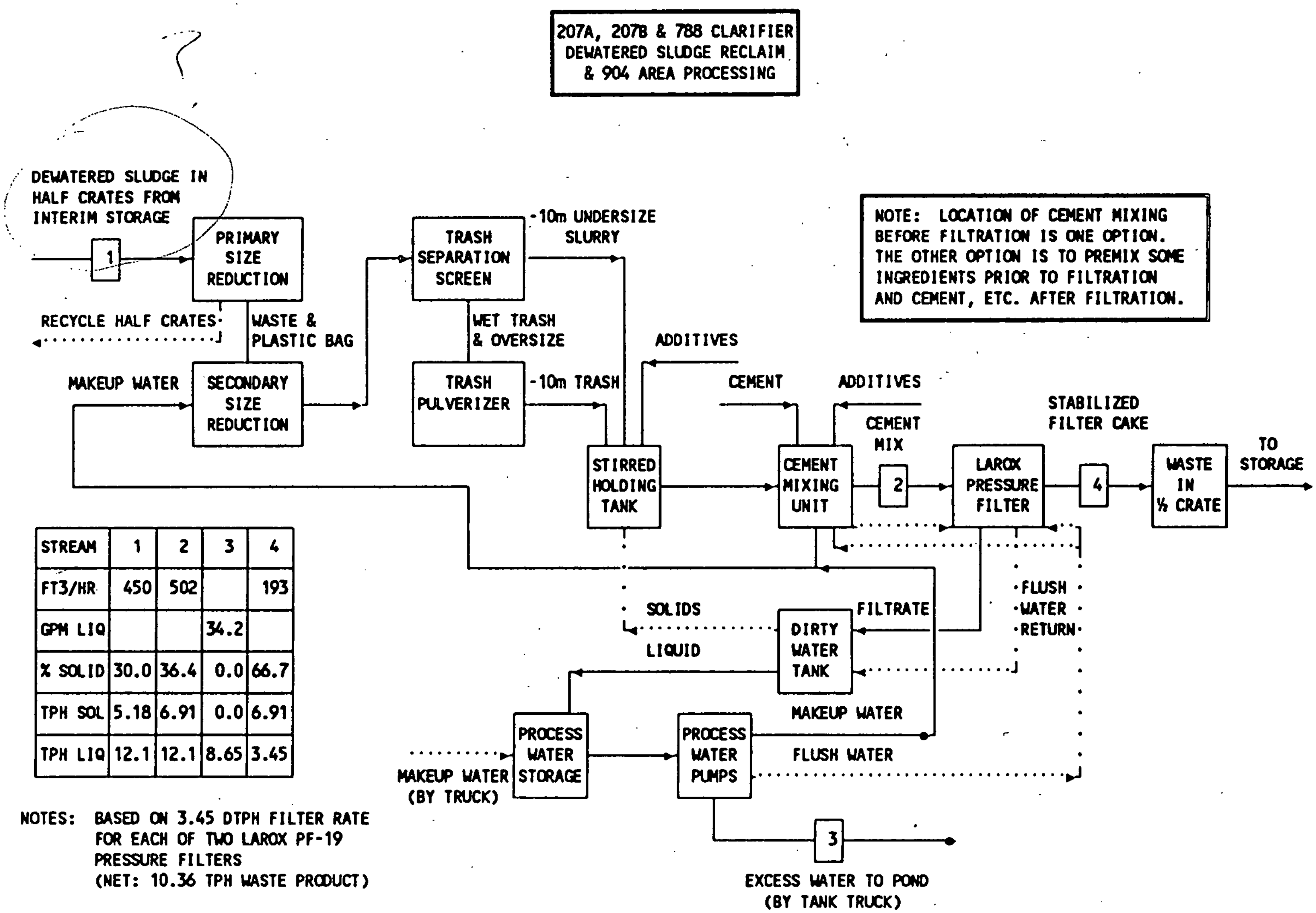
STREAM	1	2	3	4
GPM	105	24.1	80.9	
FT3/HR	842	193		240
% SOLID	7.5	30.0	0.0	66.7
TPH SOL	2.0	2.0	0.0	9.4
TPH LIQ	24.7	4.7	20.0	4.7

*NOTE: EFFECTIVE S.G POND SOLIDS = 1.50
3:2:1 SOLID:WATER:CEMENT RATIO

January 13, 1992

ATTACHMENT 2

PLAN A: STAGE II DEWATERING AND STABILIZATION PROCESSING



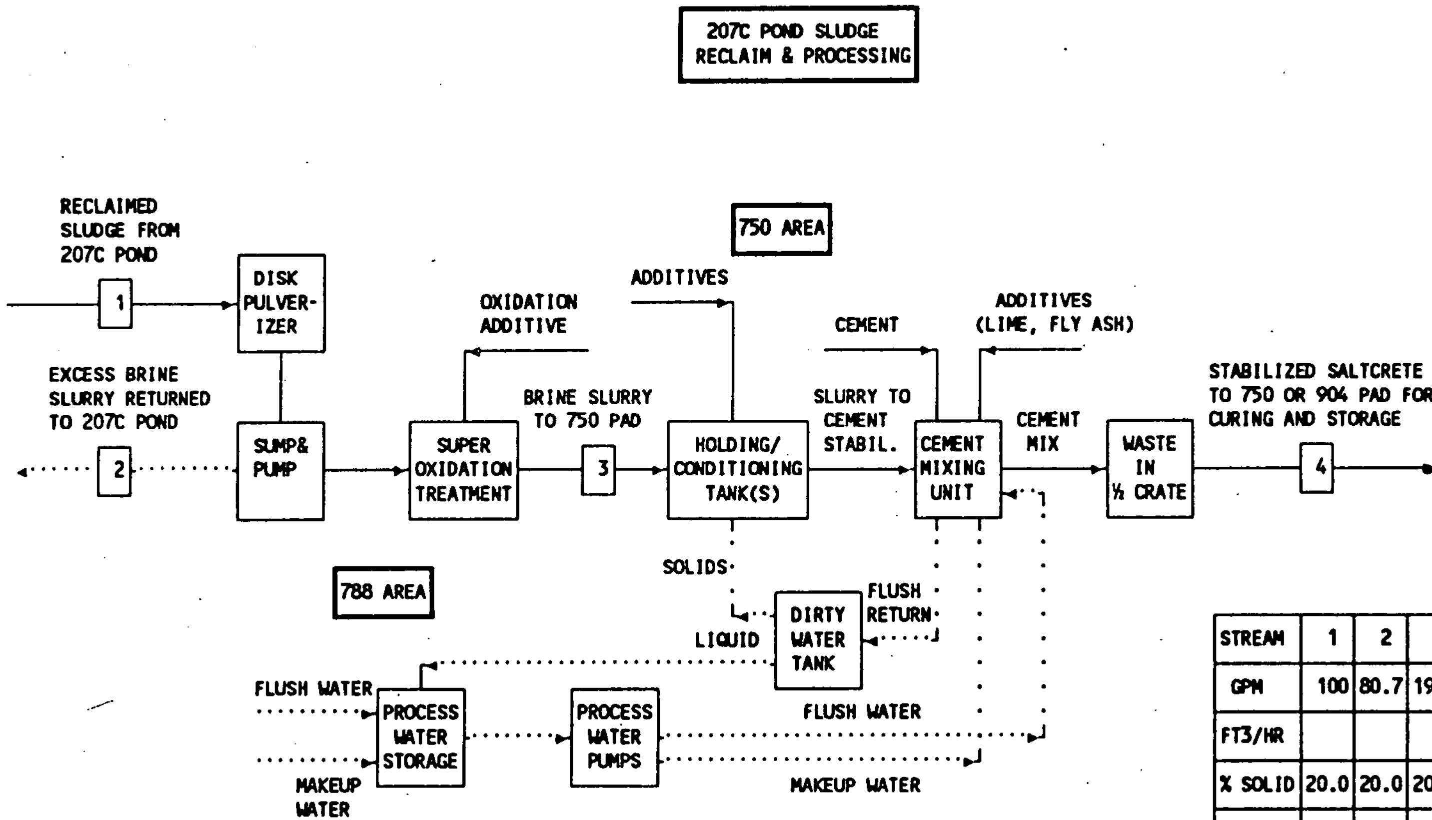
STREAM	1	2	3	4
FT3/HR	450	502		193
GPM LIQ			34.2	
% SOLID	30.0	36.4	0.0	66.7
TPH SOL	5.18	6.91	0.0	6.91
TPH LIQ	12.1	12.1	8.65	3.45

NOTES: BASED ON 3.45 DTPH FILTER RATE FOR EACH OF TWO LAROX PF-19 PRESSURE FILTERS (NET: 10.36 TPH WASTE PRODUCT)

January 13, 1992

ATTACHMENT 2

PLAN C: POND 207C RECLAIM AND STABILIZATION PROCESSING

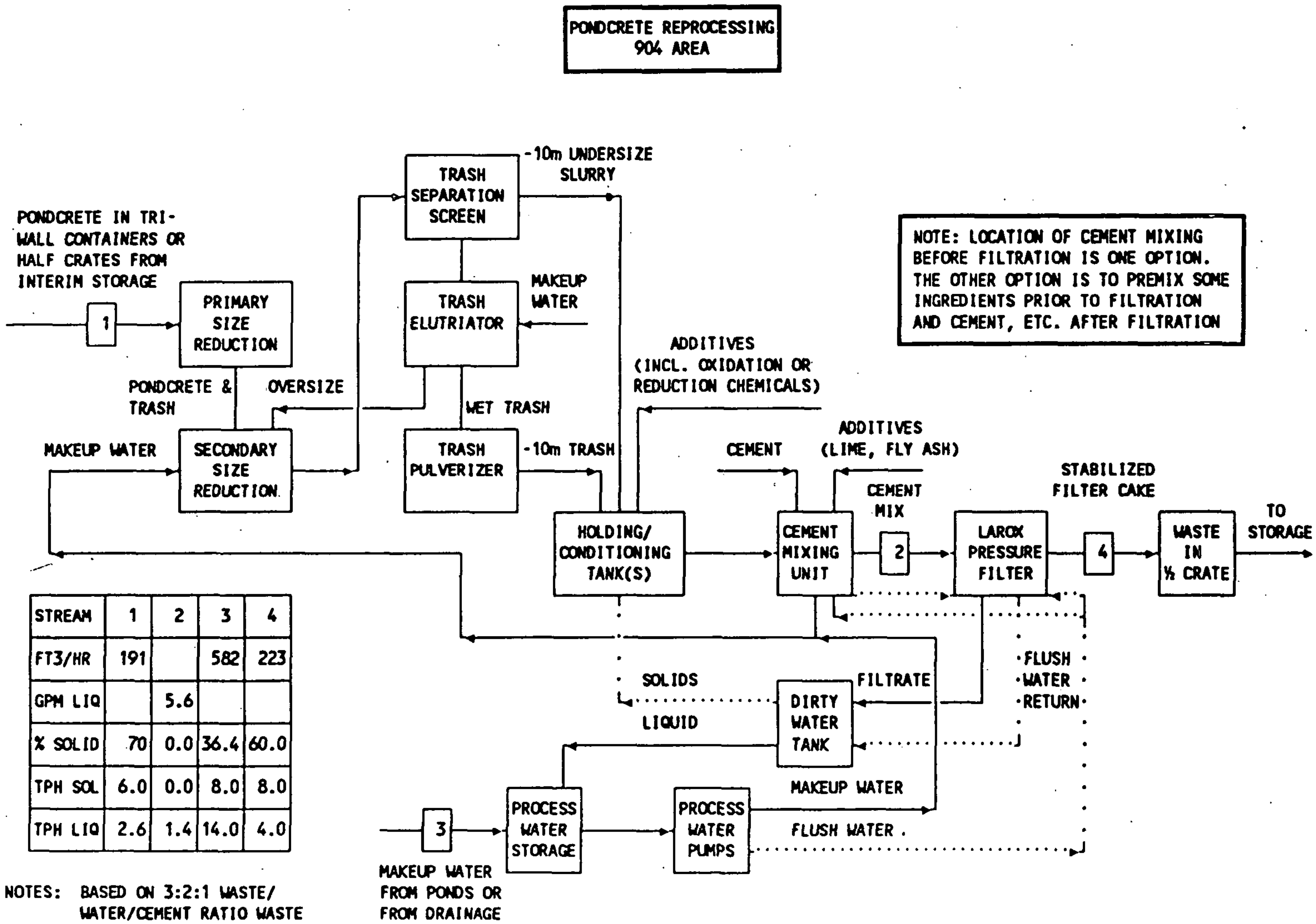


STREAM	1	2	3	4
GPM	100	80.7	19.3	
FT3/HR				255
% SOLID	20.0	20.0	20.0	60.0
TPH SOL	7.4	6.0	1.4	10.3
TPH LIQ	29.5	23.8	5.7	3.7

NOTES: BASED ON 1:1 CEMENT/SALT RATIO
35% SALT IN SATURATED BRINE
TWO 5" DIA. T/R MIXERS @ 7.0 TPH EACH

January 13, 1992

ATTACHMENT 3
PONDCRETE REPROCESSING ON 904 PAD

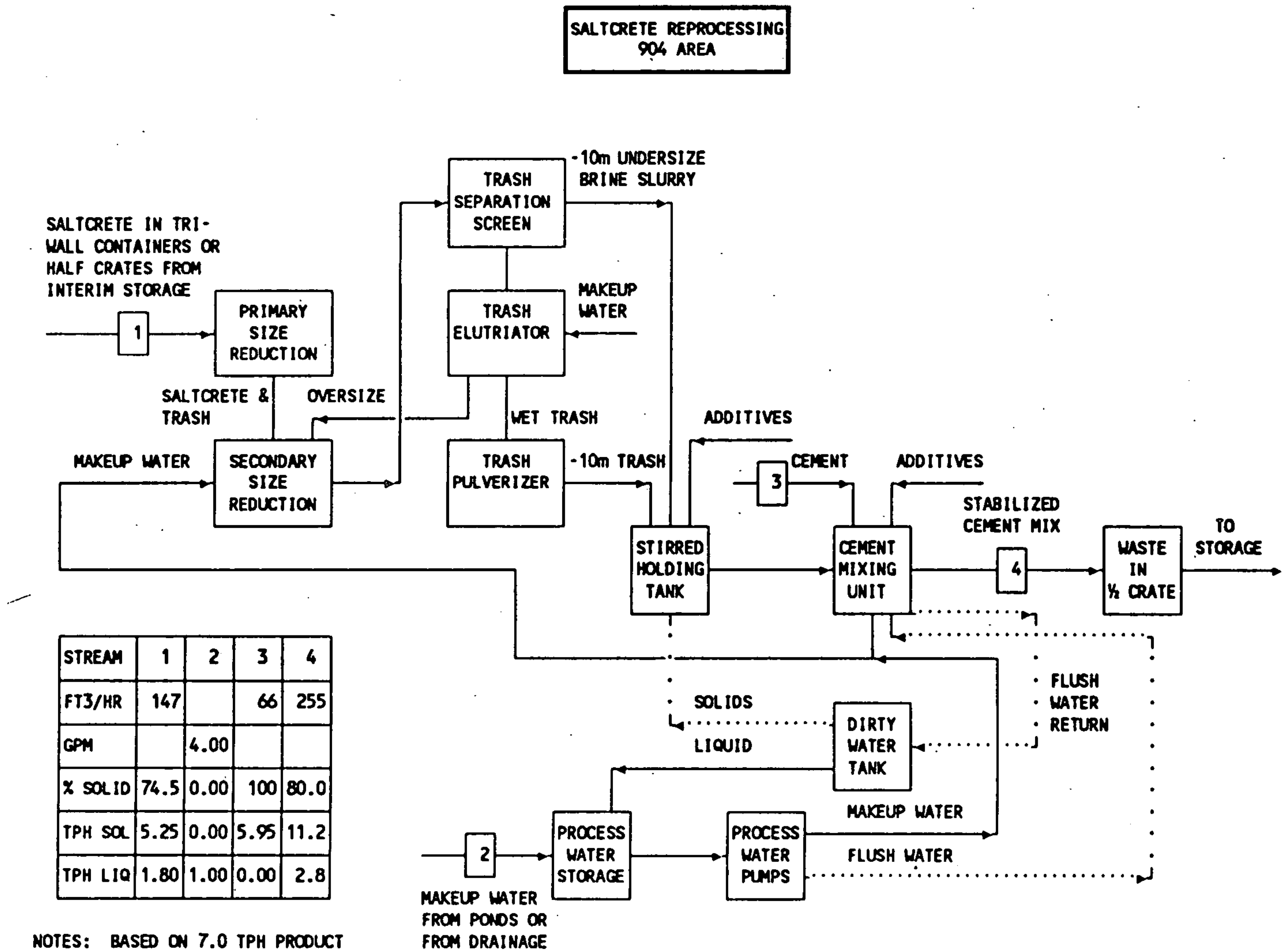


STREAM	1	2	3	4
FT3/HR	191		582	223
GPM LIQ		5.6		
% SOLID	70	0.0	36.4	60.0
TPH SOL	6.0	0.0	8.0	8.0
TPH LIQ	2.6	1.4	14.0	4.0

NOTES: BASED ON 3:2:1 WASTE/WATER/CEMENT RATIO WASTE FORMULATION
EACH OF TWO LAROX PF-19 FILTERS HAVE 6.0 TPH NET CAPACITY

January 13, 1992

ATTACHMENT 4
SALTCRETE REPROCESSING ON 904 PAD

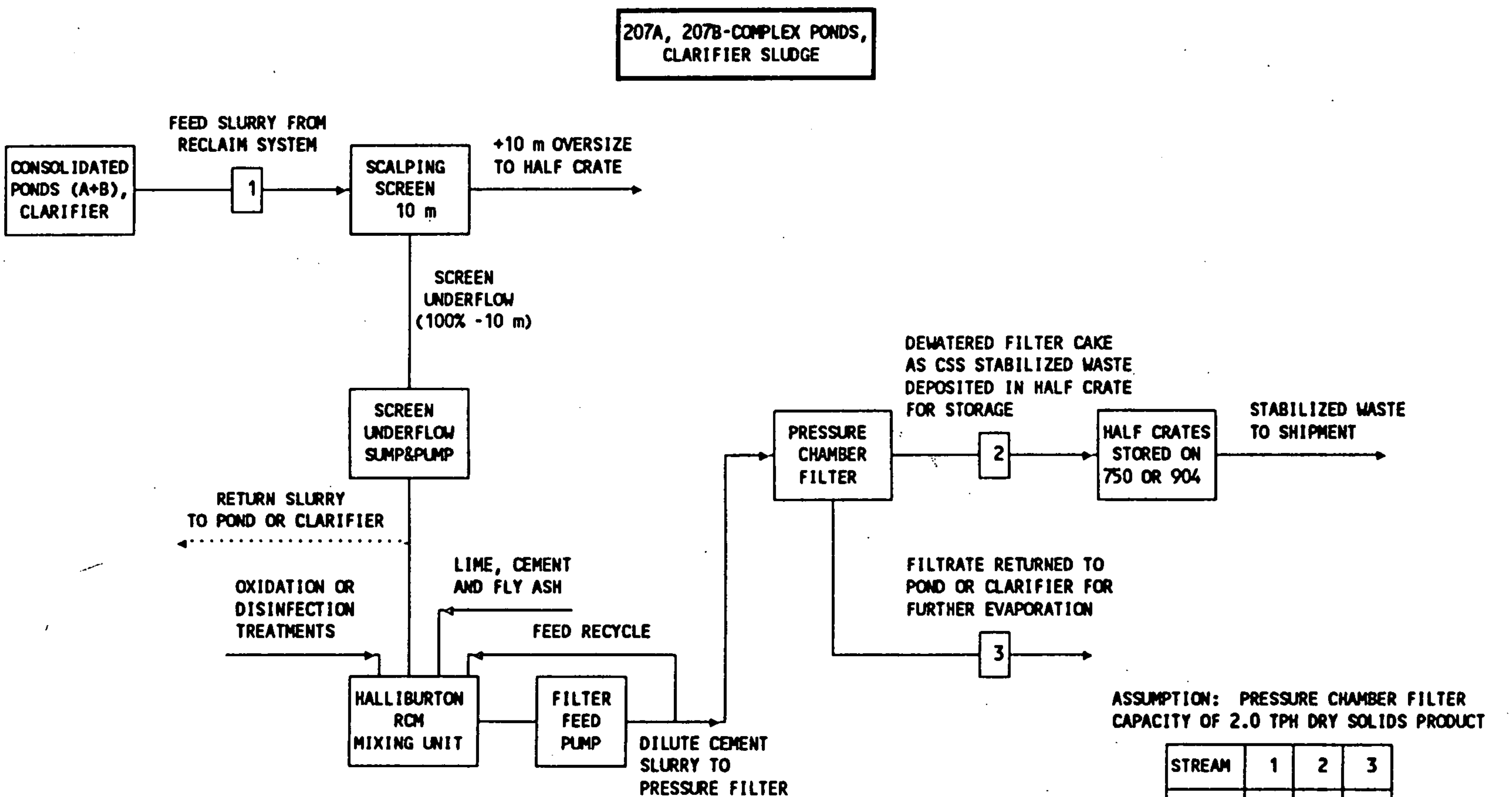


STREAM	1	2	3	4
FT3/HR	147		66	255
GPM		4.00		
% SOLID	74.5	0.00	100	80.0
TPH SOL	5.25	0.00	5.95	11.2
TPH LIQ	1.80	1.00	0.00	2.8

NOTES: BASED ON 7.0 TPH PRODUCT LIMITATION FOR EACH OF TWO T/R MIXERS
NEW SALTCRETE FORMULATION OF 1.5/1 CEMENT/SALT RATIO AND 0.47/1 WATER/CEMENT RATIO

January 13, 1992

ATTACHMENT 5
PLAN D: PROCESSING USING RCM UNIT AND CHAMBER FILTER
EQUIPMENT REQUIREMENTS OR SUBCONTRACTOR SCOPE



NOTE: ALL SLUDGES WILL REQUIRE SOME OXIDATIVE PRETREATMENT FOR DISINFECTION AND TO IMPROVE L/S SEPARATION. ONLY CLARIFIER SLUDGE WOULD NEED HIGHER-INTENSITY CHEMICAL OXIDATION TREATMENT.

ASSUMPTION: PRESSURE CHAMBER FILTER CAPACITY OF 2.0 TPH DRY SOLIDS PRODUCT

STREAM	1	2	3
GPM	53.0	12.0	45.1
% SOLID	7.5	66.7	0.0
TPH SOL	1.0	2.0	0.0
TPH LIQ	12.3	1.0	11.3

*NOTE: EFFECTIVE S.G SOLIDS = 1.50

January 13, 1992

INTEROFFICE MEMORANDUM

DATE: January 11, 1991

File No.: 765.2

TO: John R. Zak

FROM: Wayne C. Henderson

SUBJECT: Rocky Flats Solar Pond/Pondcrete Stabilization Project Brown & Root Job No. JR-1198

REFERENCE: **UPDATED TABLES FOR "NEW" CEMENT STABILIZATION FORMULATIONS AND ESTIMATED VOLUME OF WASTE FORMS FROM 207A&B POND SLUDGES**

Based on our recent discussions with HNUS and EG&G, I have recalculated the relationships between input pond sludges (at any given percent dry solids) and the output (cement only) stabilized waste form. Provided in Table 3 is an abbreviated table for a number of input slurry percent solids based on the "original" formula calculation method which assumed that all solids (pond solids plus cement) are counted in the water/solid ratio in the formulation.

A "new" formulation basis has been discussed which treats the pond solids as inerts and ratios the cement/water ratio based on the cement only. Additional cement must be added if the inert solids/cement ratio is exceeded. However, this does not occur generally except at very high percent solids (i.e. >85% solids in the feed). A recalculated table using this philosophy is presented in Table 4.

In addition, based on the recent estimate of the contained dry solids in the A & B ponds of 343.2 tons (HNUS Waste Characterization Report), Tables 1 and 2 present estimates of the output waste product given the "original" and "new" cement stabilization formulations.

CONCLUSIONS:

Based on the results of calculations presented in Table 1:

- The approximate number of half crates full of waste produced from the Medium Water Ratio processing of pond sludge (@30% feed solids to stabilization) is 1,023.
- The minimum number of half crates produced from a Low Water Ratio processing scenario (i.e. using a pressure filter to dewater to 60% prior to stabilization) is 523.

- This results in a difference in output waste forms of approximately 500 half crates for the 3/1 waste solids/cement formulation. At approximately $2000 cost to EG&G for disposal of each half crate (Reference L. Collins on 1/09/92), this is only equivalent to about $1,000,000 in potential savings on this basis. The extra risk to the project and potential time delays certainly do not warrant consideration of purchase or installation of a pressure filter exclusively for the 207A & B pond sludges. **However, if the pond sludges can be easily stored, reclaimed into the 904 pondcrete circuit which would still have significant incentives for a pressure filter, then the savings could be realized.**

- At higher cement/waste ratios, the differences in the waste volumes produced are even less. Thus, the incentives are also less.

- The biggest incentive comes from partially dewatering to the 30% solids range upon reclaim for this limited quantity of pond solids (which is assumed reclaimable at about 7.5% solids). In this case 5,413 versus 1,023 half crates of stabilized waste would be produced from the A & B pond sludges. At the $2000/half crate cost, this would be approximately $8.8 MM in additional cost for storage and disposal. (Note: No capital or operating costs are included for any of these comparisons.)

- For the approximately 4000 tons of solids in pondcrete, the saving potential for minimizing the excess water in the final waste form using the pressure filter is 10 to 15 times higher than that for the pond sludges. This would depend on the actual average percentage of moisture in the pondcrete.

cc: BJY
JHT
TLM
LMO
DNA
DAP
KRT
MAM
WJS

TABLE 1: PRODUCT SLUDGE VOLUMES FOR 207A & 207B PONDS USING ORIGINAL WASTE FORMULATION PHILOSOPHY

DRY POND SOLIDS (TONS)	PERCENT FEED SOLIDS	S.G. SLUDGE	WEIGHT SLUDGE (TONS)	VOLUME OF SLUDGE (FT3)	S:W:C CSS RATIO	STABILIZED WASTE (TONS)	STABILIZED WASTE (FT3)	WTOUT/WTIN	VOUT/VIN	HALF CRATES WASTE (@40 FT3/HC)
343.2	7.5	1.049	4,576.0	139,882.9	3:2:1	12,698.4	216,530.0	2.78	1.55	5,413
343.2	30.0	1.230	1,144.0	29,824.6	3:2:1	2,400.0	40,924.2	2.10	1.37	1,023
343.2	30.0	1.230	1,144.0	29,824.6	2:1.5:1	2,400.0	40,924.2	2.10	1.37	1,023
343.2	30.0	1.230	1,144.0	29,824.6	1:1:1	2,400.0	40,924.2	2.10	1.37	1,023
343.2	60.0	1.586	572.0	11,565.0	3:2:1	1,144.0	20,935.1	2.00	1.81	523
343.2	60.0	1.586	572.0	11,565.0	2:1.5:1	1,286.8	23,549.1	2.25	2.04	589
343.2	60.0	1.586	572.0	11,565.0	1:1:1	1,715.1	31,387.0	3.00	2.71	785

NOTE: ORIGINAL WASTE FORMULATION PHILOSOPHY ASSUMED WATER RATIO TO TOTAL SOLIDS (DRY BASIS).
THESE TOTAL SOLIDS INCLUDE WASTE SOLIDS PLUS CEMENT PLUS ANY OTHER SOLIDS (I.E. LIME, FLY ASH, ETC.)

11-Jan-92

TABLE 2: PRODUCT SLUDGE VOLUMES FOR 207A & 207B PONDS USING NEW WASTE FORMULATION PHILOSOPHY

DRY POND SOLIDS (TONS)	PERCENT FEED SOLIDS	S.G. SLUDGE	WEIGHT SLUDGE (TONS)	VOLUME OF SLUDGE (FT3)	S/C CSS RATIO (@2/1 C/W)	STABILIZED WASTE (TONS)	STABILIZED WASTE (FT3)	WTOUT/WTIN	VOUT/VIN	HALF CRATES WASTE (@40 FT3/HC)
343.2	7.5	1.049	4,576.0	139,882.9	3:1	12,698.4	216,530.0	2.78	1.55	5,413
343.2	30.0	1.230	1,144.0	29,824.6	3:1	2,745.6	46,817.3	2.40	1.57	1,170
343.2	30.0	1.230	1,144.0	29,824.6	2:1	2,745.6	46,817.3	2.40	1.57	1,170
343.2	30.0	1.230	1,144.0	29,824.6	1:1	2,745.6	46,817.3	2.40	1.57	1,170
343.2	60.0	1.586	572.0	11,565.0	3:1	800.7	14,652.5	1.40	1.27	366
343.2	60.0	1.586	572.0	11,565.0	2:1	1,029.6	18,841.6	1.80	1.63	471
343.2	60.0	1.586	572.0	11,565.0	1:1	1,029.6	18,841.6	3.00	1.63	471

NOTE: NEW WASTE FORMULATION PHILOSOPHY ASSUMED WATER RATIO TO CEMENT ONLY. A MAXIMUM SOLIDS/CEMENT RATIO AND A MINIMUM CEMENT/WATER RATIO ARE MAINTAINED. CEMENT/WATER RATIO = 2.0/1.

11-Jan-92

TABLE 3: RELATIONSHIPS BETWEEN PROCESS INPUTS AND PONDCRETE OUTPUT
3:1 MAXIMUM AGGREGATE/CEMENT RATIO

11-Jan-92

INPUT SLURRY WEIGHT%	S. G. OF SLURRY*	FOR 20 TPH PRODUCT 5.20 GAL H2O/SACK CEMENT (0.500 TONS H2O/TON DRY SOLIDS)							
		TPH SOLIDS	TPH LIQUID	TPH H2O	TPH CEMENT	TPH PRODUCT	LBS/FT3	½-CRATES/HR	V OUT/V IN
0.0	1.000	0.00	6.67	0.00	13.33	20.00	121.14	8.25	1.54
5.0	1.032	0.35	6.67	0.00	12.98	20.00	120.67	8.29	1.52
10.0	1.068	0.74	6.67	0.00	12.59	20.00	120.14	8.33	1.48
20.0	1.142	1.67	6.67	0.00	11.67	20.00	118.89	9.43	1.44
30.0	1.230	2.86	6.67	0.00	10.48	20.00	117.29	9.56	1.37
40.0	1.332	4.44	6.67	0.00	8.89	20.00	115.15	9.74	1.30
50.0	1.452	6.67	6.67	0.00	6.67	20.00	112.15	10.00	1.21
55.0	1.521	8.15	6.67	0.00	5.19	20.00	110.16	10.18	1.16
60.0	1.596	10.00	6.67	0.00	3.33	20.00	107.66	10.42	1.11
65.0	1.680	10.00	5.39	1.28	3.33	20.00	107.66	10.42	1.26
70.0	1.773	10.00	4.29	2.38	3.33	20.00	107.66	10.42	1.44
75.0	1.876	10.00	3.33	3.33	3.33	20.00	107.66	10.42	1.63
80.0	1.992	10.00	2.50	4.17	3.33	20.00	107.66	10.42	1.84

* BASED ON S.G. SOLIDS OF 2.65, LIQUID OF 1.00, PORTLAND CEMENT AT 3.13

** ABOUT 40 FT3/½-CRATE MAXIMUM FILL

BASED ON ORIGINAL WASTE FORMULATION BASED ON COUNTING POND SOLIDS AND CEMENT AS TOTAL DRY SOLIDS IN RATIO TO WATER ADDITION.

DEFINITIONS: POND SLUDGE = WET SETTLED SOLIDS WITH INTERSTITIAL WATER ONLY

POND SLURRY = UNIFORM MIXTURE OF POND SLUDGE AND FREE WATER

POND SOLIDS = DRY SOLIDS IN POND SLUDGE

TABLE 4: RELATIONSHIPS BETWEEN PROCESS INPUTS AND PONDCRETE OUTPUT - "NEW" FORMULA 3:1 MAXIMUM AGGREGATE/CEMENT RATIO

INPUT SLURRY WEIGHT%	S. G. OF SLURRY*	FOR 20 TPH PRODUCT 5.20 GAL H2O/SACK CEMENT (0.600 TONS H2O/TON DRY SOLIDS)							
		TPH SOLIDS	TPH LIQUID	TPH H2O	TPH CEMENT	TPH PRODUCT	LBS/FT3	½-CRATES/HR	V OUT/V IN
0.0	1.000	0.00	6.67	0.00	13.33	20.00	121.14	8.25	1.54
5.0	1.032	0.34	6.55	0.00	13.10	20.00	121.29	8.24	1.54
10.0	1.066	0.71	6.43	0.00	12.86	20.00	121.45	9.23	1.53
20.0	1.142	1.54	6.15	0.00	12.31	20.00	121.80	9.21	1.52
30.0	1.230	2.50	5.83	0.00	11.67	20.00	122.22	9.18	1.50
40.0	1.332	3.64	5.45	0.00	10.91	20.00	122.71	9.14	1.48
50.0	1.452	5.00	5.00	0.00	10.00	20.00	123.30	9.09	1.47
55.0	1.521	5.79	4.74	0.00	9.47	20.00	123.64	9.07	1.46
60.0	1.596	6.67	4.44	0.00	8.89	20.00	124.02	9.04	1.44
65.0	1.680	7.65	4.12	0.00	8.24	20.00	124.45	9.01	1.43
70.0	1.773	8.75	3.75	0.00	7.50	20.00	124.92	8.98	1.41
75.0	1.876	10.00	3.33	0.00	6.67	20.00	125.47	8.94	1.40
80.0	1.992	11.43	2.86	0.00	5.71	20.00	126.08	8.89	1.38

* BASED ON S.G. SOLIDS OF 2.65, LIQUID OF 1.00, PORTLAND CEMENT AT 3.13
** ABOUT 40 FT3/½-CRATE MAXIMUM FILL
BASED ON "NEW" WASTE FORMULATION BASED ON COUNTING ONLY CEMENT AS TOTAL DRY SOLIDS IN RATIO TO WATER ADDITION.

DEFINITIONS: POND SLUDGE = WET SETTLED SOLIDS WITH INTERSTITIAL WATER ONLY
POND SLURRY = UNIFORM MIXTURE OF POND SLUDGE AND FREE WATER
POND SOLIDS = DRY SOLIDS IN POND SLUDGE

11-Jan-92

DRAFT

To: Ted Bittner
From: J.D. Chiou

Date: January 13, 1992
Copies: R. Ninesteel
M. Speranza
S. Mathew

Subject: Consolidation of A Pond and B Ponds

This memorandum has been prepared to address the issue of consolidating A Pond sludge with combined B Pond sludge. Based on the quality control and process design/management considerations, it is more efficient to treat the sludge from the 207A pond and the three 207B ponds in a mixed form by the same treatment process than to treat each pond separately by different processes. To obtain the regulatory consent on this approach, it is necessary to show that mixing the materials from these four ponds does not create a chemical hazard (i.e. excessive heat, offgassing, explosion etc.) and/or undesired chemical reactions (i.e. precipitation, pH changes, miscibility problems etc.). Secondly, it must to be shown that the treatment process will be sufficient to handle the mixture. This memo summarizes the facts that are available to support the acceptance of this approach.

In response to the first concern, EG&G and HALLIBURTON NUS have completed chemical compatibility tests and demonstrated that the materials from these ponds produce no abnormal chemical reactions when mixed. Therefore, the only issue left is whether a treatment process can be developed to sufficiently treat the mixture. Successful treatability studies have already been conducted on these four ponds separately by HALLIBURTON NUS which demonstrated that the stabilized sludge can pass LDR and toxicity characteristic standards. Therefore, it is necessary only to show either that all these ponds have similar chemical concentrations or that the resulting concentrations in the mixture will be within the ranges of the original concentrations among the ponds.

Although the physical characteristics, chemicals present and pH values of these four ponds are similar, the ANOVA (ANalysis Of VAriance, which is the general title of methods developed for examining differences between the means of several groups) analyses on the analytical data can not conclude that the mean concentrations of each inorganic among these ponds are statistically the same. This is not a surprising result, considering the different locations/stages of these ponds in the former waste processing operation. Nevertheless, no compounds in the water from any of these ponds exceed either the LDR or toxicity characteristic standards. In the sludge, only cadmium from three ponds (i.e. 207A, 207B-north and 207B-center) exceeds the LDR standard. Clearly, this is a more important factor to be considered in the current stabilization process than the differences between specific chemical concentrations among these ponds. Given the governing criteria of this stabilization process, for all practical purposes, three out of these four ponds (207A, 207B-north, and 207B-center) can be considered similar and an effective treatment can be designed to treat their mixture. For 207B-south which has no compound in the water or sludge that exceeds the LDR or toxicity characteristic standard, the addition of materials from the other three ponds will increase the concentration of cadmium. However, a treatment process based on the worst-case conditions (i.e. higher cadmium concentrations) will still successfully treat this mixture.

The chemical concentrations in the mixture of water or sludge from these four ponds can be estimated by weighted averages of original concentrations in each pond. Using the volumes and specific weights of the sludge in each pond, the following equation can be derived:

$$Cmix = Ca \times 0.055 + Cb\text{-}n \times 0.344 + Cb\text{-}c \times 0.286 + Cb\text{-}s \times 0.315$$

where Cmix is the concentration in the mixture; Ca, Cb-n, Cb-c, and Cb-s are the original concentrations in 207A, 207B-north, 207B-center, and 207B-south, respectively. This equation can be applied to every chemical in the sludge. A similar equation can also be derived for the water. Numerically, Cmix will always be within the range between the maximum and minimum of the original concentrations. For example, the leachable cadmium concentrations in 207A, 207B-north, 207B-center and 207B-south are 485, 73, 136 and 24 ug/l, respectively, and the calculated Cmix is 98.2 ug/l.

In summary, the following conclusions support the acceptance of mixing the water and sludge from these four ponds and treating the mixture by a single treatment process:

- 207A, 207B-north, 207B-center and 207B-south are chemically compatible.
- 207A, 207B-north and 207B-center are the same under the LDR and toxicity characteristic standards.
- 207B-south satisfies both LDR and toxicity characteristic standards for all chemicals.
- Preliminary treatability studies for stabilization of sludges from 207A, 207B-north, 207B-center and 207B-south have been successful, producing a stabilized waste form that passes LDR and toxicity characteristic standards.
- The chemical concentrations in the mixture will be in the range of the original concentrations.
- Better process control can be achieved in a single treatment process for material from a narrower concentration range, such as a homogenous mixture.

These conclusions warrant a treatability study on the combined material from these four ponds.