HALLIBURTON NUS
Environmental Corporation

ROCKY FLATS PLANT SOLAR PONDS 207A and 207B

REMEDIATION PROGRAM DESCRIPTION

"A/B WHITE PAPER"

for

EG&G ROCKY FLATS

prepared by

HALLIBURTON NUS ENVIRONMENTAL CORPORATION

NOVEMBER 5, 1992

ROCKY FLATS PLANT SOLAR PONDS 207A and 207B

REMEDIATION PROGRAM DESCRIPTION
TABLE OF CONTENTS

ROCKY FLATS PLANT SOLAR PONDS 207A and 207B

REMEDIATION PROGRAM DESCRIPTION

ABSTRACT

In March 1991 Halliburton NUS Environmental Corp (HNUS) was awarded a contract at Rocky Flats to stabilize 750,000 gallons of mixed waste sludge contained in five Solar Evaporation Ponds and to reprocess 10,600 billets of solidified waste referred to as Pondcrete and Saltcrete. The project scope consists of waste characterization, design, construction and operation of various processing trains to remediate five different waste forms ranging from solid Pondcrete/Saltcrete blocks to aqueous high nitrate solutions. The project requires the use of high-volume grout mixing and pumping technology, development of statistically based process control procedures, and on-site installation of a mixed waste laboratory.

This paper provides an overview of the project along with criteria used to develop the remediation process. The report concentrates on one of the three processing trains - the Pond 207A and B Process Train. Various cementation technologies and environmental controls were developed to minimize volumes of waste and potential exposures to personnel and the environment during the remediation phase.

1.0 INTRODUCTION

The Rocky Flats Plant is located approximately 16 miles northwest of downtown Denver, Colorado. The area surrounding Rocky Flats is primarily agricultural or underdeveloped land. The Rocky Flats Plant, which began its nuclear weapons production program in 1953, has been an important part of the DOE Weapons Complex.

The scope of the Solar Ponds Project includes the waste characterization, technology development, design, construction and operation of process equipment to remove and solidify the sludge currently in Ponds 207A, 207B-North, 207B-Center, 207B-South, and 207C as well as the contents of the Clarifier Tank. The next phase of the project will involve the reprocessing of 10,600 solid blocks of Pondcrete and Saltcrete.

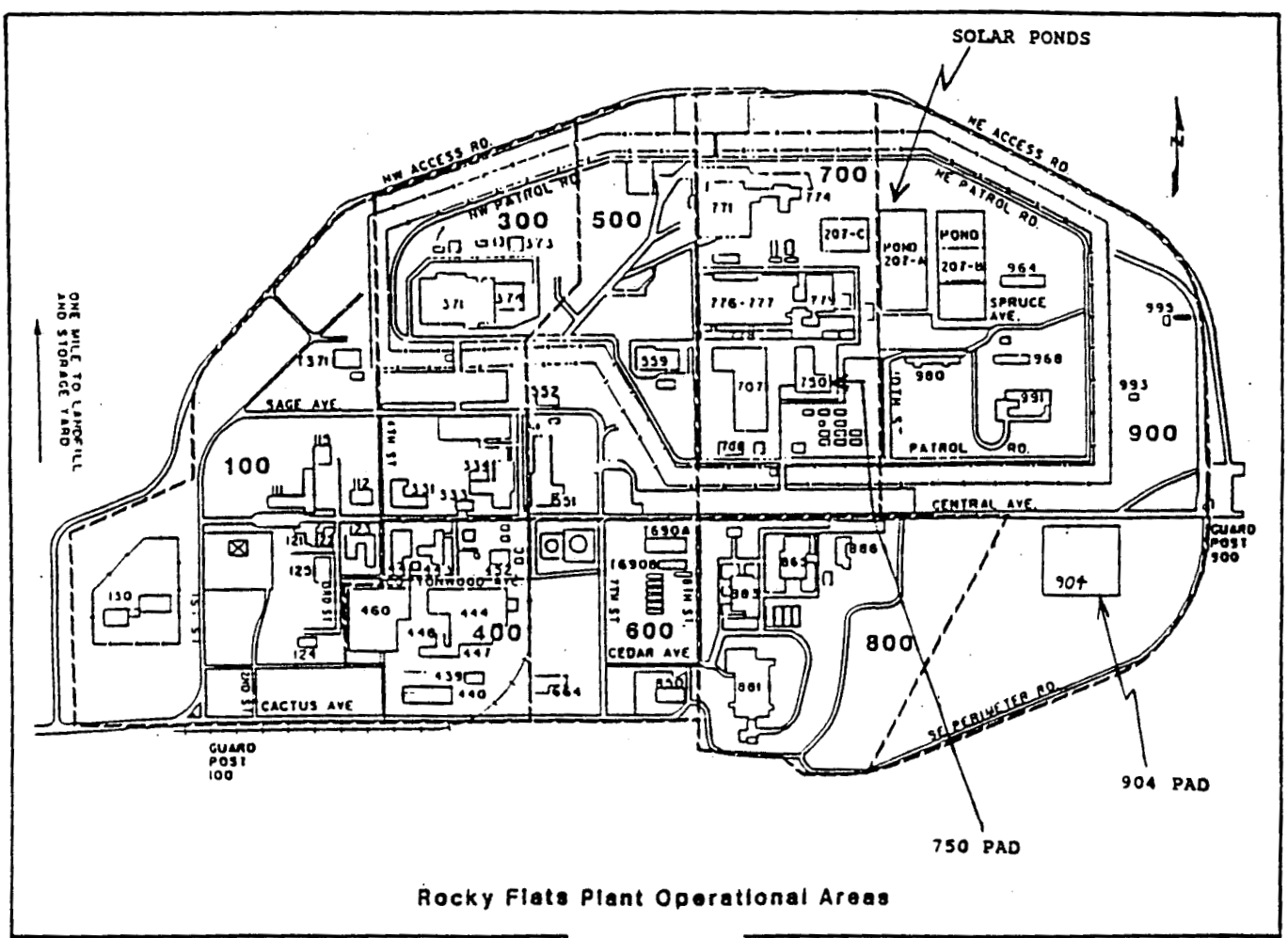
The treatment procedure is a Chemical Stabilization and Solidification (CSS) process which will produce a stabilized waste form. The final waste product from this project will be certifiable to all storage, transportation, and waste disposal

requirements established by EPA regulations, DOT regulations, and Nevada Test Site (NTS) Defense Waste Acceptance Criteria, Certification, and Transfer Requirements (NVO-325) of October 1988.

This paper provides a broad outline of the scope of the project and concentrates on the 207A and B remediation process train. The 207A and B Pond waste is predominantly composed of silt solids mixed in water.

2.0 BACKGROUND

The five Solar Evaporation Ponds are configured as a series of ponds shown in Figure 1. The Ponds, which were placed into service in August 1956, cover a total of 6.5 acres and were used to receive, store, and treat liquid process wastes having less than 100,000 picocuries per liter of total long-lived alpha activity. The Ponds are known to have received wastes including sludge, high levels of nitrates, chlorides, and various metal ions.



Rocky Flats Plant Operational Areas

FIGURE 1

Sludges from the ponds have been periodically removed to permit repair work on the pond liners. As the sludges were removed, they were mixed with cement and solidified into "Pondcrete" and its highly nitrated counterpart "Saltcrete". The Pondcrete and Saltcrete billets will require remixing and repackaging to comply with off-site disposal requirements.

The clean-out process will remove and treat the total contents of the Ponds. The amount of Pond waste requiring processing at the start of the clean-out may vary depending on evaporation, precipitation, and potential operational constraints. Estimates of the amounts of waste requiring processing are currently as shown in Table 1.

TABLE 1
ESTIMATED WASTE VOLUMES REQUIRING REMEDIATION

WASTE SOURCE	WASTE VOLUME
Pond 207A	1300 (gallons)
Pond 207B-NORTH	112000 (gallons)
Pond 207B-CENTER	38000 (gallons)
Pond 207B-SOUTH	24000 (gallons)
Pond 207C	456000 (gallons)
Clarifier	27000 (gallons)
Total Sludge Volume	658300 (gallons)
Pondcrete	8000 (billets)
Saltcrete	2600 (billets)

As of this writing, all major processing equipment is in place for the Pond 207C/Clarifier process and the electrical and piping systems are being hooked up. The Halliburton NUS Erection Crew is currently working to prepare the system for pre-operational testing.

All major pieces of equipment, except for the Mixer, for Pond 207 A/B processing are currently on location at the Rocky Flats Plant, but erection work on the process has been suspended until further notice from EG&G. The contents of 207A Pond have been pumped into the three 207B Ponds. The next phase of pumping to consolidate and concentrate the slurries into Pond 207B South has begun.

3.0 HEALTH & SAFETY CRITERIA

Halliburton NUS has developed a Site Specific Health & Safety Plan (HASP) to accommodate the health and safety requirements of this project. The HASP includes sections on hazard assessment, hazard communication, site control, personal protective equipment, material handling safety, decontamination procedures, medical surveillance, health and safety monitoring, training for radiation worker protection, and emergency response. The Plan was prepared in accordance with 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response) and 29 CFR 1910.1200 (Hazard Communication).

The equipment design and installation have incorporated features for environmental and worker protection. Field operators will be physically isolated from Pond material by use of remotely controlled equipment. Double-walled piping, properly-sized secondary containment and the existing Pond berms will provide spill prevention during processing. High Efficiency Particulate Air (HEPA) filtered ventilation systems will control atmospheric emissions. The scalping screen equipment is enclosed for splash control, and all tanks have been constructed with high level sensors and alarms where appropriate. Tanks also have secondary containments. All secondary containments have been sized in accordance with 6 CCR 1007-3, Part 264. The Cement Mixer is in an enclosure designed to contain dust and wash water over-spray. The entire process train from Reclaim to the Casting Station is sealed from the atmosphere to minimize potential exposures to personnel. Finally, ambient and surface radioactivity will be monitored during operations.

USE OF PPE

The use of Personal Protective Equipment (PPE) is required when engineering and administrative controls are insufficient to prevent all exposures to hazardous chemicals and radioactive materials, or to enact ALARA (as low as reasonably achievable) policy. It is anticipated that all personnel assigned to the site will be required to wear PPE and will be trained in the proper inspection and use of PPE.

The ALARA order and hazard assessment and risk analysis in Section 3 of the Health & Safety Plan, Rev. 2, requires Level D protection for routine operational activities that will be supplemented with modified Level D, or Level C, as needed. The latter Levels will be needed if there is a potential for unexpected inhalation of, or contact with, radionuclides or hazardous chemicals.

4.0 QUALITY ASSURANCE REQUIREMENTS

Process Control is the most important aspect of the project. The process must be controlled and documented to guarantee that the processed waste will meet established criteria. Halliburton NUS is preparing an extensive Process Control Plan, which is an integrating procedure that ensures the output of each waste form processing unit meets all established requirements in a documentable form.

5.0 CHARACTERIZATION AND TREATABILITY STUDY OVERVIEW

Halliburton NUS undertook a detailed waste characterization effort followed by treatability studies to develop a process to remediate the waste in the 207A and B-series Ponds. These studies included:

- sampling and characterization of the waste to determine its chemical composition,
- examination of the physical characteristics of the waste to evaluate methods to reclaim the waste material and to prepare a slurry suitable for solidification,
- performance of treatability studies to develop recipes to effectively produce a durable, certifiable waste form,
- studying the physical properties of the cemented slurry for equipment selection considerations, and
- preparation of surrogate material which mimics the handling characteristics of the cemented waste, allowing the performance of field tests to finalize the equipment required for the remediation.

5.1 Sampling and Characterization

The 207A and B-series Ponds were sampled to characterize their contents and to determine the variability of the chemical constituents in the multiple media present. The data was examined to:

1) assess the regulatory implications of the waste based on Land Disposal Restrictions (LDR's), and Toxicity Characteristics, and

2) define the design parameters and process development requirements of the remediation scheme to be developed.

The 207A and B-series Ponds each consist of a water phase and a solids phase composed of sand, silt and significant

organics. Each Pond as a whole can be considered to be a low dissolved solids water solution with Total Dissolved Solids (TDS) (ranging from 2600 to 16,000 mg/l) and settled sludge (ranging from 6.6 to 28.2% solids, by weight).

No semi-volatile organic compounds or alcohols were detected in any of the 207A and B-series Pond waters or sludges. Volatile organic compounds were detected in three of the four pond sludges, but none are above the land disposal restrictions.

The water phase in each of the 207A and B series Ponds did not exceed the Land Disposal Restrictions standards for any of the volatiles, semi-volatiles, alcohols, metals or anions (including cyanides) which were analyzed. The TCLP extracts obtained from the 207A and B-series Ponds' water phases showed no concentrations which would classify the water phase as a RCRA waste based on the characteristic of toxicity.

For Ponds 207A, B-North, and B-Center, the only Land Disposal Restrictions standard exceeded was for cadmium in the sludge phases.

For the 207B-South Pond sludge, no LDR standards were exceeded, nor were the TCLP standards for classifying the sludges as a RCRA hazardous waste, based on the characteristic of toxicity.

Radioactive Contamination:

The gross alpha or gross beta for the 207A and B-series Pond waters is very low at a maximum of 3000 pCi/l.

The gross alpha or gross beta for the 207B-series Pond sludges is also very low, ranging from 5 to 61 pCi/g.

The 207A Pond sludges gross alpha and gross beta are 570 and 95 pCi/g, respectively.

The 207A and B-series Ponds are physically and chemically similar in nature, and fall under similar regulatory considerations. Therefore, the 207A and B-series ponds have been consolidated to create a single waste form.

5.2 Treatability Study

The objective of the Treatability Study was to develop a formulation to solidify and stabilize the waste into a

product that meets all the criteria for certification as defined in NVO 325, Oct 1988. Due to uncertainty of the future availability of an ultimate disposal site, a series of freeze/thaw and wet/dry tests were also conducted on the stabilized waste form to ensure a stabilized product that would be durable under extremely variable ambient conditions.

To achieve this objective, a series of factorial experiments was designed to allow independent evaluation of the effect that a change of each variable had on the interaction of the other variables. The variables tested included varying amounts of waste loadings, different dosages of cement, flyash, lime, and a series of proprietary Halliburton chemicals. The goal of adding these proprietary chemicals was to provide the final waste form with properties such as durability and strength. Many of the chemicals were also tested to ascertain their abilities to render the pozzolan/waste mixture with the plasticity and setability characteristics to enhance ease of processing.

As a result of the Treatability Study, it was determined that a certifiable waste could be produced if the waste was mixed with a pozzolan blend (including cement, flyash and other chemicals in a fixed ratio) within a defined water to pozzolan ratio regime. This is achieved by measuring the quantity of free water present in the feed to the Cement Mixer.

The Treatability Study also shows that the addition of chlorine to the consolidated 207A and B-series sludge, followed by a sufficient settling period, facilitates dewatering of the sludge. This results in a significant decrease in the volume of stabilized waste produced.

Plasticizer Utilization

Testing was conducted at the HNUS Pittsburgh Laboratory to:

- evaluate the effectiveness of utilizing a plasticizer in the process to improve the handling characteristics of the final waste product, and
- evaluate the impact on NVO-325 certification requirements.

The final report (Memo, Simcik to Bittner of 10/13/92) contained the following conclusions:

"The addition of superplasticizer to the 207A/B CSS formulation mixture at the dosages tested increased the fluidity. The dosage of superplasticizer was sufficient to enable a simulated halfcrate to be filled with simulated vibration. The addition of superplasticizer had no adverse affects on the ability of the stabilized waste to pass the NTS (Nevada Test Site) acceptance criteria."

5.3 Pilot Testing

After the range of acceptable formulations were determined, surrogates were prepared that mimicked the rheological properties of the waste/pozzolan mixture. These surrogates were used to conduct a series of field tests primarily designed to:

- test and modify the mixing and conveying equipment proposed for use during processing,
- examine the material handling requirements for the transportation of freshly cast material,
- test the pouring and packaging concepts being considered for casting the cemented slurry into boxes called halfcrates, and
- study the problems associated with the curing of a large cemented monolith, i.e. temperature rise, porosity, set time, and transportation time.

The information obtained from these surrogate tests was incorporated into the process design, which is outlined in subsequent sections.

6.0 PROCESS AND EQUIPMENT CRITERIA

6.1 General Criteria

The primary goal of the Project is to remediate the Solar Evaporation Ponds by reclaim and stabilization of the waste into a certified waste form suitable for disposal. It is also important to accomplish this in a manner which provides safety for the operating personnel, and which protects and preserves the environment. Therefore, the basic criteria used for design is to be appropriately conservative, provide redundancy of function where possible, and to have sufficient contingency in the operating plan and strategy for compromise to achieve the operating goal. In addition, the process design and the stabilization mix formulation aim at minimizing the

stabilized waste volume produced as a result of the process.

Because of the restrictive nature of mixed waste remediation, no equipment testing or large-scale materials property testing on the actual Pond material was possible. This prevented the typical vendor- testing of the equipment with the processing material. However, testing with surrogates having similar rheological properties as the waste has provided some insights into equipment design requirements.

The proposed Qualtec Mixer, classified as a pug mill, is of a different design than the pug mill formerly used at Rocky Flats Plant in the solidification process. Appendix B provides a comparative perspective of the two mixers and discusses the short-falls of the mixer used previously versus the rationale why HNUS proposes the Qualtec Mixer.

The reagent storage and delivery system to be used in the process train utilizes existing, proven field service equipment wherever feasible to provide reliable operation and to reduce the time required for equipment design and erection. This type of equipment satisfies the requirements for modular components, minimization of field erection, and necessary interfacing.

The nominal design operating rate for the process is approximately 7.5 tons per hour of stabilized waste product. These criteria were established to provide HNUS a comparable basis for technical and commercial evaluations. The current production schedule is based on a rate of 4 halfcrates per hour, 12 operating hours in a double shift mode, or 48 halfcrates per day.

6.2 Environmental Controls

In keeping with the effort to comply with all relevant environmental regulations and provide a safe working atmosphere for plant personnel, Halliburton NUS incorporated the following goals as an integral part of the design strategy:

- eliminate any emissions from the remediation process,
- minimize any potential for exposure of personnel to the waste or any other possible hazards, and
- protect the health and safety of the people operating the process.

The approaches followed in the design and equipment

selection and the definition of the operational requirements of the process have provided a system that assures the isolation of the waste from personnel and the environment. The key elements of the environmental controls incorporated in the design are the following:

- Reclaim operations utilize remote controlled equipment that eliminates the need for personnel within the Pond.
- The Scalping Screens for oversize removal are sealed and vented.
- All tankage and piping systems from the reclaim operations to the filling of the halfcrate waste containers are enclosed or covered.
- Passive HEPA filters are installed on all tank exhausts for filtration when volumetric air displacement occurs.
- All unit operations are double contained and designed to minimize the potential for leakage.
- Active HEPA filters are installed in the Mixer chambers and the Casting Station Module to create a partial vacuum which ensures isolation from the atmosphere.
- All bulk storage tanks, fuel storage tanks, fuel off-loading systems, generators, air compressors, diesel-powered hydraulic systems, etc. are equipped with the appropriate secondary containments and vent systems.
- Noise levels for operating equipment have been specified to be within acceptable health and safety guidelines.

The levels of environmental controls that have been incorporated into the process ensure that operating personnel working near or around the operating equipment will not need extraordinary safety equipment, respirators or full-containment clothing.

The Mixer and Pozzolan Supply Systems will be contained within a climate controlled, negative air enclosure with HEPA filtration. An airlock and step-off pad will be incorporated to allow for decontamination and radiological

surveillance. The Concrete Pump will be totally enclosed and connected with a sealed chute to the output of the Mixer. Secondary containment will be provided for the Mixer, the Concrete Pump, and the Casting Station.

6.3 Processing Criteria

The processing criteria used as a basis for the stabilization process design are summarized below. The process is designed to:

- Produce a certifiable waste form

  The stabilization process system design is required to achieve, maintain and control the stabilization process within the limits which have been defined for the certified waste form. This primarily consists of controlling the free water to pozzolan ratio in the stabilization Mixer, but also includes production rate control and feed material character control within acceptable limits.

- Reduce waste volume

  The major impact on the stabilized product waste volume results from the free water to pozzolan ratio requirements of the stabilization mix formulation. Free water available for pozzolan hydration is defined as the mass of the liquid phase which is not dissolved solids. Processes have been incorporated to de-water the sludges to approximately 20%, which will reduce the final waste volume.

- Minimize Footprint of Equipment

  Suitable space available for locating processing equipment within the Plant boundaries is at a premium. In addition, attempts have been made to reduce interference with other plant activities.

- Minimize On-site Erection Labor

  The Rocky Flats Plant, due to high security requirements, environmental sensitivity, and radiation health and safety requirements, requires a number of extraordinary work rules, practices and procedures which are not typical for most industrial environments. Therefore, off-site fabrication, assembly and testing have been maximized for all equipment and systems utilized in the stabilization

process.

- Minimize Plant Interface

  The process has been designed to minimize the interface with the rest of the Plant. Almost all utilities, including power, compressed air, fuel, and reagents have been provided independent of the existing systems at the Rocky Flats Plant.

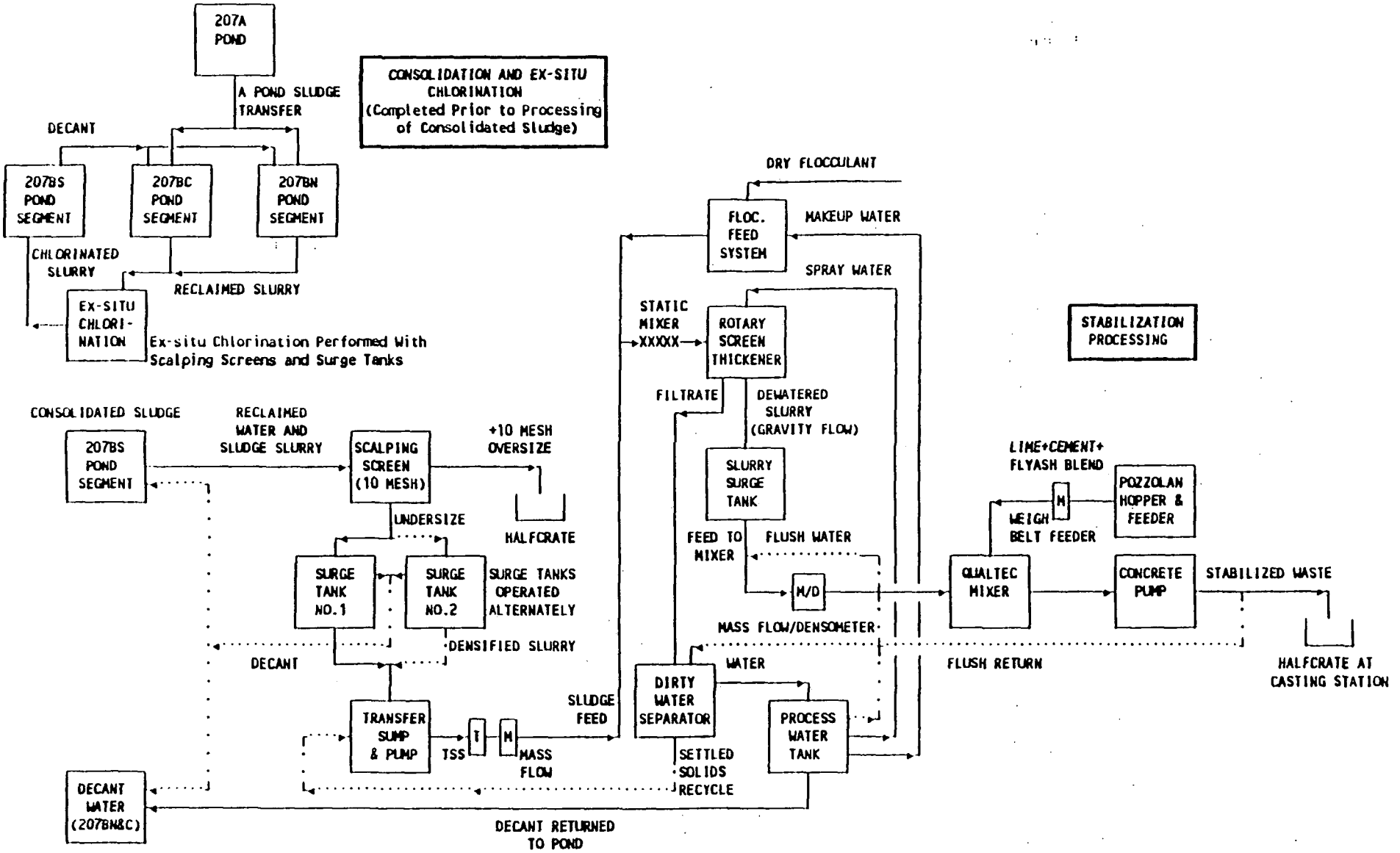
7.0 REMEDIATION PLAN

The plan for remediation and stabilization of the mixed silt solids waste in solution in Ponds 207A and B at the Rocky Flats Plant (RFP) consists of a number of sequenced preparation and processing steps. From Pond homogenization to stabilized waste product casting, the process train has been designed to permit equipment operation to satisfy the requirements of Section 6.

7.1 Process Flowsheet Overview

The Process Flowsheet for the 207A and B Ponds process train is schematically shown in Figure 2. The main functional areas include: the Reclamation and Initial Settling Phase, the Flocculation and Thickener Phase, Cement Addition and Mixing Phase, and the Casting and Halfcrate Handling Phase.

FIGURE 2
CONTINUOUS PROCESSING SYSTEM - PONDS 207A AND 207B



November 4, 1992

The 207A/B Solar Pond slurry consists of silt solids mixed in water. The goal is to remove the solids content from each Pond, partially dewater it, and treat the material through use of a CSS process to produce a stabilized waste form. The stabilization process will be conducted in accordance with the process parameters which will be set forth in the Process Control Plan (Deliverable # 251/252).

Process control equipment (except for subcontractor equipment) will utilize a computerized Distributive Control System (DCS). The Mixing Phase will be controlled by the QUALTEC Mixer weight-ratio control system in order to maintain the desired output product formulation. These control functions are presented in Section 7.8.

7.1.1 Reclamation and Initial Settling Phase

Note: Equipment tag numbers, eg. SU-05, are referenced in the Process Flow Diagram (PFD), Appendix A.

The reclaim flow rate has been designed to effectively remove sludge from the Ponds by providing sufficient velocity to assure solids entrainment. The reclaimed Pond material passes through the Scalping Screen (SC-01) to remove extraneous (coarse) material prior to processing. The coarse material reports to a halfcrate for EG&G separation of trash from oversize particles and later stabilization during Pondcrete and Saltcrete processing, and the screen underflow reports to the Screen Undersize Sump (SU-05) for pumping to the Surge Tanks.

The Surge Tanks (S-13/S-14) allow all but the finest particulate solids to gravity settle. A relatively clear or low solids content decant (<500 ppm TSS) overflows a weir into a drop box compartment within the Surge Tank, and is pumped back to the Pond(s).

7.1.2 Flocculation and Thickener Phase

The Transfer Sump (SU-01) is equipped with a variable speed Agitator (A-01) designed to suspend a slurry with a variable percent solids content. A variable speed Transfer Pump (P-01) delivers slurry to the Rotary Screen Thickener (RST) system. A Mass/Density Transmitter located between the Transfer Pump and the Rotary Screen Thickener transmits a signal to the DCS, which processes it into a proportional speed signal used by the Transfer Pump to control the flow

rate of flocculant addition.

The process design utilizes a Flocculant Feed System (FFS) (Z-03) in the circuit to achieve the desired level of sludge flocculation prior to stabilization. (A flocculant causes small particles to agglomerate together into larger particles which result in displacement of free liquids. The free liquids can then be separated from the solids.)

The flocculated slurry then enters the base of the Rotary Screen Thickener Feed Tank (S-10). A low speed, low shear variable speed Agitator (A-10) in the Tank gently suspends the flocculated sludge. Sludge from the Feed Tank overflows to the RST (TH-01), where it is partially dewatered to produce a 15-25% solid (by weight) material and a relatively clear decant (<500 ppm TSS).

The dewatered solids from the RST discharge by gravity to the Slurry Surge Tank (S-04), and the decant proceeds to the Process Water Tank via the Dirty Water Separator. The decant is a non-hazardous liquid, which may contain a minimal amount of flocculent, whose properties are annotated on the MSDS Sheet found in Appendix C. Process Water System serves two primary purposes: contains and clarifies the circulating process and flush waters within the stabilization system and to provide surge for excess water being returned to the ponds (207B-North and/or Central) for further evaporation.

The Pond Flush Water Pump (P-02) provides process water for flushing residue sludges in Pond 207B-South. The Pond 207C-South wash down system will transport process water to the berm for Pond 207B. At that point the responsibility for the provision for equipment and operation reverts to EG&G. The physical washdown will utilize the slope of the bottom (from the southeast corner to the northwest corner) of the pond to facilitate the operation.

7.1.3 Cement Addition and Mixing Phase

Viscous slurry is pumped from the Slurry Surge Tank to the QUALTEC Mixer. The Mass/Density Transmitter installed between the Mixer Feed Pump (P-03) and the QUALTEC Mixer (MX-08) sends a signal to the DCS. The DCS operator inputs data to the DCS for: liquid specific gravity, solids specific gravity, TDS,

product rate and water to pozzolan ratio. The DCS calculates the necessary pozzolan demand and relays a signal to the QUALTEC Mixer System.

The DCS also monitors the actual pozzolan addition rate and compensates with a feed back signal to ensure an effective and accurate flow of pozzolans.

The pozzolan/slurry mixture is pumped by the Concrete Pump (P-50) to the Casting Station.

7.1.4 Casting and Halfcrate Handling

At the Casting Station, the pozzolan/slurry mixture is pumped into halfcrates.

The filled halfcrate is moved from the Casting Station, via a chain conveyor system, to the Waste Form Inspection and Box Closure Stations. Chain conveyer systems are also used to stage and feed the empty halfcrates to the Casting Station. The casting and box handling operations are semi-automatic, and require few personnel to operate. The inspection and box closure operations are manual. Accumulating conveyor sections provide the surge and delay times required between manual operations.

The filled, sealed and inspected halfcrate is moved by fork lift to curing and interim storage. After the day's operations and for emergency shut-down, process lines and equipment which carry cemented product are flushed.

Sub-sections 7.2 thru 7.9 elaborate on the various unit operations in greater detail.

7.2 PRE-PROCESSING

An ex-situ Chlorination method has been proposed and is awaiting CDH approval. Chlorination (with Calcium Hypochlorite) has been recommended for four reasons:

- satisfy NVO 325 requirements which stipulate that no pathogens may be present in the final waste form,
- provide personnel protection,
- destroy the bio-mass, and
- enhance sludge settling.

It is HNUS's recommendation to address these items in the following three distinct stages.

7.2.1 Consolidation -- Scope: All Sludges Consolidated Into One Pond

The contents of the 207A Pond have been transferred to the 207B-series Ponds.

The initial accelerated processing schedule required Chlorination to enhance the settling of the sludges in order to meet critical deadlines imposed on the project. However, in view of the recent discussions between EG&G/DOE, and the various options that are being considered, there in all likelihood will be a substantial time period (in the magnitude of several months to more than a year) for consolidation of the sludges into 207B-South. Therefore the settling rate of sludge becomes less significant, as the extended period of time will allow the sludge to gravity-settle to its terminal density (the maximum density achievable) without Chlorination.

7.2.2 Ex-situ Chlorination for Bio-mass Destruction -- Slurry Returned to Pond

Following consolidation of the 207B Ponds into 207B-South, gravity settling of the sludges, and decanting of the clear decant from 207B-South, the sludges will be Chlorinated ex-situ (detailed in 7.2.3 below) to eliminate the existing bio-mass. The Chlorinated Pond slurry will then be pumped to the 207B-South Pond. The destruction of the bio-mass will facilitate the minimization of waste volume. It was determined in lab tests that an extended period (approximately a month) of exposure time is necessary for the Chlorine to be most effective in this effort. This procedure is not a certification requirement, but a recommendation to facilitate processing.

7.2.3 Ex-situ Chlorination for Pathogen Destruction -- In-process

Pathogen destruction will be achieved during the actual processing operation using the same Chlorination procedures/equipment as used for elimination of the bio-mass. However, the Chlorinated slurry from the Surge Tank(s) will not be returned to the Ponds, but will be introduced into the process train in accordance with Section 7.3.4.
Proven technology commonly used in the waste-water treatment industry will be used in the Chlorination of 207A and B Pond contents.
Equipment which is currently part of the A/B

processing operation and that is envisioned to be utilized for Chlorination includes the Reclaim System, Scalping Screen and Sump, and the Surge Tanks. In addition, Make-up Tanks (2), a Diaphragm Pump, a Static Mixer, and a Mass Flow Meter will be required to inject and mix the Calcium Hypochlorite with the slurry.

Pond 207B-South will have its contents transferred to 207B-North; which will have been emptied as a result of the EG&G's evaporation efforts. Pond slurry will be reclaimed from the B-North pond and transferred to the Scalping Screen/Screen Undersize Sump to remove oversize particles (10 mesh and larger). Undersize materials will flow into the Undersize Sump. Slurry will be pumped from the Undersize Sump through a Mass Flow Meter to the In-line Static Mixer. A signal generated from the Mass Flow Meter will control the rate of addition of Chlorine solution which will be added to the Pond slurry at the In-line Static Mixer. From the Static Mixer, the combined slurry will be directed to one of the two 12,800 gal Surge Tanks. The slurry will remain in the Surge Tank for the required 30 minute minimum retention period. The other Surge Tank will be filled using the same process.

7.3 Reclamation and Initial Settling Phase

As described in Section 7.2, the sludge material in the 207A and 207B Ponds is to be consolidated and concentrated into the 207B-South Pond.

7.3.1 The Pond Reclaim System will consist of:

- A Reclaim and Transfer Pumping System.
- Flexible transport piping from the Pump to the Pond containment boundary.
- Rigid, double-containment pipeline from the Pond containment boundary to the Scalping Screen.
- Rigid, double-containment return pipelines which will direct excess decant and filtrate liquids from the Surge Tank Effluent Recycle and Process Water Tanks to the 207B-North and 207B-Center ponds, as appropriate.

7.3.2 Scalping Screen (SC-01)

The reclaimed sludge slurry is pumped from the Pond containment to the Scalping Screen Feed Box located South of A Pond. A nominal 10 mesh (2.0 mm) screen opening is used (this maximum solid particle size has been shown in laboratory testing to insure encapsulation of solid wastes in the cement stabilization process and to minimize the potential for heavy metals leaching to meet TCLP requirements).

7.3.3 Surge Tanks (S-13/S-14)

Two parallel 12,800 gallon Surge Tanks allow a wide range of feed flow rates and intermittent Reclaim System operation without a negative impact on the feed rate to the Rotary Screen Thickener (TH-01) or other downstream operations. The Tanks are sealed and have an internal V-bottom which slopes to the weirs and suction lines. Clarified liquid overflows the weir and is returned back to one of the decant Ponds.

To facilitate settling and partial dewatering of the reclaimed sludge, the Surge Tanks are fed alternately. One Surge Tank is allowed to settle while the other Surge Tank is fed.

7.3.4 Transfer Sump (SU-01)

The agitated Transfer Sump receives the partially-settled sludge from the Surge Tanks and provides a relatively homogeneous mixture as feed to the Rotary Screen Thickener.

The measurements from the Mass Flow Meter and optical analyzer (TSS) on the Transfer Pump (P-01) discharge stream define the addition rate of polymer from the Flocculant Feed System.

The normal flow rate from the Transfer Sump will be set by the operator through the DCS, and will be based on: the desired Cement Mixer flow rate, the density of the partially-settled Pond sludge slurry, and the degree of dewatering being achieved in the Rotary Screen Thickener (discussed in Section 7.8).

7.4 Flocculation and Thickener Phases

7.4.1 Flocculant Feed System (Z-03)

The Flocculant Mixing and Feed System uses a dry solid polymer that can be diluted to the proper concentration, aged, stored and mixed in controlled dosage rates with the feed slurry enroute to the Rotary Screen Thickener. The System includes:

- A polymer feed tank and injection system which controls the rate of polymer addition based on sludge solids mass flow. (Not detailed in Appendix A)
- A Static Mixer (W-01) for initial blending of diluted flocculant with the settled sludge slurry which discharges into the RST Feed Tank (S-10).

7.4.2 Rotary Screen Thickener (RST) (TH-01)

The Rotary Screen Thickener System consists of several elements:

- The RST Feed Tank with a low-speed agitator to complete the mixing of flocculant with sludge, and to promote floc growth. This Tank overflows to the Rotary Screen Thickener.
- The Rotary Screen Thickener separates and de-waters the flocs. The partially-dewatered sludge discharges to a cone-bottomed Slurry Surge Tank (S-04) and the excess liquid (filtrate) overflows to the Cement Flush Water Sump (SU-02).

The RST output will produce 20% (by wt) solids with a relatively-small range of variation (15-25% by wt).

7.4.3 Slurry Surge Tank/Mixer Feed System (S-04)

The Slurry Surge Tank is equipped with a variable-speed Agitator which keeps the Tank contents homogenized and free-flowing. The agitation keeps the flocs suspended and maintains the fluidity of the partially-dewatered sludge material.

7.5 Cement Addition and Mixing Phase

The transport pipeline to the Cement Mixer contains instruments for mass flow and slurry density measurements which are used by the DCS as primary measurements for the stabilization Mixer Control System.

Pumping of the dewatered slurry to the cement stabilization system is accomplished by the Mixer Feed Pump (P-03). The speed control of the Pump is governed by the demand for free water from the Mixer Control System from signals originated in the DCS.

The primary components of the system include a Dry Reagent Storage Bin, a Feed System, a Weigh Belt Feeder, a High Shear Mixer, and controls.

7.5.1 Reagent Storage/Feed System (Z-11/FE-11)

Dry reagent additives will be stored on-site in Halliburton Services Field Storage Tanks. The reagents will be pneumatically conveyed to the Reagent Storage Bin, and delivered to the Mixer at a controlled rate through a Rotary Vane Feeder. The Rotary Vane Feeder is controlled by the DCS via a Ratio Speed Controller.

7.5.2 Reagent Control System (FE-12)

The regulated quantity of feed from the Rotary Vane Feeder is deposited on a Weigh Belt Feeder, which conveys the dry reagent to the Mixer and simultaneously weighs the amount being transported. The signal from the Weigh Belt Feeder provides feedback to the Rotary Vane Feeder Controller to correct for over/under feed conditions.

These corrections made by the Rotary Vane Feeder controller are instantaneous, resulting in a feed rate which corresponds exactly to the requirements of the mix formulation.

7.5.3 Mixer System (MX-08)

The QUALTEC, Inc. Mixer is a modified pug mill-type mixer which has been designed to handle varieties of sludges, slurries, and soil-like materials. The Mixer is a twin shaft model with 80 paddles which can be adjusted to control the amount of residence time in the mixing chamber. The chamber is approximately 4' wide, 2.75' high, and 8' long. The shafts are hydraulically driven by a 90 hp motor and nominally

rotate at 90 RPM. The mix chamber maintains its contents in a highly agitated state. During processing, the QUALTEC mix chamber is maintained under a slight negative pressure using a H.E.P.A. filtration system to prevent any dry reagent dust from escaping.

Additionally, QUALTEC, Inc. provides secondary containment for any escaping dust by enclosing the entire Dry Reagent Feed System and Mixer operation within a sealed box container. The enclosed operating environment has air lock doors and is air conditioned for control of heat generated in the mixing process. The enclosure is totally sealed against the outside environment.

7.5.4 Concrete Pumper Product Transfer Pump (P-50)

A Concrete Pumping System is utilized to transfer the mixed product to the Casting Station operation. The Mixer and Pumping System are integrated to allow the mixed product to gravity feed into the Concrete Pump Hopper. The units will be mated and sealed to prevent fugitive emissions.

7.6 Casting and Half-Crate Handling

The Halfcrate Handling System is designed to handle 6 halfcrates per hour. This rate reflects the carrying capacity of the Halfcrate Handling System and not the throughput of the processing train.

The product is discharged from the Mixer into halfcrates at the Casting Station. The Casting Station and Halfcrate Handling Systems consist of two-strand chain conveyor elements configured in a linear train. These Systems, which consist of five stations, transport the halfcrates from crate assembly to casting, inspection, closure, and smear testing prior to transport by fork lift to curing and interim storage. The crate movement operations are semi-automatic with operator initiation, with sensors which detect position and control movement from one station to the next. A number of accumulating conveyors are provided prior to some of the stations to permit upstream operations to proceed and to form a queue of halfcrates awaiting servicing.

The sealed and inspected stabilized waste form is transported in halfcrates, via a forklift, from the Casting Station to storage tents for curing and interim storage.

The operations at the various stations associated with the Halfcrate Handling System are discussed below:

Station No. 1: Halfcrate Storage and Assembly Area

At this station the empty halfcrate is staged for the casting operation with the plastic liner, and inspected. In addition, a brace is installed around the box.

Station No. 2: The Casting or Pouring Station

The empty halfcrate moves into operating Station No. 2, which is the stabilized waste Casting Station. An electrically operated discharge gate on the pouring spout (manually controlled by the Casting Station Operator) opens to allow the pumped product to discharge into the empty halfcrate through the Casting Nozzle. Two operators will be involved at the Casting Station; Operator #1 will fill the halfcrate by manually moving the Casting Nozzle, while Operator #2 will rake the material to fill the corners and voids.

Operator #1 continues to fill the halfcrate until the stabilized waste reaches a height limit (of about 20 inches from the bottom of the crate) or a maximum allowable weight limit. The Casting Station is equipped with an electronic scale. If the halfcrate weight reaches the limit, the signal from the scale will shift the Pump into a stand-by mode to terminate material flow to the halfcrate. The size of the Concrete Pump Hopper provides for intermittent stoppages of the Concrete Pump and continued mixing of the Mixer. The Mixer Operator will be able to observe the level in the Hopper and by controlling the mixing operation prevent over-filling of the Hopper. If extended down-time is incurred at the Casting Station, the Operator will shut down the mixing operation.

The Casting Station is equipped with an Air-Suction System which captures any potential fugitive emissions from the halfcrate or pouring spout. This negative pressure system is vented through HEPA filtration before discharge.

In Laboratory tests it was demonstrated that the waste product from the pouring spout will not splash or exit in an uncontrolled manner.

The minimum operating time per halfcrate at Station No. 2 is 10 minutes.

Station No. 3: Closure and Inspection of Liners

The filled halfcrates are conveyed to Station No. 3, which consists of three accumulating conveyors. Here the liner is folded over the top of the stabilized waste and sealed with tape.

Station No. 4: Sealing of Halfcrates, Brace Removal and Banding

This Station consists of three distinct assembly-line operations: gluing and sealing of the halfcrate lid, removal of the peripheral pouring support brace, and affixing steel bands around the box.

The accumulation chain conveyors for each sub-work station in Station No. 4 are grouped in sets of three to normally accommodate a group of three halfcrates, which are moved together as a unit. This facilitates the individual assembly-line operations being accomplished.

Station No. 5: Radiological Smear Testing and Inspection

The final operation in the Casting and Handling System is radiological smear testing and inspection prior to transport to curing and interim storage.

7.7 Instrumentation and Data Acquisition

The primary functions of the instrumentation are to:

- Provide operating and equipment status and performance information to the operators. These will be monitored to ensure that the systems are functioning within the operating envelopes and operating safely. These include level indicators, pressure gauges, etc.

- Provide process information and in-process material properties for mix formulation control.

- Provide equipment operating status indications. Local status is provided on each operating skid or module.
- Provide communication between the operators of the individual components. Hard-wired phone connections will be utilized to keep the operators informed of processing status.

- Provide verification of the certifiability of the stabilized waste form by compiling a record of the operating and physical property data associated with the material being processed.

- Merge pertinent laboratory data with the operating record within the data recording device.

The Casting and Halfcrate Handling Systems employ a number of "operator permissive" controls as well as automatic sensors (pressure-sensitive elements or limit switches) in its operation. In addition, the Casting Station Control System dictates and directs (either automatically or by operator initiation) the number of sequential operations required to move halfcrates from one work or inspection station to the next along the Chain Conveyor Handling Train. Status indication is provided for each step for operator control.

Documentation of the operating variables, production systems operation, and the degree of control achieved in the waste stabilization processes required for waste certification, is provided by the local in-line monitoring systems, the laboratory back-up measurements, and electronically stored data in the DCS computer systems. The following will be recorded in a time-coded data file and correlated with the actual halfcrates of waste produced:

- All on-line operating data (mass flows, densities, actual pozzolan rate, etc.),
- Manually-entered data (specific gravities, %TDS, W/P, etc.)
- Calculated operational variables (free water rate, target pozzolan rate, etc.)

The DCS Operator will be able to track any variable trends through displays on the Visual Display Monitor (VDM) or plots and/or data tabulations on the DCS printer system. Any deviations from the established operating envelope parameters will be highlighted.

The DCS allows for direct operator control of the process as well as producing the data base to confirm qualification of the waste produced.

7.8 Process Control

The process control systems employed for the A/B Pond stabilization process include a mixture of manual operations, operator permissive semi-automatic controls, and interlocks. However, overall control is provided through a computerized Distributed Control System (DCS).

The DCS performs:

- plant control functions,
- sequence of events monitoring,
- annunciation,
- logging,
- trending, and
- graphic display of process parameters and equipment status.

Plant control functions include:

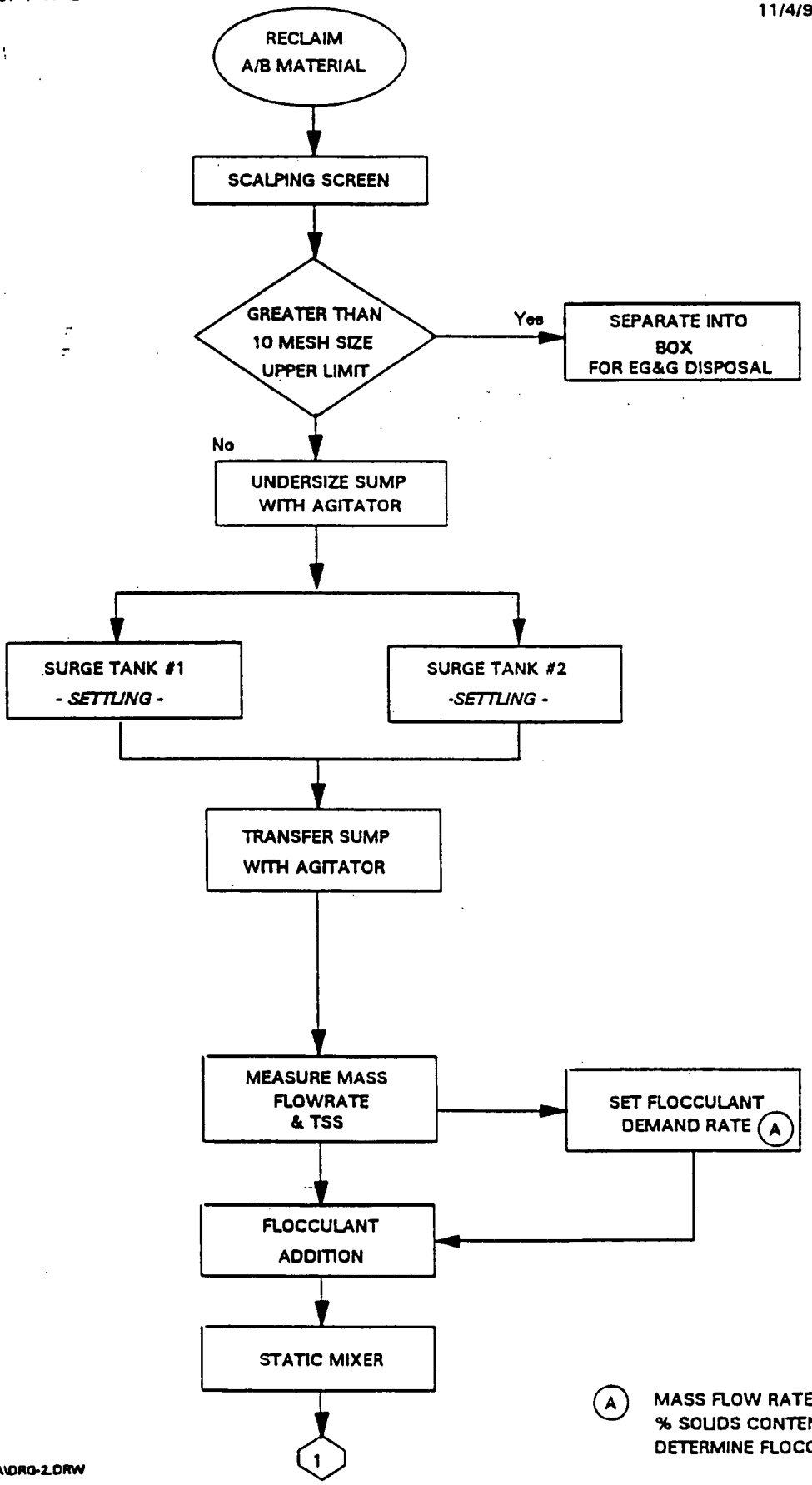
- start permissives for pumps and flush water systems to prevent inadvertent operation,
- trip interlocks to preclude tank overflows, and
- calculations of process control parameters.

Process control parameters critical to product qualification are stored in memory, from which hard copy reports will be generated.

A process control logic flow diagram for the A/B process control activities is provided as Figure #3.

SECTION 7.8 - FIGURE 3
SHEET 1 OF 2

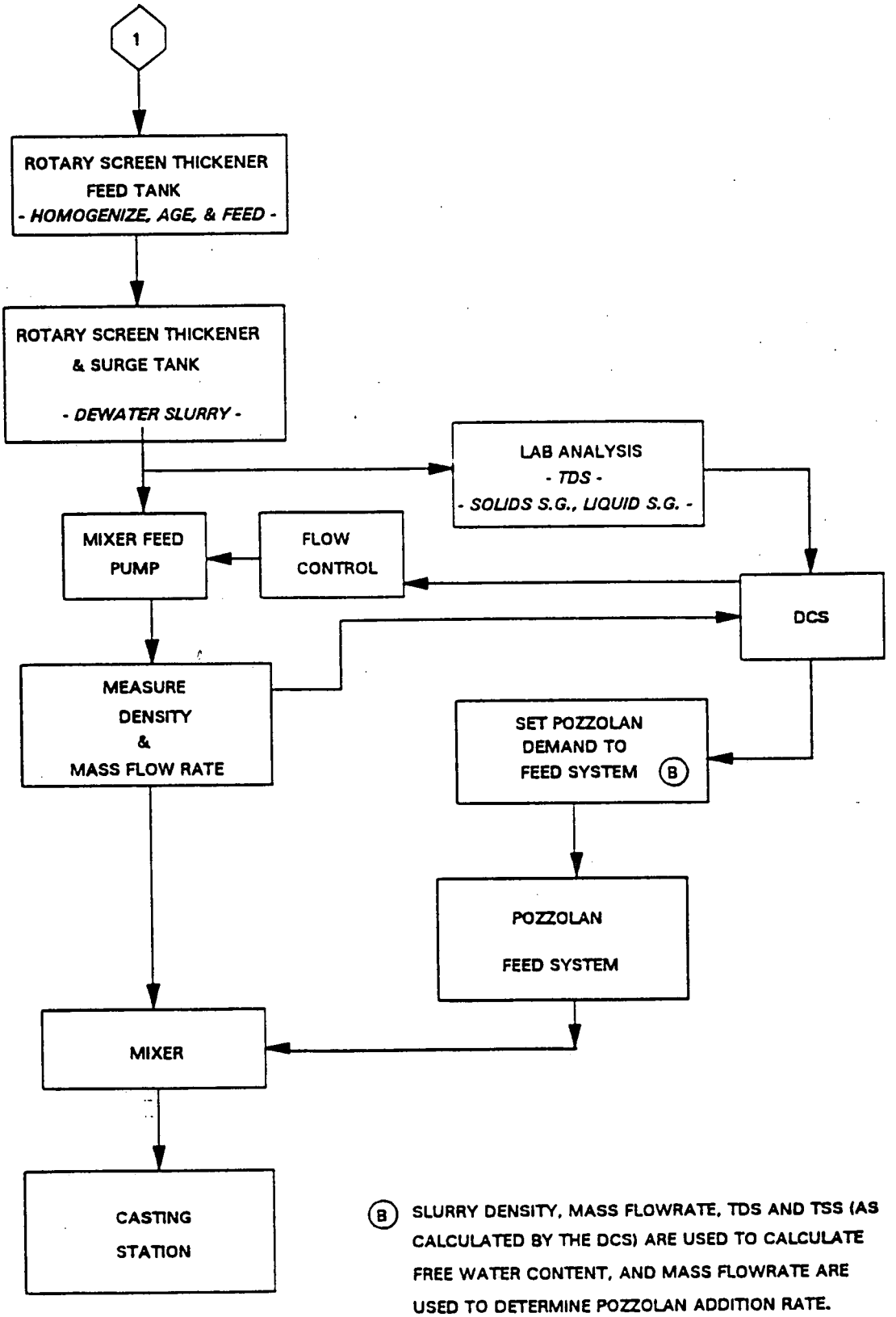
PROCESS CONTROL FLOW DIAGRAM
PONDS 207 A & B
11/4/92



A MASS FLOW RATE & TSS DETERMINE % SOLIDS CONTENTS WHICH IS USED TO DETERMINE FLOCCULANT DEMAND RATE.

P:\AA\DRG-2.DRW

PROCESS CONTROL FLOW DIAGRAM
PONDS 207 A & B
11/4/92



(B) SLURRY DENSITY, MASS FLOWRATE, TDS AND TSS (AS CALCULATED BY THE DCS) ARE USED TO CALCULATE FREE WATER CONTENT, AND MASS FLOWRATE ARE USED TO DETERMINE POZZOLAN ADDITION RATE.

P:\COMLA0W03.DRW

7.8.1 Flocculant Mixing System

The Flocculant Mixing System is an essential element of the dewatering effort, as dewatering the sludge to 20 weight percent solids substantially reduces the resultant stabilized waste volumes. Proper operation of the downstream Rotary Screen Thickener is dependent on proper operation of the flocculant feed system.

Dry solid flocculant will be diluted to the proper feed concentration (½ to 1 weight %) using Pond water in an agitated tank, aged, and stored prior to being mixed with the feed slurry to the Rotary Screen Thickener.

The settled Pond sludge from the Transfer Pump flows through an instrument (FIC-115) which will measure the Total Mass Flow and the Slurry Specific Gravity; an optical analyzer will measure the Total Suspended Solids (TSS-by weight percent).

The DCS will:

1) calculate the flowrate of the dry solids in the slurry, using the Total Mass Flow and the TSS;
2) calculate the flocculant demand rate based on the solids flowrate in the slurry feed; and
3) provide the control signal to the variable-speed Flocculant Addition System Pump, based on a flocculant requirement of 5.6 pounds dry flocculant per ton of dry solids.

7.8.2 Rotary Screen Thickener (RST)

The normal flow rate from the Transfer Sump to the Rotary Screen Thickener (RST) will be set by the Operator via the DCS, and will be based on the desired Cement Mixer flow rate, the TSS of the partially-settled pond sludge, and the degree of dewatering achieved in the RST.

Based on laboratory testing, the output product of the RST is expected to be relatively insensitive to feed rate and feed percent solids. The RST output will produce 20% (by wt) solids with a relatively-small range of variation (15-25% by wt).

The process trend monitoring of the RST will be through the in-line density measurement of the homogenized product material being fed to the Cement Mixer. The RST filtrate will also be periodically sampled and analyzed for TSS to ensure effective decanting.

Additionally, a subjective, yet effective indicator of the performance of the RST is determined visually by observing the character of the flocs in the flocculent Feed/Mixing Tank prior to the Drum Screen and in the overflow from the Drum Screen.

7.8.3 Qualtec Mixer Feed Control

The DCS will monitor the slurry feed to the Cement Mixer using in-line monitoring systems for slurry density and mass flow.

The operator will manually enter into the DCS the following set points determined by the On-site Lab:

- Liquid Specific Gravity (SG_{Liq}),
- %TDS in the liquid phase,
- solids specific gravity (SG_{sol}),
- pozzolan specific gravity,

from the Treatability Study Report:

- target free water/pozzolan ratio (W/P) for the cement stabilization mix,

and

- target output product rate.

Using the above measured data and/or manually entered set points for the partially-dewatered slurry feed to the Cement Mixer, the DCS will algebraically calculate:

- the percent Total Suspended Solids (%TSS),
- the target pozzolan feed rate for the contained free water,
- the target mass flow rate for the partially-dewatered slurry, and
- free water as function of mass flow.

The algebraic logic to translate the observed feed slurry density into a percentage free water in the feed slurry has been based on the following:

If the mass flow rate M (lbs/minute or equivalent) of the slurry mixture is measured or known, the mass flow rate of the water can be calculated from the weight percentage of free water in the slurry. This forms the basis for the control strategy using density and mass flow. In this strategy, the specific gravity components of the Pond solids and the Pond liquid phase need to be known (or approximated). For the solids, a periodic sample will be taken and the SG_{Sol} determined. For the liquid, a conductivity measurement which in turn is translated into %TDS by a correlation of conductivity versus %TDS (or TDS) will allow estimation of the SG_{Liq}. For a given, well mixed Pond, this is not expected to change significantly.

Periodic grab samples and laboratory checks will confirm the on-line measurements and assumptions used for the Solid Specific Gravities and %TDS of the Pond liquid variables.

The DCS will also calculate the pozzolan demand rate. The DCS will send a proportionate control signal for the pozzolan demand rate to the feeder speed controller on the Mixer Pozzolan Hopper. Feedback control logic from the Pozzolan Weigh Belt Scale (after the Pozzolan Feeder) will insure that the pozzolan delivery satisfies the demand required by the free water feed rate and W/P ratio set-point.

Since the target output product rate is determined by the operator, and the corresponding pozzolan demand rate is automatically adjusted to conform to the stabilization mix formulations, the production rate in the Mixer System can be adjusted to compensate for any of the downstream or upstream production bottlenecks or limitations. Any delay in the Casting or Halfcrate Handling System can be compensated for by lowering the cement mixing target production rate. Likewise, the production rate can be decreased should there be interruptions in the Reclaim System or the need for a longer holding time in the Surge Tanks. The DCS makes it possible to maintain the overall A/B Pond processing systems in balance.

The size of the Surge Tanks which will permit independent operation of the Cement Mixing System (up to two-days of feed) even if the Reclaim System is not operating. Likewise, the Surge Tanks can be receiving water from the Reclaim System and returning decanted water back to the Ponds at a faster rate or independently of the downstream cement stabilization

mixing operations. The independence of these systems provides considerable flexibility in the overall operation.

Process control of the output waste product will be verified with manual samples tested by the On-site Laboratory.

7.9 Shut-down and Clean-up Procedures

Clean-up of the Mixer System has as its primary goal to ensure the shearing surfaces are effectively exposed to the materials during the mixing operation. Additionally, in order not to inhibit operations, other components (e.g., the Chute from the Mixer to the Cement Pump and the Pump Hopper) will require flushing to preclude excess cemented material build-up.

Flushing

In order to minimize cement build-up in the Mixer and downstream components, a water flush of this system will be conducted approximately every four hours of operations. Approximately 1000 gallons of wash-up (flushwater) will be required to flush the Mixer Cement Pump and fill lines to the Casting Station for each occurrence. This water will be obtained from the Process Water Tank. The wash water generated (cement flushwater) will be collected in the Cement Flush Water Sump. From this Sump it will be processed through the Dirty Water Separator System, which will include passing the material over a screen to remove greater than 10 mesh materials. (Approximately 0.25 cy of solids will be produced during each flush. This volume includes residual solids in the Mixer, Cement Pump, and fill line from the pumping system to the casting operation. Most of these solids will be hardened cemented materials.) Decant water will be returned to the Process Water Tank for future use in the Flushwater Systems. High solids content materials removed from the system will be pumped to the Transfer Sump and processed through the A/B processing/solidification system.

Clean-Up

Since the clean-up operations will require manually chipping away the cemented residues, health and safety issues will be addressed in a comprehensive plan. All pertinent Rocky Flats Plant requirements will by incorporated in the plan, to include:

- EG&G Lockout/Tagout Procedure
- Confined Space Entry Permit
- PPE requirements
- RPT support.

The Mixer clean-up shall be performed at such intervals and frequency as required by field conditions to maintain proper mixing by the unit. The minimum frequency is expected to be once per day; however, it may be necessary once per shift.

This clean-up is expected to consist of clearing paddles and the discharge port of excess build-up. Build-up shall be permitted to cure sufficiently to allow for chipping with hand tools (hammer and chisel). Dislodged build-up shall be manually removed and/or vacuumed from the mixing chamber.

Disposal of cleaned-out debris will be performed by EG&G.

7.10 Laboratory Testing

The purpose of the On-site Laboratory, located within the permacon of tent #5 on 750 Pad, is to provide on-site analytical testing capabilities during pondsludge processing to accomplish the following:

- Product Certification Data Acquisition
- Instrument Verification
- Process Monitoring
- Trouble Shooting

The Off-site HNUS Laboratory in Pittsburgh will conduct the more complex regulatory tests for Toxic Characteristic Leach Procedures (TCLP -- extractions and analyses) for both inorganic and organic components.

These requirements will be detailed in the Process Control Plan (Deliverable 251/252).

8.0 SUMMARY

HNUS has diligently addressed the goal of developing a process train (from Pond characterization thru the Treatability Study, to equipment selection and procurement) that will produce a waste product which satisfies all regulatory requirements.

This effort has materialized in a process train that is physically located at the Rocky Flats Plant (RFP), and could be installed/erected and ready for operations within a time period of 12 weeks. Appendix D provides a schedule for processing completion which is based on the latest RFP constraints.

Even though there have been an inordinate number of obstacles to overcome, the focus to effectively process the waste has remained paramount, and all systems are now in place to accomplish it.

HALLIBURTON NUS
Environmental Corporation

APPENDIX B

INTERNAL CORRESPONDENCE

450.250/160

To: Ted Bittner

From: John Kohli

Date: July 1, 1992

Subject: Previous Pond A&B Processing at Rocky Flats

Document No. RF-HEH-092-079

I have reviewed and assimilated documentation and reports on the prior attempts to stabilize the Ponds A&B waste at Rocky Flats with the intention of justifying the use of the Qualtec, Inc. mixing equipment. A demonstration was performed during the period May 28 through May 31, 1992 and a report issued to your attention on July 1, 1992 titled "Qualtec, Inc. High Shear Mixer System Demonstration, Revision 1." A summation of my review follows.

PREVIOUS POND "A" CLEANOUT ACTIONS[1]

In June 1985 work began to cleanout the sludge in the 207A pond and solidify this sludge with cement to produce solid monoliths known as "Pondcrete". The pondcrete process was set up near the 207A pond. Sludge was pumped by a "Mud Cat" pumper floatation handling unit to a sludge thickener. Water from the pond was filtered and used in the sludge thickener as make-up water. The filtrate water from this operation was sent to pond 207C. From the thickener the sludge/water was transferred to a pug mill where Portland cement (Type I) was mixed and the wet material was transferred via a chute to plastic lined boxes ("Triwalls"). The pondcrete was allowed to cured, labeled, and transported to two outdoor pads for storage until shipment to Nevada Test Site (NTS) for disposal.

A back-up pondcrete system allowed sludge from the thickener to be mixed in a mobile concrete mixing truck was also used during this period. Both of these treatment methods were essential batch type operations as measured amounts of cement was mixed with the sludge/water mixture. The basic concrete formula that was planned to be used during the cleanout of 207A pond used a feed of 20% weight solids mixed at a water/cement ratio of 1.5.

The hardened pondcrete was routinely disposed of at NTS during the initial phase of the 207A pond cleanout until the fall of 1986 when the pondcrete was identified as low level mixed waste. From 1986 until May 1988 a total of approximately 18,000 boxes of pondcrete were produced and stored outside on the two storage pads. Deformation of pondcrete boxes was observed in late May 1988 by operations personnel. The pondcrete had deteriorated, crumbled, cracked, and a least one box had spilled open.

REAGENT ANALYSIS

"Analysis of processing data from original production of pondcrete shows that the target water/cement ratio was 1.25....References for mixing concrete recommend water to cement ratios from 0.35 to 0.68 depending on the anticipated exposure conditions and the desired strength...It appears that previous recipes did not contain sufficient cement to produce a stabilized waste form. Indeed, the pondcrete still on site has been characterized as having considerable quantities of free water in the matrix."[2]

EQUIPMENT/PROCEDURES[3]

The original pondcrete was produced from the solids on the 207A area pads using the following processes:

- Solids from the ponds and liquid as dilute slurries (about in the range of 2 to 5% solids by weight) was pumped from the ponds into the clarifier/thickener (Dorr-Oliver about 18 ft diameter). Their reclaim was by a self-priming centrifugal pump with a hose inlet which was moved around the pond bottom.

- The solids were allowed to settle and the underflow was pumped to the pug mill. The thickener underflow density ranged between 15 to 20% solids and was typically about 18%.

- The thickener/clarifier was usually operated in a batch mode with a volume of slurry being pumped in until the thickener was overflowing. The solids were allowed to settle and then pumped into the pug mill. Typically, the thickener was filled and settled overnight and the pug mill operated during the day shift. Sometimes the thickener underflow was recirculated back to the feed and the sludge blanket agitated with air to prevent the rake from seizing.

- No flocculent was used to control underflow density or to produce a high-clarity liquid decant. Neither was the thickener/clarifier operated in a continuous feed, continuous withdrawal mode. The reason for the latter which were cited was that when there was pressure to increase the production rate through the system, the thickener could not handle the throughput rates.

- According to Forrey and DeWitt, the pug mill operated reasonably well. Early in the program when throughput rates were supposedly lower, the system using the pug mill was able to produce hard concrete blocks with little problems with water. Many (up to 90%) of the blocks produced were shipped. However, few were tested using the TCLP test and only the hardness was a criteria.

From discussions with Steve DeWitt, the pug mill utilized was powered by a single 2 HP 1710 RPM motor, was a single shaft with only five (5) 8" mixer blades, and rotated at a nominal rate of 100 rpm.[4]

OBSERVED PROBLEMS/SHORTFALLS

Many observations of the shortfalls and problems have been made and documented including the following:

1. These..."previous sludge treatment processes used at Rocky Flats were not technically satisfactory or sufficiently advanced to process solar pond sludge under compressed time constraints."[1]

2. "The original waste form degradation may have resulted from any or all the problems mentioned below:[1]

   ... - Lack of strict process controls resulted in inadequate rations of cement to sludge/water in the pondcrete process. Process logs indicate a reduction in cement usage as production increased and total dissolved solids in the feed decreased.

   ... -Inadequate quality control, which failed to identify any problems in almost 3 years of making the pondcrete.

   ... - Inadequate characterization of waste material and failure to recognize effects on the cement matrix of the waste sludge material.

   ... - Equipment utilized in the process was marginally effective. The material being solidified in this operation was essentially a grout which require high speed mixing to effectively obtain a homogeneous mixture, but the mixing equipment used in this operation was not well suited for this type of material. Most of the equipment was designed for concrete mixing which requires aggregate to aid in mixing.

3. "The pneumatic feed system to the bulk cement storage hoppers created and vented a lot of cement dust. This was primarily due to poor control of the venting air as well as due to occasional overfilling. No high level alarms or transport system shutoffs were provided. This cement due aggravated the environmental controls and vendibility."[3]

4. "The cement was dry mixed into the wet slurry in the pug mill. Water vapor from the pug mill would cause the star feeder pockets to cake up and fill with cement.

Eventually little or no dry cement was being fed through the star feeder. This caused a shortage of cement in the feed mix; thus production of soupy concrete."[3]

5. "The lack of firm controls were also a primary downfall in controlling the quality of the pondcrete blocks produced. Initially, the target goals were to shoot for about 40% contained moisture in pondcrete blocks. At a ratio of 18% solids and 80% cement added, the following was the nominal mix per 1300 lb block: 118.2 lbs of solids from the pond, 656.5 lbs of water from the pond, and 525.3 lbs of cement.[3]

REFERENCES:

1. "Rocky Flats Solar Pond Program Lessons Learned" by Joe Wienand, DOE-Rocky Flats Office and Steve Howard, Systematic Management Services.

2. "Stabilization of A&B Pond Sludges" from treatability study by Rich Ninesteel, HALLIBURTON NUS.

3. "Conversations with C.Robert Forrey and Steve DeWitt about Operating Campaigns and Material Characteristics on March 27, 1991 - A.M." by Wayne C. Henderson, Lead Process Engineer, Brown & Root, Inc.

4. Steve DeWitt with Ted Bittner, from conversations about previous pug mill system use at Rocky Flats.

REVIEW/ANALYSIS OF PROPOSED METHODOLOGIES

From the previous survey of the operations and problems associated with the solidification efforts at Rocky Flats, it is apparent that three major areas had significant impact on the lack of success. They are as follows:

REAGENT MIX DESIGN

It appears that the mix design was inappropriate for the desired results expected of the operation. The HNUS treatability study shows that an inadequate type and amount of cement was specified. Prior testing indicated large volumes of calcium hydroxide, low volumes of portland cement, and free water were found in previous pondcrete samples which are typical of a high water-cement ratio grout.

The HALLIBURTON NUS treatability study more thoroughly addresses these issues. The current mix design should produce desired results which will meet regulatory requirements.

QUALITY CONTROL

It had been observed that very poor quality control methods had been established and followed. These included the inadequate cement to sludge and water ratios , inadequate characterization of the waste materials, and inadequate control of the reagent addition to the mixing operation.

The treatability study addresses the inadequate mix ratios and waste characterization. The current design criteria address the inadequate control of reagent addition. These include the use of weigh belts feeders for reagent addition and proper control and documentation of slurry and reagent input to the mixing operation.

EQUIPMENT

As has been previously identified, the pug mill and cement mixing equipment previously used were inadequate for creating a uniform, homogeneous mix. The pug mill system utilized prior, even though it had operated reasonably well, was underpowered (2HP), was a single shaft, contained only 5 mixer blades.

As was described in the Qualtec mixer demonstration, the currently proposed mixing system is driven by a 125 HP power plant, has twin shafts and 80 mixer blades, and rotates at over 90 RPM. It was shown during the mixing demonstration that it would produce a uniform, homogeneous mixture at varying rates of reagent addition and with different slurry types.

CONCLUSIONS

The use of a properly formulated and controlled mix design with an appropriate mixing system should provide desired results.

cc: John Schmidt
Bob Orwig
Arnie Allen

CHEMICAL ADDITIVE CONSIDERATIONS

CHEMICAL STORAGE

There are requirements for three chemical storage systems for the **Ponds A/B** process: the Calcium Hypochlorite used during chlorination, the flocculant, and the dry pozzolan mixture.

Calcium Hypochlorite:

Calcium Hypochlorite is supplied in a dry, granular form (as pellets or granules) in 100 pound drums of 65% pure calcium hypochlorite. This material contains approximately 35% by weight of other materials (CaO, $CaCO_3$, Na_2O, SiO_2, etc.) which are essentially inerts. Typically, these fibre drums are supplied on pallets; six 100-pound drums to each pallet. The bulk supply of pallets of Calcium Hypochlorite drums will be stored off-site at the distributors. The "shelf life" of the Calcium Hypochlorite is about six months.

Flocculant:

The flocculant for dewatering the sludge is a very high charge cationic flocculant by Stockhausen, Praestol 644BC. This flocculant is a dry polyacrylate powder material.

The flocculant will be delivered on a banded pallet containing twenty-five 50-lb bags of dry flocculant.

The Flocculant Hopper will hold about 100 lbs of dry flocculant. Covered storage is provided adjacent to the Flocculant Mixing System on the skid module for the Rotary Drum Thickener.

This material is stable for up to 2 years if kept dry and not exposed to extremes in temperature. The pallets of flocculant will be maintained in an off-site warehouse until required.

Pozzolan Storage:

The dry pozzolan mix (Type V Portland cement, Type C flyash, hydrated lime, and plasticizer) is pre-mixed off-site and delivered in 15 ton (365 cubic feet) dry bulk transport trucks to the site. The pozzolan material is off-loaded pneumatically from the transport trucks to a 4000 cubic foot (165 tons) bulk field storage tank located adjacent to the

Pond A/B casting station. In addition to the 4000 cubic foot field storage bin will be a 1410 cubic foot, 3 compartment, field storage bin which will be used for interim storage of the pozzolans enroute to the mixer operation.

At a nominal 7.5 tons per hour stabilized product processing rate, approximately 4.92 tons per hour of dry pozzolan mix is required. For a nominal 12 hour production day, about 60 tons of pozzolan mix (1500 cubic feet) would be required. Therefore, it is estimated that 4 to 5 delivery trucks per day will be required.

The dry pozzolan is pneumatically conveyed to the reagent bin located at the mixer operation. The tanks and conveying system are equipped with dust collection and filter systems to prevent any visible emissions of the pozzolan dust.

MSDS INFORMATION

MSDS sheets are attached to this Appendix for the chemicals discussed in the above paragraphs:

- Calcium Hypochlorite
- Flocculant
- Pozzolans
    - * Cement
    - * Flyash
    - * Lime
    - * Plasticizer

MATERIAL SAFETY DATA SHEET

(Complies with OSHA's Hazard Communication Standard, 29 CFR 1910.1200)

SOUTHWESTERN
PORTLAND CEMENT COMPANY

LYONS, COLORADO

SECTION I

MANUFACTURER'S NAME AND ADDRESS

Southwestern Portland Cement Co.
1200 Smith Street Suite #2500
Houston, Texas 77002-4486

EMERGENCY TELEPHONE NO.

(713) 650-8307

CHEMICAL NAME AND SYNONYMS

Portland Cement (CAS #65997-15-1)

TRADE NAME AND SYNONYMS

Type I (Construction Cement)
Type I/II (Construction Cement)
Type I/II - Low Alkali (Construction Cement)
Type II - AASHTO - Low Alkali (Construction Cement)
Type II - Modified (Construction Cement)
Product (Construction Cement)
Type III - Low Alkali (Construction Cement)
Type V - Low Alkali (Construction Cement)
"Richmortar Type N" (Masonry Cement)

CHEMICAL FAMILY	FORMULA	
Calcium Salts:	$3CaO \cdot SiO_2$	(CAS #12168-85-3)
	$2CaO \cdot SiO_2$	(CAS #10034-77-2)
	$3CaO \cdot Al_2O_3$	(CAS #12042-78-3)
	$4CaO \cdot Al_2O_3 \cdot Fe_2O_3$	(CAS #12068-35-8)
	$CaSO_4 \cdot 2H_2O$	(CAS #13397-24-5)
	Additionally, small amounts of CaO, $CaCO_3$, and $4CaO \cdot 3Al_2O_3 \cdot SO_3$ (in Type K cement) may be present.	
Other Salts:	Small amounts of MgO, and trace amounts of K_2SO_4 and Na_2SO_4 may also be present.	

SECTION II — HAZARDOUS INGREDIENTS

Portland cement is classified merely as a nuisance dust by OSHA (29 CFR 1910.1000, Table Z-3), MSHA (30 CFR 56.5001, ACGIH TLV's for 1973, Appendix E), and ACGIH (TLV's for 1985-86, Appendix D). Portland cement is **NOT** listed by NTP, IARC, or OSHA as containing carcinogens.

SECTION III — PHYSICAL DATA

BOILING POINT

Not applicable, as portland cement is a powdered solid

VAPOR PRESSURE

Not applicable, as portland cement is a powdered solid

VAPOR DENSITY

Not applicable, as portland cement is a powdered solid

SOLUBILITY IN WATER

Slight (0.1-1.0%)

SPECIFIC GRAVITY

3.10-3.20

PERCENTAGE VOLATILES BY VOLUME

0%

EVAPORATION RATE

Not applicable, as portland cement is a powdered solid

APPEARANCE AND ODOR

Gray powder; no odor

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT

Portland cement is noncombustible and nonexplosive

FLAMMABLE OR EXPLOSIVE LIMITS

Not applicable

EXTINGUISHING MEDIA

Not applicable

SPECIAL FIREFIGHTING PROCEDURES

Not applicable

UNUSUAL FIRE & EXPLOSION HAZARDS

None

SECTION V — HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE

Respirable Dust - 5 mg/m^3
Total Dust - 10 mg/m^3

EMERGENCY & FIRST AID PROCEDURES

Irrigate eyes with water; consult physician. Wash exposed skin areas with soap and water.

EFFECTS OF OVEREXPOSURE

Acute: Wet cement, especially as an ingredient in plastic (unhardened) concrete, can dry the skin and cause alkali burns. Cement dust can irritate the eyes and upper respiratory system.

Chronic: Cement dust can cause inflammation of the lining tissue of the interior of the nose and inflammation of the eye. Hypersensitive individuals may develop an allergic dermatitis (skin rash).

SECTION VI — REACTIVITY DATA

STABILITY

Product is stable. Keep dry until used.

INCOMPATIBILITY

None

HAZARDOUS DECOMPOSITION PRODUCTS

None

HAZARDOUS POLYMERIZATION

Will not occur

SECTION VII — SPILL PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS SPILLED

Use dry cleanup methods that do not disperse the dust into the air.

WASTE DISPOSAL METHOD

Material can be returned to container for later use, or it can be disposed of as a common waste.

SECTION VIII — SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION

In dusty environments, use a NIOSH approved respirator.

VENTILATION

Use exhaust fans to control airborne dust levels.

EYE PROTECTION

In dusty environments, use tight fitting goggles.

SKIN PROTECTION

Use barrier creams, gloves, boots and clothing to protect the skin from prolonged contact with wet cement, especially in plastic (unhardened) concrete. Immediately after working with cement, workers should shower with soap and water. Precautions must be observed because wet cement burns with little warning — little heat is sensed.

SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

None (See Section VIII)

OTHER PRECAUTIONS

None

SECTION X — ABBREVIATIONS

ACGIH

American Conference of Governmental Industrial Hygienists

CAS

Chemical Abstract Service

CFR

Code of Federal Regulations

IARC

International Agency for Research on Cancer

m^3

cubic meter

mg.

milligram

MSHA

Mine Safety and Health Administration

NIOSH

National Institute for Occupational Safety & Health

NTP

National Toxicology Program

OSHA

Occupational Safety and Health Administration

TLV's

Threshold Limit Values

BOB TRUJILLO
Chief Chemist
303-534-4206

MATERIAL SAFETY DATA SHEET
HALLIBURTON SERVICES
DUNCAN, OKLAHOMA 73536

DATE: 06-10-92
REVISED DATE 10-17-90

EMERGENCY TELEPHONE: 405/251-3565 OR 405/251-3569
AFTER HOURS: 405/251-3760

SECTION I - PRODUCT DESCRIPTION

CHEMICAL CODE: LIME, HYDRATED
PART NUMBER: 890502700
PKG QTY: 50# SACK
APPLICATION: COMPONENT
SERVICE USED: CEMENTING

SECTION II - COMPONENT INFORMATION

COMPONENT	PERCENT	TLV	PEL
CALCIUM HYDROXIDE	> 60 %	5 MG/M3	5 MG/M3

SECTION III - PHYSICAL DATA

PROPERTY	MEASUREMENT
APPEARANCE	WHITE SOLID, POWDER
ODOR	ODORLESS
SPECIFIC GRAVITY (H2O=1)	2.243
BULK DENSITY	75.00 LB/CU.FT.
PH	12.2
SOLUBILITY IN WATER AT 20 DEG C. GMS/100ML H2O	.2
BIODEGRADABILITY	N/D
PERCENT VOLATILES	N/A
EVAPORATION RATE(BUTYL ACETATE=1)	N/A
VAPOR DENSITY	N/A
VAPOR PRESSURE (MMHG)	N/D
BOILING POINT(760 MMHC)	N/A
POUR POINT	N/A
FREEZE POINT	N/A
SOLUBILITY IN SEAWATER	NOT EVALUATED
PARTITION COEF (OCTANOL IN WATER)	NOT EVALUATED

SECTION IV - FIRE AND EXPLOSION DATA

NFPA(704) RATING:
HEALTH 0 FLAMMABILITY 0 REACTIVITY 0 SPECIAL NONE
FLASH POINT N/A
AUTOIGNITION TEMPERATURE ND F / ND C
FLAMMABLE LIMITS (OZ. PER CU. FT.) LOWER ND UPPER ND

EXTINGUISHING MEDIA:
USE MEDIA APPROPRIATE FOR SURROUNDING MATERIALS.
SPECIAL FIRE FIGHTING PROCEDURES:
NOT APPLICABLE.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
DO NOT ALLOW RUNOFF TO ENTER WATERWAYS.

SECTION V - HEALTH HAZARD DATA

CALIFORNIA PROPOSITION 65:
PRODUCT OR PRODUCT COMPONENTS ARE NOT REGULATED UNDER CALIF. PROPOSITION 65.

N: 890502700

ARCINOGENIC DETERMINATION:
RODUCT OR COMPONENTS ARE NOT LISTED AS A POTENTIAL CARCINOGEN
CCORDING TO : "NTP, IARC, OSHA, OR, ACIGH".

RODUCT TOXICITY DATA: TOX ORL-RAT LD50: 7340 MG/KG
AQU TLM96: 1000-10 PPM

RODUCT TLV: 5MG/M3

---------- EFFECTS OF EXPOSURE ----------

OUTES OF EXPOSURE:
EYE OR SKIN CONTACT, INHALATION.
YE:
MAY CAUSE SEVERE IRRITATION WHICH MAY BE PERSISTENT.
KIN:
PROLONGED OR REPEATED SKIN CONTACT MAY CAUSE SEVERE IRRITATION OR BURNS ESPECIALLY IF SKIN IS MOIST OR IF MATERIAL IS CONFINED.
NHALATION:
MAY BE IRRITATING.
NGESTION:
NO DATA AVAILABLE
HRONIC EFFECTS:
NO CHRONIC EFFECTS EXPECTED.
THER SYMPTOMS AFFECTED:
BECAUSE OF ITS IRRITATING PROPERTIES, THIS MATERIAL MAY AGGRAVATE AN EXISTING DERMATITIS.

---------- EMERGENCY AND FIRST AID PROCEDURES ----------

EYE:
IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. IF IRRITATION PERSISTS, SEEK PROMPT MEDICAL ATTENTION.
SKIN:
PROMPTLY WASH SKIN WITH SOAP AND WATER.
INHALATION:
REMOVE TO FRESH AIR. IF IRRITATION PERSISTS, SEEK MEDICAL ATTENTION,
INGESTION:
DO NOT INDUCE VOMITING! IN GENERAL, NO TREATMENT IS NECESSARY UNLESS LARGE QUANTITIES ARE INGESTED. HOWEVER, MEDICAL ADVICE SHOULD BE OBTAINED.

* * * * * * * * * * * SECTION VI - REACTIVITY DATA * * * * * * * * * * * *

STABILITY: STABLE
CONDITIONS TO AVOID:
NOT APPLICABLE.
INCOMPATIBILITY (MATERIALS TO AVOID):
STRONG ACIDS.
HAZARDOUS DECOMPOSITION PRODUCTS:
NONE KNOWN.
HAZARD POLYMERIZATION: WON"T OCCUR
CONDITIONS TO AVOID:
NOT APPLICABLE.

* * * * * * * * * * SECTION VII - SPILL OR LEAK PROCEDURES * * * * * * * * * *

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
USE PROTECTIVE EQUIPMENT. SWEEP UP AND REMOVE. AVOID CREATING OR INHALING DUST.
WASTE DISPOSAL METHOD:
IF NOT CONTAMINATED, REUSE PRODUCT.
GET APPROVAL FROM LANDFILL OPERATOR AND TRANSPORT TO SANITARY LANDFILL.

* * * * * * * * * SECTION VIII - SPECIAL PROTECTION INFORMATION * * * * * * * * *

ESPIRATORY PROTECTION (USE NIOSH/MSHA APPROVED EQUIPMENT):
TOXIC DUST/MIST RESPIRATOR.
ENTILATION:
USE ONLY WITH ADEQUATE VENTILATION.
ROTECTIVE CLOVES:
IMPERVIOUS RUBBER GLOVES.
YE PROTECTION:
WEAR GOGGLES AND/OR FACE SHIELD. PROVIDE EYEWASH AND QUICK DRENCH SYSTEM.
THER PROTECTIVE EQUIPMENT:
RUBBER APRON TO PREVENT DIRECT SKIN CONTACT.

* * * * * * * * * * * SECTION IX - SPECIAL PRECAUTIONS * * * * * * * * * * *

RECAUTIONARY LABELING LIME, HYDRATED 890.502700

WARNING!
IRRITATING TO THE EYES, SKIN AND RESPIRATORY SYSTEM.
MAY CAUSE SKIN BURNS IF CEMENT IS WET OR WITH CONFINED INTIMATE CONTACT.
FOR PRECAUTIONARY STATEMENTS, REFER TO SECTIONS IV-VIII.
THER HANDLING AND STORAGE CONDITIONS:
STORE AWAY FROM STRONG ACIDS.
STORE IN DRY LOCATION TO PROTECT PRODUCT QUALITY. REQUIRES COVERED STORAGE.
AVOID CREATING OR INHALING DUST.
AVOID CONTACT WITH SKIN, EYES AND CLOTHING.
ONTAINER DISPOSITION:
EMPTY CONTAINER COMPLETELY. DISPOSE OF EMPTY CONTAINER IN SANITARY LANDFILL BY FIRST OBTAINING LANDFILL OPERATOR'S AUTHORIZATION.

* * * * * * * * * * SECTION X - TRANSPORTATION INFORMATION * * * * * * * * * *

DOT SHIPPING DESCRIPTION:
NOT RESTRICTED

* * * * * * * * * * SECTION XI - ENVIRONMENTAL EVALUATION * * * * * * * * * *

EPA SUPERFUND(SARA) TITLE III - HAZARD CLASSIFICATION & ASSOCIATED INFORMATION
FIRE: N PRESSURE: N REACTIVE: N ACUTE (IMMEDIATE): Y
CHRONIC (DELAYED): N MIXTURE OR PURE MATERIAL: PURE

B. EPA - CERCLA/SUPERFUND, 40 CFR 302 (REPORTABLE SPILL QUANTITY)
N/A

C. EPA - SARA TITLE III, CFR 355 (EXTREMELY HAZARDOUS SUBSTANCES)
PRODUCT CONTAINS NO EXTREMELY HAZARDOUS COMPONENTS

D. EPA - SARA TITLE III, 40 CFR 372 (LIST OF TOXIC CHEMICALS)
CHEMICAL CONTAINS NO TOXIC INGREDIENTS

E. COMPONENTS LISTED ON FOLLOWING CHEMICAL INVENTORIES
TSCA YES CEPA NE EEC YES ACOIN YES NPR NE DRSM NE

H. EPA - RCRA (HAZARDOUS WASTE), 40 CFR 261

IF PRODUCT BECOMES A WASTE, IT DOES NOT MEET THE CRITERIA OF A HAZARDOUS WASTE

* *

THE INFORMATION WHICH IS CONTAINED IN THIS DOCUMENT IS BASED UPON AVAILABLE DATA AND BELIEVED TO BE CORRECT. HOWEVER, AS SUCH AS IT HAS BEEN OBTAINED FROM VARIOUS SOURCES, INCLUDING THE MANUFACTURER AND INDEPENDENT LABORATORIES, IT IS GIVEN WITHOUT WARRANTY OR REPRESENTATION THAT IT IS COMPLETE, ACCURATE AND CAN

BE RELIED UPON. HALLIBURTON HAS NOT ATTEMPTED TO CONCEAL IN ANY WAY THE DELETERIOUS ASPECTS OF THE PRODUCT LISTED HEREIN, BUT MAKES NO WARRANTY AS TO SUCH. FURTHER, AS HALLIBURTON CANNOT ANTICIPATE NOR CONTROL THE MANY SITUATIONS IN WHICH THE LISTED PRODUCT OR THIS INFORMATION MAY BE USED BY OUR CUSTOMER, THERE IS NO GUARANTEE THAT THE HEALTH AND SAFETY PRECAUTIONS SUGGESTED WILL BE PROPER UNDER ALL CONDITIONS. IT IS THE SOLE RESPONSIBILITY OF EACH USER OF THE LISTED PRODUCT TO DETERMINE AND COMPLY WITH THE REQUIREMENTS OF ALL APPLICABLE LAWS AND REGULATIONS REGARDING ITS USE OR DISPOSAL. THIS INFORMATION IS GIVEN SOLELY FOR THE PURPOSES OF HEALTH AND SAFETY TO PERSONS AND PROPERTY. ANY OTHER USE OF THIS INFORMATION IS EXPRESSLY PROHIBITED. REGULATORY AFFAIRS DEPARTMENT, HALLIBURTON ENERGY SERVICES GROUP

WESTERN ASH COMPANY

MATERIAL SAFETY DATA SHEET

To comply with OSHA's Hazard
Communication Standard
29 CFR 1910.1200

IDENTITY (As Used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.
Sub-bituminous Coal Fly Ash - Class C	

SECTION I

Manufacturer's Name	Emergency Telephone Number
Basin Electric Power Cooperative	701/223-0441
Address (Number, Street, City, State, and ZIP Code)	Telephone Number for Information
Laramie River Station	307/322-9601
P.O. Box 1346	Date Prepared January 27, 1986
Wheatland, WY 82201	Signature of Preparer (optional)

SECTION II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity, Common Name(s))	Range**	OSHA PEL	ACGIH
Alumina (Al_2O_3)	13%	5 mg/m^3*	5 mg/m^3*
Calcium Oxide (CaO)	20%	5 mg/m^3	2 mg/m^3
Iron Oxide (Fe_2O_3)	4.7%	5 mg/m^3*	5 mg/m^3*
Silica (SiO_2), Crystalline Quartz	3-5%	1.0 mg/m^3*	0.1 mg/m^3*

* Respirable Dust Particles less than 10 microns in size.
** Values listed are percent ranges and the percentage may vary depending on the load of coal, boiler type and other factors.

SECTION III - Physical/Chemical Characteristics

Boiling Point Not Applicable	-	Specific Gravity (H_2O=1) Not Applicable	2.60
Vapor Pressure (mm Hg.) Not Applicable	-	Melting Point Not Applicable	-
Vapor Density (AIR = 1) Not Applicable	-	Evaporation Rate (Butyl Acetate = 1) Not Applicable	-

Solubility in Water
0-5%

Appearance and Odor
Fine gray powder, odorless.

Laramie River Station

SECTION IV - Fire and Explosion Hazzard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL
Not Applicable	Not Applicable	--	--

Extinguishing Media
Using extinguishing media appropriate to the surrounding fire.

Special Fire Fighting Procedures
Not Applicable

Unusual Fire and Explosion Hazards
Non-flammable and non-explosive

SECTION V - Reactivity Data

Stability			Conditions to Avoid
	Unstable		
	Stable	X	

Incompatability (Materials to Avoid)

Hazardous Decomposition or Byproducts

Hazardous Polymenzation			Conditions to Avoid
	May Occur		
	Will not Occur	X	

SECTION VI - Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
	Yes	Yes	No

Health Hazards (Acute and Chronic)
Irritation of eyes, skin, and mucous membranes of the respiratory system. Prolonged inhalation exposure may cause pulmonary fibrosis or chronic bronchitis.

Carcinogenicity:	NTP?	LARC Monographs?	OSHA Regulated?
	No	No	No

Signs and Symptoms of Exposure
Irritation of eyes, skin and respiratory system.

Medical Conditions
Generally Aggravated by Exposure Respiratory disorders

Emergency and First Aid Procedures
Eye contact: Flush with water. Inhalation: Remove to fresh air. Skin contact: Wash with mild soap and water. Seek medical attention if irritation occurs.

Laramie River Station

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled
Those involved in clean-up of spills need protection for the eyes and against dust inhalation. Provide ventilation. Wetting with water will reduce airborne dust.

Waste Disposal Method
Material can be disposed of as an inert solid in a landfill. Follow Federal, State and local regulations.

Precautions to Be Taken in Handling and Storing
Avoid inhalation of dust. Follow good housekeeping procuedures.

Other Precautions
Industrial Hygiene survey of worker exposures would provide the information needed to determine the need for other special precautions.

SECTION VIII - Control Measures

Respiratory Protection (Specify Type)
When exposure approaches the TLV for the indgredients listed, use NIOSH-approved dust respirator.

Ventilation	Local Exhaust May be used to control dust levels.	Special
	Mechanical (General) May be used to control dust levels.	Other

Protective Gloves Clean work gloves.	Eye Protection Goggles.

Other Protective Clothing or Equipment
Protective clothing may be necessary under heavy dusting conditions.

Work/Hygienic Practices
Follow good hygiene and housekeeping procedures.

FLY ASH RETARDER PAGE 1

MATERIAL SAFETY DATA SHEET DATE: 08-20-92
HALLIBURTON SERVICES REVISED DATE 09-06-9
DUNCAN, OKLAHOMA 73536

EMERGENCY TELEPHONE: 405/251-3565 OR 405/251-3569
AFTER HOURS: 405/251-3760

* * * * * * * * * * * SECTION I - PRODUCT DESCRIPTION * * * * * * * * * * * *

CHEMICAL CODE: FLY ASH RETARDER PART NUMBER: 516006410
PKG QTY: 50 POUNDS APPLICATION: RETARDER
SERVICE USED: CEMENTING

* * * * * * * * * * * SECTION II - COMPONENT INFORMATION * * * * * * * * * * *

COMPONENT	PERCENT	TLV	PEL
MODIFIED LIGNOSULFONATE	> 60 %	10 MG/M3	15 MG/M3

* * * * * * * * * * * SECTION III - PHYSICAL DATA * * * * * * * * * * * *

PROPERTY	MEASUREMENT
APPEARANCE	BROWN SOLID POWDER
ODOR	SLIGHT
SPECIFIC GRAVITY (H2O=1)	N/D
BULK DENSITY	N/D LB/CU.FT.
PH	NOT DETERMINED
SOLUBILITY IN WATER AT DEG C. GMS/100ML H2O	SOLUBLE
BIODEGRADABILITY	N/D
PERCENT VOLATILES	N/A
EVAPORATION RATE(BUTYL ACETATE=1)	N/A
VAPOR DENSITY	N/A
VAPOR PRESSURE (MMHG)	N/A
BOILING POINT(760 MMHG)	N/A
POUR POINT	N/A
FREEZE POINT	N/A
SOLUBILITY IN SEAWATER	NOT EVALUATED
PARTITION COEF (OCTANOL IN WATER)	NOT EVALUATED

* * * * * * * * * * SECTION IV - FIRE AND EXPLOSION DATA * * * * * * * * * *

NFPA(704) RATING:
HEALTH 1 FLAMMABILITY 0 REACTIVITY 0 SPECIAL NONE
FLASH POINT N/A
AUTOIGNITION TEMPERATURE ND F / ND C
FLAMMABLE LIMITS (OZ. PER CU. FT.) LOWER N/A UPPER N/A

EXTINGUISHING MEDIA:
USE WATER SPRAY, FOAM, DRY CHEMICAL, OR CARBON DIOXIDE.
SPECIAL FIRE FIGHTING PROCEDURES:
FULL PROTECTIVE CLOTHING AND NIOSH/MSHA APPROVED SELF-CONTAINED BREATHING APPARATUS REQUIRED FOR FIRE FIGHTING PERSONNEL.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
INCOMPLETE THERMAL DECOMPOSITION MAY PRODUCE CARBON DIOXIDE, CARBON MONOXIDE AND SULFUR OXIDES.
ORGANIC DUST IN THE PRESENCE OF A SOURCE OF IGNITION CARRIES A POTENTIAL EXPLOSION HAZARD IF THE CONCENTRATION IN THE AIR IS TOO HIGH. GOOD HOUSEKEEPING PROCEDURES ARE REQUIRED TO MINIMIZE THIS POTENTIAL HAZARD.

FLY ASH RETARDER PAGE 1

MATERIAL SAFETY DATA SHEET DATE: 08-20-92
HALLIBURTON SERVICES REVISED DATE 09-06-9
DUNCAN, OKLAHOMA 73536

EMERGENCY TELEPHONE: 405/251-3565 OR 405/251-3569
AFTER HOURS: 405/251-3780

* * * * * * * * * * SECTION I - PRODUCT DESCRIPTION * * * * * * * * * *

CHEMICAL CODE: FLY ASH RETARDER PART NUMBER: 51600641
PKG QTY: 50 POUNDS APPLICATION: RETARDER
SERVICE USED: CEMENTING

* * * * * * * * * * SECTION II - COMPONENT INFORMATION * * * * * * * * * *

COMPONENT	PERCENT	TLV	PEL
MODIFIED LIGNOSULFONATE	> 60 %	10 MG/M3	15 MG/M3

* * * * * * * * * * SECTION III - PHYSICAL DATA * * * * * * * * * *

PROPERTY	MEASUREMENT
APPEARANCE	BROWN SOLID POWDER
ODOR	SLIGHT
SPECIFIC GRAVITY (H2O=1)	N/D
BULK DENSITY	N/D LB/CU.FT.
PH	NOT DETERMINED
SOLUBILITY IN WATER AT 20 DEG C. GMS/100ML H2O	SOLUBLE
BIODEGRADABILITY	N/D
PERCENT VOLATILES	N/A
EVAPORATION RATE(BUTYL ACETATE=1)	N/A
VAPOR DENSITY	N/A
VAPOR PRESSURE (MMHG)	N/A
BOILING POINT(760 MMHG)	N/A
POUR POINT	N/A
FREEZE POINT	N/A
SOLUBILITY IN SEAWATER	NOT EVALUATED
PARTITION COEF (OCTANOL IN WATER)	NOT EVALUATED

* * * * * * * * * * SECTION IV - FIRE AND EXPLOSION DATA * * * * * * * * * *

NFPA(704) RATING:
HEALTH 1 FLAMMABILITY 0 REACTIVITY 0 SPECIAL NONE
FLASH POINT N/A
AUTOIGNITION TEMPERATURE ND F / ND C
FLAMMABLE LIMITS (OZ. PER CU. FT.) LOWER N/A UPPER N/A

EXTINGUISHING MEDIA:
USE WATER SPRAY, FOAM, DRY CHEMICAL, OR CARBON DIOXIDE.
SPECIAL FIRE FIGHTING PROCEDURES:
FULL PROTECTIVE CLOTHING AND NIOSH/MSHA APPROVED SELF-CONTAINED BREATHING APPARATUS REQUIRED FOR FIRE FIGHTING PERSONNEL.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
INCOMPLETE THERMAL DECOMPOSITION MAY PRODUCE CARBON DIOXIDE, CARBON MONOXIDE AND SULFUR OXIDES.
ORGANIC DUST IN THE PRESENCE OF A SOURCE OF IGNITION CARRIES A POTENTIAL EXPLOSION HAZARD IF THE CONCENTRATION IN THE AIR IS TOO HIGH. GOOD HOUSEKEEPING PROCEDURES ARE REQUIRED TO MINIMIZE THIS POTENTIAL HAZARD.

SECTION V - HEALTH HAZARD DATA

CALIFORNIA PROPOSITION 65:
PRODUCT OR PRODUCT COMPONENTS ARE NOT REGULATED UNDER CALIF. PROPOSITION 65.

CARCINOGENIC DETERMINATION:
PRODUCT OR COMPONENTS ARE NOT LISTED AS A POTENTIAL CARCINOGEN
ACCORDING TO : "NTP, IARC, OSHA, OR, ACIGH".

PRODUCT TOXICITY DATA: NOT DETERMINED

PRODUCT TLV: NOT ESTABLISHED

EFFECTS OF EXPOSURE

PRIMARY ROUTES OF EXPOSURE:
EYE OR SKIN CONTACT.
EYE:
MAY CAUSE MILD IRRITATION.
SKIN:
ESSENTIALLY NON-IRRITATING.
INHALATION:
TREAT AS NUISANCE DUST.
INGESTION:
NO DATA AVAILABLE
CHRONIC EFFECTS:
NO CHRONIC EFFECTS EXPECTED.
OTHER SYMPTOMS AFFECTED:
A REVIEW OF AVAILABLE DATA DOES NOT IDENTIFY ANY CONDITIONS WORSENED BY EXPOSURE TO THIS PRODUCT.

EMERGENCY AND FIRST AID PROCEDURES

EYE:
IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. IF IRRITATION PERSISTS, SEEK PROMPT MEDICAL ATTENTION.
SKIN:
PROMPTLY WASH SKIN WITH SOAP AND WATER. WASH CLOTHING BEFORE REUSE.
INHALATION:
REMOVE TO FRESH AIR. IF IRRITATION PERSISTS, SEEK MEDICAL ATTENTION,
INGESTION:
DO NOT INDUCE VOMITING! IN GENERAL, NO TREATMENT IS NECESSARY UNLESS LARGE QUANTITIES ARE INGESTED. HOWEVER, MEDICAL ADVICE SHOULD BE OBTAINED.

SECTION VI - REACTIVITY DATA

STABILITY: STABLE
CONDITIONS TO AVOID:
NOT APPLICABLE.
INCOMPATIBILITY (MATERIALS TO AVOID):
STRONG OXIDIZERS.
HAZARDOUS DECOMPOSITION PRODUCTS:
SULFUR DIOXIDE, CARBON DIOXIDE AND CARBON MONOXIDE.
HAZARD POLYMERIZATION: WON"T OCCUR
CONDITIONS TO AVOID:
NOT APPLICABLE.

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
USE PROTECTIVE EQUIPMENT. ISOLATE SPILL AND STOP LEAK WHERE SAFE. CONTAIN AND ABSORB SPILL WITH AN INERT MATERIAL. SCOOP UP AND REMOVE.
WASTE DISPOSAL METHOD:
GET APPROVAL FROM LANDFILL OPERATOR AND TRANSPORT ABSORBED MATERIAL TO SANITARY LANDFILL

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (USE NIOSH/MSHA APPROVED EQUIPMENT):
NOT NORMALLY NECESSARY.
TOXIC DUST/MIST RESPIRATOR.
VENTILATION:
USE ONLY WITH ADEQUATE VENTILATION. LOCAL EXHAUST VENTILATION IS NOT NORMALLY NEEDED.
PROTECTIVE GLOVES:
IMPERVIOUS RUBBER GLOVES.
EYE PROTECTION:
GOGGLES AND/OR FACE SHIELD.
OTHER PROTECTIVE EQUIPMENT:
NORMAL WORK COVERALLS.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING FLY ASH RETARDER 516.006410

CAUTION:
MAY CAUSE MILD IRRITATION TO EYES, SKIN AND UPPER RESPIRATORY SYSTEM.
FOR PRECAUTIONARY STATEMENTS, REFER TO SECTIONS IV-VIII.
OTHER HANDLING AND STORAGE CONDITIONS:
STORE AWAY FROM OXIDIZERS.
KEEP CONTAINER CLOSED WHEN NOT IN USE.
AVOID CONTACT WITH SKIN, EYES AND CLOTHING.
AVOID BREATHING VAPORS.
CONTAINER DISPOSITION:
IF CONTAINER RETAINS PRODUCT RESIDUES, LABEL PRECAUTIONS MUST BE OBSERVED.
STORE CONTAINER WITH CLOSURES IN PLACE. OFFER EMPTY CONTAINER TO RECONDITIONOR OR RECYCLER FOR RECONDITIONING OR DISPOSAL. ENSURE RECONDITIONER OR RECYCLER IS AWARE OF THE PROPERTIES OF THE CONTENTS.
SPECIAL PRECAUTIONS:
PRODUCT HAS A SHELF LIFE OF 24 MONTHS.

SECTION X - TRANSPORTATION INFORMATION

DOT SHIPPING DESCRIPTION:
NOT RESTRICTED

SECTION XI - ENVIRONMENTAL EVALUATION

EPA SUPERFUND(SARA) TITLE III - HAZARD CLASSIFICATION & ASSOCIATED INFORMATION
FIRE: N PRESSURE: N REACTIVE: N ACUTE (IMMEDIATE): Y
CHRONIC (DELAYED): N MIXTURE OR PURE MATERIAL: PURE

B. EPA - CERCLA/SUPERFUND, 40 CFR 302 (REPORTABLE SPILL QUANTITY)
N/A

C. EPA - SARA TITLE III, CFR 355 (EXTREMELY HAZARDOUS SUBSTANCES)
PRODUCT CONTAINS NO EXTREMELY HAZARDOUS COMPONENTS

D. EPA - SARA TITLE III, 40 CFR 372 (LIST OF TOXIC CHEMICALS)
CHEMICAL CONTAINS NO TOXIC INGREDIENTS

E. COMPONENTS LISTED ON FOLLOWING CHEMICAL INVENTORIES
TSCA YES CEPA NE EEC NO ACOIN YES NPR NE DRSM NE

F. EPA - RCRA (HAZARDOUS WASTE), 40 CFR 261

IF PRODUCT BECOMES A WASTE, IT DOES NOT MEET THE CRITERIA OF A

Clin

MATERIAL SAFETY DATA

OCEAN NETWORK EMERGENCY PHONE 1-800-OLIN-911

THIS MATERIAL SAFETY DATA SHEET (MSDS) HAS BEEN PREPARED IN COMPLIANCE WITH THE FEDERAL OSHA HAZARD COMMUNICATION STANDARD, 29 CFR 1910.1200. THIS PRODUCT MAY BE CONSIDERED TO BE A HAZARDOUS CHEMICAL UNDER THAT STANDARD. (REFER TO THE OSHA CLASSIFICATION IN SEC. I.) THIS INFORMATION IS REQUIRED TO BE DISCLOSED FOR SAFETY IN THE WORKPLACE. THE EXPOSURE TO THE COMMUNITY, IF ANY, IS QUITE DIFFERENT.

I. PRODUCT IDENTIFICATION

REVISION NO = 8
REVISION DATE = 8/13/91
PRODUCT CODE = CPE133267
FILE NUMBER = CPE00002.0023
PRODUCT NAME: CCH(R) DRY CHLORINATOR GRANULAR

SYNONYMS: None
CHEMICAL FAMILY: Hypochlorite
FORMULA: Not Applicable/Mixture
DESCRIPTION: Sanitizer and oxidizer
OSHA HAZARD CLASSIFICATION: Oxidizer, irritant

II. COMPONENT DATA

PRODUCT COMPOSITION

CAS or CHEMICAL NAME: Calcium hypochlorite
CAS NUMBER: 7778-54-3
PERCENTAGE RANGE: 65-75%
HAZARDOUS PER 29 CFR 1910.1200: Yes
EXPOSURE STANDARDS: None Established

CAS or CHEMICAL NAME: Sodium chloride
CAS NUMBER: 7647-14-5
PERCENTAGE RANGE: 10-20%
HAZARDOUS PER 29 CFR 1910.1200: No
EXPOSURE STANDARDS: None Established

CAS or CHEMICAL NAME: Calcium chlorate
CAS NUMBER: 10137-74-3
PERCENTAGE RANGE: 0-5%
HAZARDOUS PER 29 CFR 1910.1200: Yes
EXPOSURE STANDARDS: None Established

CAS or CHEMICAL NAME: Calcium chloride
CAS NUMBER: 10043-52-4
PERCENTAGE RANGE: 0-5%
HAZARDOUS PER 29 CFR 1910.1200: Yes
EXPOSURE STANDARDS: None Established

CAS or CHEMICAL NAME: Calcium hydroxide
CAS NUMBER: 1305-62-0
PERCENTAGE RANGE: 0-4%
HAZARDOUS PER 29 CFR 1910.1200: Yes
EXPOSURE STANDARDS:

	OSHA(PEL)		ACGIH(TLV)	
	ppm	mg/cubic-meter	ppm	mg/cubic-meter
TWA:		5		5
CEILING:	None		None	
STEL:	None		None	

CAS or CHEMICAL NAME: Calcium carbonate
CAS NUMBER: 471-34-1
PERCENTAGE RANGE: 0-4%
HAZARDOUS PER 29 CFR 1910.1200: Yes
EXPOSURE STANDARDS:

	OSHA(PEL)		ACGIH(TLV)	
	ppm	mg/cubic-meter	ppm	mg/cubic-meter
TWA:		15 (Total Dust) 5 (Respirable fraction)		10
CEILING:	None		None	
STEL:	None		None	

CAS or CHEMICAL NAME: Water
CAS NUMBER: 7732-18-5
PERCENTAGE RANGE: 5.5-10%
HAZARDOUS PER 29 CFR 1910.1200: No
EXPOSURE STANDARDS: None Established

III. PRECAUTIONS FOR SAFE HANDLING AND STORAGE

DO NOT TAKE INTERNALLY. AVOID CONTACT WITH EYES, SKIN OR CLOTHING. UPON CONTACT WITH SKIN OR EYES, WASH OFF WITH WATER.

STORAGE CONDITIONS: Keep tightly sealed. Store in a cool, dry, well-ventilated area.
DO NOT STORE AT TEMPERATURES ABOVE: 52 Deg.C (125 Deg.F)

PRODUCT STABILITY AND COMPATIBILITY
SHELF LIFE LIMITATIONS: Approximately 2 years at temperatures greater than 52 Deg.C (125 Deg.F) and low humidity.
INCOMPATIBLE MATERIALS FOR PACKAGING: Containers must be clean and free of organic residues.
INCOMPATIBLE MATERIALS FOR STORAGE OR TRANSPORT: Acids, other organic materials, oxidizers, all corrosive liquids

IV. PHYSICAL DATA

APPEARANCE: White, free flowing powder
FREEZING POINT: Not Applicable
BOILING POINT: Not Applicable
DECOMPOSITION TEMPERATURE: 177 Deg.C (350 Deg.F)
SPECIFIC GRAVITY: Not Applicable
BULK DENSITY: 0.8 g/cc, loose
pH @ 25 DEG.C: 10.5-11.5 (1% solution)
VAPOR PRESSURE @ 25 DEG.C: Not Applicable
SOLUBILITY IN WATER: Approximately 18% @ 25 Deg.C (Product also contains calcium hydroxide and calcium carbonate which will leave a residue.)
VOLATILES, PERCENT BY VOLUME: Not Applicable
EVAPORATION RATE: Not Applicable
VAPOR DENSITY: Not Applicable
MOLECULAR WEIGHT: 143 (Active ingredient)
PRODUCT IS: Not cryogenic and not a compressed gas
ODOR: Chlorine-like
COEFFICIENT OF OIL/WATER DISTRIBUTION: Not Applicable

V. PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

PERSONAL PROTECTION FOR ROUTINE USE OF PRODUCT:

RESPIRATORY PROTECTION: Wear NIOSH/MSHA approved respirator.

VENTILATION: Use local exhaust ventilation to minimize dust and chlorine levels.

SKIN PROTECTIVE EQUIPMENT: Wear gloves, boots, chemical goggles, aprons or impermeable suit to avoid skin and eye contact.

EQUIPMENT SPECIFICATIONS (WHEN APPLICABLE):

RESPIRATOR TYPE:	NIOSH/MSHA approved full face-piece with chlorine cartridges and dust/mist filter
GLOVE TYPE:	Neoprene or PVC
BOOT TYPE:	Neoprene or PVC
APRON TYPE:	Neoprene or PVC
FACE SHIELD:	Not Normally Required
PROTECTIVE SUIT:	Not Normally Required

VI. FIRE AND EXPLOSION HAZARD INFORMATION

FLAMMABILITY DATA:
- FLAMMABLE: No
- COMBUSTIBLE: No
- PYROPHORIC: No
- FLASH POINT: Not Applicable
- AUTOIGNITION TEMPERATURE: Not Applicable
- FLAMMABLE LIMITS AT NORMAL ATMOSPHERIC TEMPERATURE AND PRESSURE (PERCENT VOLUME IN AIR): Not Applicable

NFPA RATINGS:
- Health: 2
- Flammability: 0
- Reactivity: 2
- Special Hazard Warning: OXIDIZER

HMIS RATINGS:
- Health: 2
- Flammability: 0
- Reactivity: 2

EXTINGUISHING MEDIA: Not Applicable

FIRE FIGHTING TECHNIQUES AND COMMENTS: Use water to cool containers exposed to fire. Also see Section XI.

OTHER: Do not use dry extinguishers containing ammonium compounds

VII. REACTIVITY INFORMATION

CONDITIONS UNDER WHICH THIS PRODUCT MAY BE UNSTABLE:
- TEMPERATURES ABOVE: 177 Deg.C (350 Deg.F)
- MECHANICAL SHOCK OR IMPACT: No
- ELECTRICAL (STATIC) DISCHARGE: No
- HAZARDOUS POLYMERIZATION: Will not occur
- INCOMPATIBLE MATERIALS: Acids, organics, nitrogen containing compounds, dry powder fire extinguishers (containing mono-ammonium phosphate), corrosive, flammable or combustible materials
- HAZARDOUS DECOMPOSITION PRODUCTS: Chlorine gas
- OTHER CONDITIONS TO AVOID: High temperatures > 125 Deg.F, high humidity

SUMMARY OF REACTIVITY:
- OXIDIZER: Yes
- PYROPHORIC: No
- ORGANIC PEROXIDE: No
- WATER REACTIVE: No
- OTHER: Olin calcium hypochlorite products meet the specifications of ASTM method E-487-74 as set forth in 49 C. F. R. Sec. 173.21, Title 49-Code of Federal Regs.(DOT Regs.)

VIII. FIRST AID

EYES: Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Call a physician at once.

SKIN: Immediately flush with water for at least 15 minutes. Call a physician. If clothing comes in contact with the product, it should be removed immediately and laundered before reuse.

INGESTION: Immediately drink large quantities of water. DO NOT induce vomiting. Call a physician at once. DO NOT give anything by mouth if the person is unconscious or if having convulsions.

INHALATION: Remove victim to fresh air. Support respiration if needed. Call a physician.

IX. TOXICOLOGY AND HEALTH INFORMATION

ROUTES OF ABSORPTION

Inhalation, Skin, Eye, Ingestion

WARNING STATEMENT AND WARNING PROPERTIES

HARMFUL IF INHALED OR INGESTED. HARMFUL IF EXPOSED TO SKIN OR EYES.

HUMAN RESPONSE DATA

ODOR THRESHOLD: Approximately 1.7 mg/cubic-meter (0.3 ppm) based on odor of chlorine.

IRRITATION THRESHOLD: There is no data for irritation threshold.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH: The product has the potential to be immediately dangerous to life or health.

SIGNS, SYMPTOMS, AND EFFECTS OF EXPOSURE

INHALATION

ACUTE:

Inhalation of this material is irritating to the nose, mouth, throat and lungs. It may also cause burns to the respiratory tract with the production of lung edema which can result in shortness of breath, wheezing, choking, chest pain, and impairment of lung function. Inhalation of high concentrations can result in permanent lung damage.

CHRONIC:
Chronic (repeated) inhalation exposure may cause impairment of lung function and permanent lung damage.

EYE
Severe irritation and/or burns can occur following eye exposure. Contact may cause impairment of vision and corneal damage.

SKIN
ACUTE:
Dermal exposure can cause severe irritation and/or burns characterized by redness, swelling and scab formation. Prolonged skin exposure may cause destruction of the dermis with impairment of the skin at site of contact to regenerate.
CHRONIC:
Effects from chronic skin exposure would be similar to those from single exposure except for effects secondary to tissue destruction.

INGESTION
ACUTE:
Irritation and/or burns can occur to the entire gastrointestinal tract, including the stomach and intestines, characterized by nausea, vomiting, diarrhea, abdominal pain, bleeding and/or tissue ulceration.
CHRONIC:
There are no known or reported effects from chronic exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE
Asthma, respiratory and cardiovascular disease

INTERACTIONS WITH OTHER CHEMICALS WHICH ENHANCE TOXICITY
None known or reported

ANIMAL TOXICOLOGY
ACUTE TOXICITY:
Inhalation LC 50: Approximately 1700 mg/cubic-meter for 1 hour in the rat based on acute toxicity for chlorine
Oral LD 50: 850 mg/kg (rat)
Dermal LD 50: > 2 g/kg (rabbit)
Aquatic LC 50: 0.088 mg/l (bluegill)
Causes burns to eyes and skin

CHRONIC TOXICITY:
There are no known or reported effects from repeated exposure.

REPRODUCTIVE TOXICITY:
There are no known or reported effects on reproductive function or fetal development.

CARCINOGENICITY:

This product is not known or reported to be carcinogenic by any reference source including IARC, OSHA, NTP, or EPA.

MUTAGENICITY:

Calcium hypochlorite has been reported to produce mutagenic activity in two in vitro assays. It has, however, been shown to lack the capability to produce mutations in animals based on results from the micronucleus assay. In vitro assays frequently are inappropriate to judge the mutagenic potential of bactericidal chemicals due to a high degree of cellular toxicity. The concentration which produces mutations in these in vitro assays is significantly greater than the concentrations used for disinfection. Based on high cellular toxicity in in vitro assays and the lack of mutagenicity in animals, the risk of genetic damage to humans is judged not significant.

X. TRANSPORTATION INFORMATION

THIS MATERIAL IS REGULATED AS A DOT HAZARDOUS MATERIAL.

DOT DESCRIPTION FROM THE HAZARDOUS MATERIALS TABLE 49 CFR 172:
CALCIUM HYPOCHLORITE, HYDRATED, OXIDIZER, UN 2880

REPORTABLE QUANTITY: 10 lbs. (Per 49 CFR 172.101, Appendix)

The material described above is subject to the U.S. DOT HAZARDOUS MATERIALS REGULATIONS via the modes and packaging quantities indicated below with the letter "x":

MODE	PACKAGING QUANTITIES	
_x_ Rail	_x_ Bulk	_x_ Non-Bulk
_x_ Motor	_x_ Bulk	_x_ Non-Bulk
_x_ Water	_x_ Bulk	_x_ Non-Bulk
_x_ Air	_x_ Bulk	_x_ Non-Bulk

The applicable packaging sections in 49 CFR are 173.153 and 173.217.

XI. SPILL AND LEAKAGE PROCEDURES

FOR ALL TRANSPORTATION ACCIDENTS, CALL CHEMTREC AT 800-424-9300.

REPORTABLE QUANTITY: 10 lbs. (as Calcium hypochlorite) Per 40 CFR 302.4

SPILL MITIGATION PROCEDURES:
Hazardous concentrations in air may be found in local spill area and immediately downwind. Remove all sources of ignition. Stop source of spill as soon as possible and notify appropriate personnel.

AIR RELEASE: Vapors may be suppressed by the use of a water fog. All water utilized to assist in fume suppression, decontamination or fire suppression may be contaminated and must be contained before disposal.

WATER RELEASE: This material is heavier than water. This material is soluble in water. Monitor all exit water for available chlorine and pH. Advise local authorities of any contaminated water release.

LAND SPILL: Containerize all virgin material in a clean dry container using clean dedicated equipment to clean up material. Containerize all contaminated material in a clean dry container and remove to a well ventilated area being sure to not seal tightly. Contaminated spill mate-rial may become a hazardous waste.

SPILL RESIDUES:
Dispose of per guidelines under Section XII, WASTE DISPOSAL.

This material may be neutralized for disposal; you are requested to contact OCEAN at 800-OLIN-911 before beginning any such operation.

PERSONAL PROTECTION FOR EMERGENCY SPILL AND FIRE-FIGHTING SITUATIONS:
For a spill of this material no extra protection beyond that listed in Section V is required.
In a fire involving this material a self contained breathing apparatus (SCBA) is required as well as standard fire protective clothing.

XII. WASTE DISPOSAL

If this product becomes a waste, it meets the criteria of a hazardous waste as defined under 40 CFR 261 and would have the following EPA hazardous waste number: D001.

If this product becomes a waste, it will be a hazardous waste which is subject to the Land Disposal Restrictions under 40 CFR 268 and must be managed accordingly.

As a hazardous solid waste, it must be disposed of in accordance with local, state, and federal regulations in a permitted hazardous waste treatment, storage and disposal facility by treatment.

CARE MUST BE TAKEN TO PREVENT ENVIRONMENTAL CONTAMINATION FROM THE USE OF THIS MATERIAL. THE USER OF THIS MATERIAL HAS THE RESPONSIBILITY TO DISPOSE OF UNUSED MATERIAL, RESIDUES AND CONTAINERS IN COMPLIANCE WITH ALL RELEVANT LOCAL, STATE AND FEDERAL LAWS AND REGULATIONS REGARDING TREATMENT, STORAGE AND DISPOSAL FOR HAZARDOUS AND NONHAZARDOUS WASTES.

XIII. ADDITIONAL REGULATORY STATUS INFORMATION

TOXIC SUBSTANCES CONTROL ACT:
This substance is listed on the Toxic Substances Control Act inventory.

SUPERFUND AMENDMENT AND REAUTHORIZATION ACT TITLE III:
HAZARD CATEGORIES, PER 40 CFR 370.2:
HEALTH:
Immediate (Acute)
PHYSICAL:
Fire and Reactivity

EMERGENCY PLANNING AND COMMUNITY RIGHT TO KNOW, PER 40 CFR 355, APP.A:
EXTREME HAZARDOUS SUBSTANCE - THRESHOLD PLANNING QUANTITY:
None Established
SUPPLIER NOTIFICATION REQUIREMENTS, PER 40 CFR 372.45:
None Established

XIV. ADDITIONAL INFORMATION

REGULATED UNDER FIFRA, USDA & FDA

XV. MAJOR REFERENCES

1. ACGIH Guide to Protective Clothing. Cincinnati, OH: American Conference of Government Industrial Hygienists, 1987.
2. ANSI Z88.2. Recommended Practice for Respiratory Protection. American National Standards Institute, New York, NY.
3. Baker, C. J., The Fire Fighter's Handbook of Hazardous Materials, 4th Ed., Indiana: Maltese Enterprises, Inc., 1984.
4. Bretherick, L., Handbook of Reactive Chemical Hazards, 3rd Ed., Boston, MA: Butterworths, 1985.

5. Cassarett, L. and J. Doull, Eds., Toxicology: The Basic Science of Poisons, 3rd Ed., New York: Macmillan Publishing Co., Inc. 1986.
6. CERIS (Chemical Emergency Response Information System) On Line Database. Association of American Railroads.
7. Chemical Degradation and Permeation Database and Selection Guide for Resistant Protective Materials. Austin, TX.
8. Clayton, G. and F. Clayton, Eds., Patty's Industrial Hygiene and Toxicology, Vol. 2A-C 3rd Ed., New York: John Wiley & Sons, 1981-1982.
9. Code of Federal Regulations, Titles 21, 29, 40 and 49. Washington, DC: U.S. Government Printing Office.
10. Emergency Response Guide (D.O.T.). Washington, DC: U.S. Government Printing Office, 1987.
11. Fire Protection Guide on Hazardous Materials, 9th Ed., National Fire Protection Association, Batterymarch Park, Quincy, MA, 1986.
12. Gosselin, R., et al., Gosselin-Clinical Toxicology of Commercial Products, 5th Ed., Baltimore: Williams and Wilkins, 1984.
13. Hazardline, Occupational Health Services Inc., New York, NY.
14. IARC Monogram on the Evaluation of Carcinogenic Risk of Chemicals to Man., Geneva: World Health Organization, International Agency for Research on Cancer.
15. Lenga, R., The Sigma-Aldrich Library of Chemical Safety Data, 1st Ed., Milwaukee, WI: Sigma-Aldrich Corporation, 1985.
16. Lewis, R. and D. Sweet, Eds., Registry of Toxic Effects of Chemical Substances, 1985-1986, Washington, DC: U.S. Government Printing Office, 1987.
17. Medline, U.S. National Library of Medicine, Bethesda, MD.
18. NIOSH Pocket Guide to Chemical Hazards. Washington, DC: U.S. Government Printing Office, 1985.
19. Olin Respiratory Protection Manual.
20. Sax, N. Irving, Dangerous Properties of Hazardous Materials 6th Ed., New York: Van Nostrand Reinhold Company, 1984.
21. Threshold Limit Values and Biological Exposure Indices for 1987-88. Cincinnati, OH: American Conference of Government Industrial Hygienists, 1987.
22. Toxic Substances Control Act Inventory, Washington, DC: U.S. Government Printing Office, 1986.
23. Ishidate, M. et al. (1984). Primary mutagenicity screening of food additives currently used in Japan. Fd. Chem. Toxicol. 22:623-636.
24. Hayashi, M. et al. (1988). Micronucleus tests in mice on 39 food additives and eight miscellaneous chemicals. Fd. Chem. Toxicol. 26:487-500.

THE INFORMATION IN THIS MATERIAL SAFETY DATA SHEET SHOULD BE PROVIDED TO ALL WHO WILL USE, HANDLE, STORE, TRANSPORT, OR OTHERWISE BE EXPOSED TO THIS PRODUCT. THIS INFORMATION HAS BEEN PREPARED FOR THE GUIDANCE OF PLANT ENGINEERING, OPERATIONS AND MANAGEMENT AND FOR PERSONS WORKING WITH OR HANDLING THIS PRODUCT. OLIN BELIEVES THIS INFORMATION TO BE RELIABLE AND UP TO DATE AS OF THE DATE OF PUBLICATION, BUT MAKES NO WARRANTY THAT IT IS. ADDITIONALLY, IF THIS MATERIAL SAFETY DATA SHEET IS MORE THAN THREE YEARS OLD, YOU SHOULD CONTACT OLIN AT THE PHONE NUMBER LISTED BELOW TO MAKE CERTAIN THAT THIS SHEET IS CURRENT.

OLIN MSDS CONTROL GROUP
Olin Corporation
120 Long Ridge Road
Stamford, CT 06904

Phone Number: (203) 356-3449

POLLU-TECH, INC.
POLLUTION TECHNOLOGY
888 SECOND STREET PIKE
BRANDYWINE II, SUITE B-300
RICHBORO, PA 18954
FAX NO. 215-357-0366

215-357-1821

PRAESTOL™ 644-BC **TECHNICAL DATA**

PRAESTOL™ 644-BC is a very high charge cationic, high molecular weight co-polymerized polyacrylamide supplied as a DRY product.

TYPICAL PROPERTIES

Ionic Character.....Very High Cationic
Bulk Density (lbs/ft^3)..... 38
Viscosity (1% soln. in distilled water)... 5000 cps
pH (1% solution).....7.0
Recommended use concentration.....0.2%, Maximum
Active Content..... Polymer, only
Chemical Description..... DMAPA

APPLICATIONS

PRAESTOL™ 644-BC is recommended for use in wastewater treatment applications both as a settling agent and in sludge dewatering, particularly in belt press, thickening and centrifuge applications.

STORAGE STABILITY

Two (2) years, must be kept dry and stored at 65-75 ^{0}F
0.1% solution - about 1 day.

Store indoors at room temperatures. Do not stored for long periods over 85^{0}F or below freezing conditions.

PACKAGING AND HANDLING

PRAESTOL™ 644-BC is packaged in 50-pounds, net weight, moisture resistant bags. Shrink wrapped in 25-bag/pallet quantity shipments.

PRAESTOL™ 644-BC exhibits a very low degree of toxicity and no special precautions are necessary when handling. However, since solutions are slippery, any product spilled on the floor should be soaked up with sand or sawdust, or washed away with a strong stream of water. HANDLE AS AN IRRITANT. DO NOT GET INTO EYES. AVOID PROLONGED/REPEATED SKIN CONTACT. DO NOT INGEST.

WARRANTY

All information, recommendations, and suggestions given herein are believed to be reliable. However, as use conditions are not within our control, we cannot assume any responsibility for use of our products, nor is freedom from any patents implied.

POLLU-TECH, INC.

POLLUTION TECHNOLOGY
853 SECOND STREET PIKE
BROWNSTONE, II, SUITE B-200
RICHBORO, PA 18954
215-357-1821
FAX - 215-357-0368

MATERIAL SAFETY DATA SHEET **PRAESTOL 644BC**

Effective Date: 03/01/85 Date Printed 09/02/90

1. INGREDIENTS: CATIONIC ACRYLAMIDE COPOLYMER

SERIAL NO. 02213
Chemical Family — Organic Polymer

Molecular Formula — Propietary

Substances listed in the Ingredients Section are those identified as being present at a concentration of 1% or greater, or 0.1% if the substance is on the list of potential carcinogens cited in OSHA Hazard Communication Standard. Where proprietary ingredient shows, the identity of this substance may be made available as provided in 29 CFR 1910.1200(1).

2. PHYSICAL DATA:

Boiling Point:	Decomposes
VAP Press:	Negligible
VAP Density:	Not applicable
SOL. in Water:	Very Soluble
Bulk Dasity:	approx. 43/lbs. cubic ft.
Appearance:	White free flowing amporphous solid
Odor:	Slightly acrylic

3. FIRE AND EXPLOSION HAZARD DATA:

Flash Point: Over 400F
Method Used: DIN 51367

Flammable Limits
LFL: Not determined
UFL: Not determined

Extinguishing Media: Foam, CO2, dry chemical, water fog.

PRAESTOL IS A TRADEMARK OF STOCKHAUSEN, INC.
PRAESTOL 644BC is manufactured and packaged by Stockhausen, Inc.
PRAESTOL 644BC IS INVENTORIED AND MARKETED BY POLLU-TECH, INC.

3. FIRE AND EXPLOSION HAZARD DATA: (Continued)

Fire and Explosion Hazards: This product can burn if ignited. Addition of water to product produces extremely slippery surfaces or conditions if spilled.

4. REACTIVITY DATA:

STABILITY: (Conditions to Avoid) Solids soften at 428-446F, 220-230C. Decomposition evident at 518F, 270C.

INCOMPATIBILITY: (specific matairal to avoid) Oxidizing material.

HAZARDOUS DECOMPOSITION PRODUCTS: Nitrogen oxides when heated.

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

Action to Take for Spills/Leaks: Remove sources of ignition. If material spilled on floor, sweep up immediately. If material in contact with water on floor, slippery conditions will result, absorb with sawdust or commercial absorbent. When dry sweep up. Handle as an irritant.

Disposal Method: Incinerate or dispose of in accordance with local, state, and federal regulations.

6. HEALTH HAZARD DATA:

EYE: May cause slight transient (temporary) eye irritation.

SKIN CONTACT: Prolonged or repeated exposure may cause skin irritation. Persons dermatologically sensitive should wear face mask.

SKIN ABSORPTION: The dermal LD50 has not been determined. Skin absorption of acrylamide monomer, which is present in the product in trace amounts, can occur. When the product is handled properly, exposure to the monomer is at a level below those anticipated to be hazardous.

INGESTION: Single dose oral toxicity is low. No hazards anticipated from ingestion incidental to industrial exposure.

INHALATION: Single exposure to dust is not likely to be hazardous. Vapors are unlikely due to physical properties.

6. HEALTH HAZARD DATA: (continued)

SYSTEMIC & OTHER EFFECTS: Based on available data from similar polyacrylamide products, repeated exposures are not anticipated to cause any significant adverse effects. Similar polyacrylamide products did not produce cancer in long-term animal studies. Polyacrylamide products have trace amounts of acrylamide monomer. Acrylamide monomer may cause peripheral nervous system effects and, in studies with laboratory animals, has produced increased tumors at high levels of exposure. When the polyacrylamide product is handles properly, exposure to the monomer is at levels below those anticipated to be hazardous.

7. FIRST AID:

EYES: Irrigate immediately with water for at least 15 minutes.

SKIN: Wash off in flowing water or shower with soap.

INGESTION: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.

INHALATION: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.

8. HANDLING PRECAUTIONS:

VENTILATION: Provide general and/or local exhaust ventilation to control airborne levels below the exposure guidelines.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guideline. When respiratory protection is required for certain operations, use an approved air-purifying respirator.

SKIN PROTECTION: Wear clean, long-sleeved, body-covering clothing. Use impervious gloves. Remove contaminated clothing no later than the end of the work period and clean before reuse.

EYE PROTECTION: Use safety glasses.

9. ADDITIONAL INFORMATION:

Special Precautions To Be Taken In Handling and Storage:
Practice reasonable caution and personal cleanliness at all times to prevent slippery floors.
STORE IN DRY LOCATION BELOW 104.

PONDS 207A/B SCHEDULE

Schedule assumptions for the attached A/B Pond Processing:

1. A/B Pond sludge is cemented. Other options being considered include stabilizing the waste in a de-watering (to provide a DOT solid) step, but not cementing; if de-watering is required, additional Treatability Studies will be required.

2. Consolidation of B Ponds will not be completed until late summer of 1993.

3. EG&G can not support simultaneous processing of C Pond and A/B.

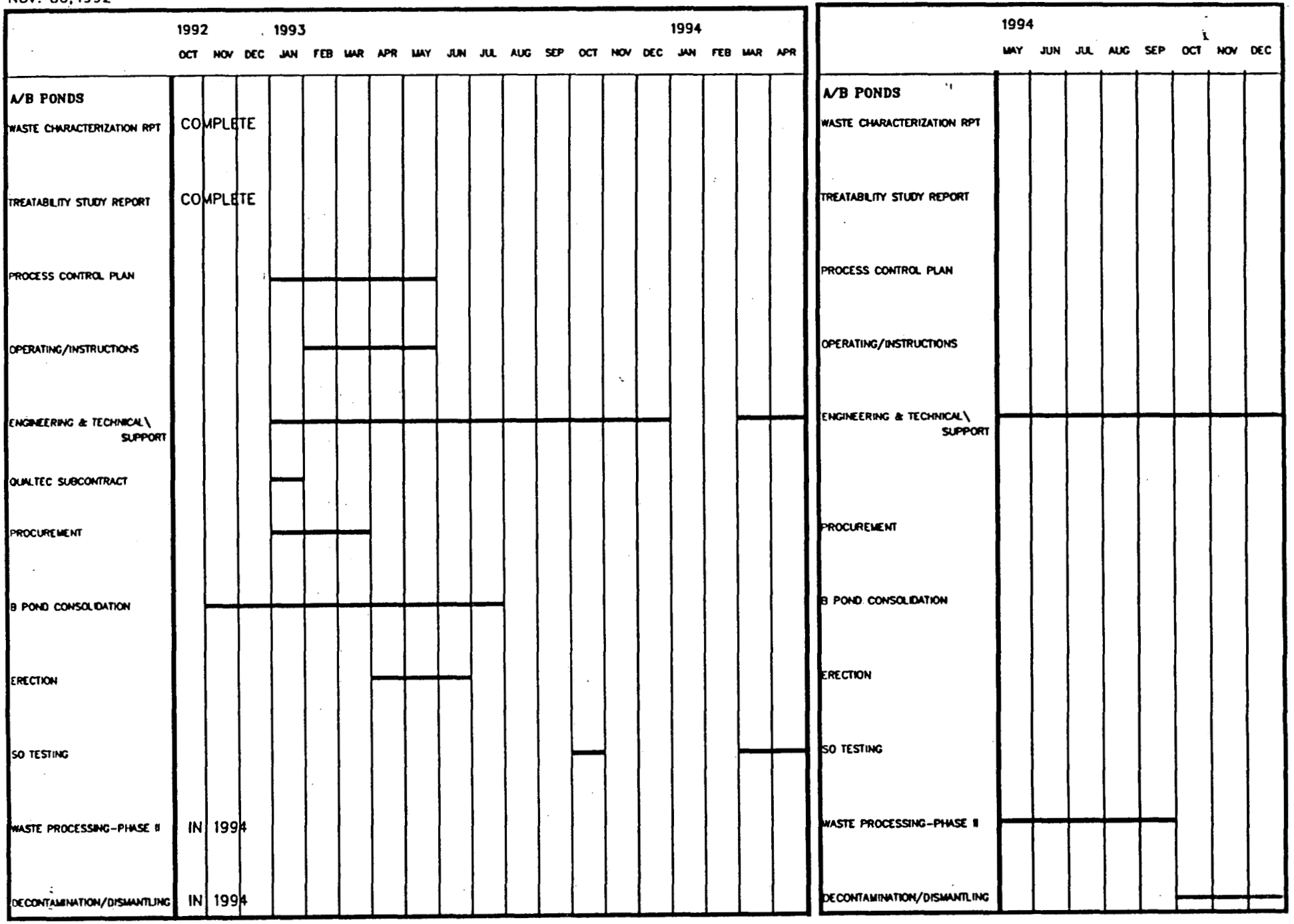
4. C Pond will not be ready to process until June '93 and will be completed 10/1/93.

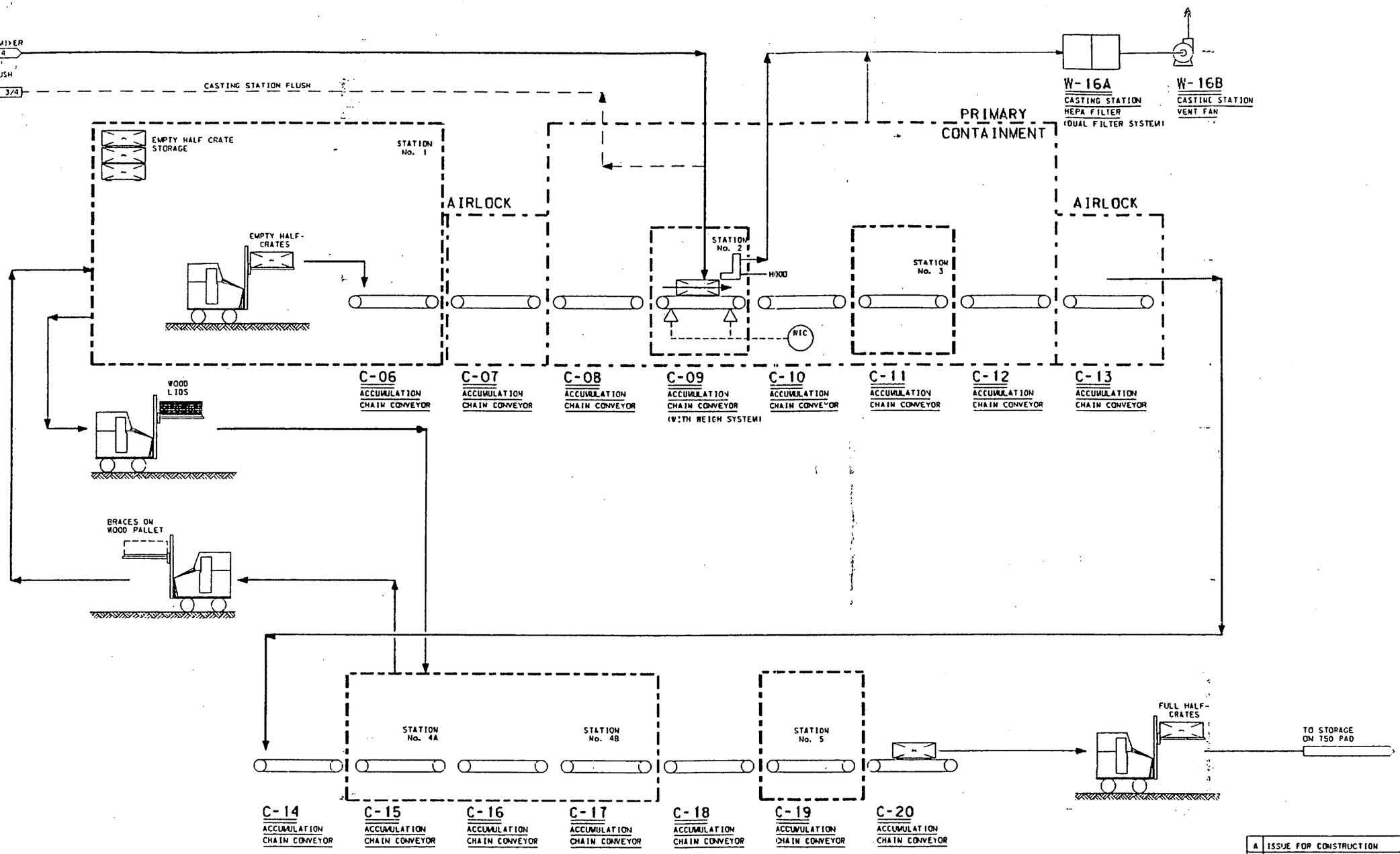
5. A/B Pond processing can not start on 10/1, due to cold weather (equipment limitations), and will take 5 months to complete.

6. Procurement activity shown is for the QUALTEC Mixer. QUALTEC has proposed 60 days from receipt of subcontract to equipment delivery.

NOV. 06, 1992

A/B PROCESS TRAIN – ACTIVITIES TO COMPLETE





PART	QUAN.	DESCRIPTION	MATERIAL

NOTES:

1. ALL EQUIPMENT ITEM NUMBERS ON THIS DRAWING HAVE "439" PREFIX.
2. STPH - SHORT TONS PER HOUR.
3. THIS DRAWING SHOWS MAJOR/CERTIFICATION INSTRUMENTS ONLY.
4. STATION DESIGNATIONS:
   - No. 1 EMPTY HALF CRATE STORAGE AND ASSEMBLY
   - No. 2 POURING AND INSPECTION
   - No. 3 BAG CLOSURE AND INSPECTION
   - No. 4 CRATE CLOSURE AND INSPECTION
     - *No. 4A INSTALL LID
     - *No. 4B INSTALL BANDING
   - No. 5 RADIOLOGICAL SURVEY

DESCRIPTION	STRM NO. / UNITS
TOTAL FLOW	STPH
SOLIDS FLOW	STPH
LIQUID FLOW	STPH
TOTAL FLOW	GPM
SOLIDS WT%	WT%
SOLIDS S. G.	-
SLURRY S. G.	-

NO.	ISSUE	BY	CHKD	APPD
A	ISSUE FOR CONSTR.	DRB	BR	HH
3	CLIENT APPROVAL	DRB	BR	HH
2	CLIENT APPROVAL	DRB	BR	HH
1	CLIENT APPROVAL	DRB	BR	HH
0	OFFICE CHECK	DRB	BR	HH

HALLIBURTON NUS Environmental Corporation

NO.	DESCRIPTION	DATE	PP	PP	PP	DOE	CLASS	JOB NO.
A	ISSUE FOR CONSTRUCTION	07/24/92						JR-1198
3	CLIENT APPROVAL	07/14/92						JR-1198
2	CLIENT APPROVAL	05-22-92						JR-1198
1	CLIENT APPROVAL	04/23/92						JR-1198
0	OFFICE CHECK	04/23/92						JR-1198

KEYWORDS
1. SOLAR PONDS
2. STABILIZATION
3. POND 207 A&B
4. FLOW DIAGRAM
5. CASTING STATION
BLDG/FACILITY
ROOM/AREA
OHD DOCUMENT NO.

TOLERANCES UNLESS NOTED OTHERWISE: DEC. ±, ANGLE ±, REMOVE BURRS AND SHARP EDGES, MFGT REQUIREMENT

	BY	DATE
DESIGNED	DRB	03/13/92
DRAWN	RL	04/14/92
CHECKED	BR	04/24/92
APPROVED	HH	04/24/92
SUBMITTED		
APPROVED PP		
APPROVED DOE		

SCALE: NONE

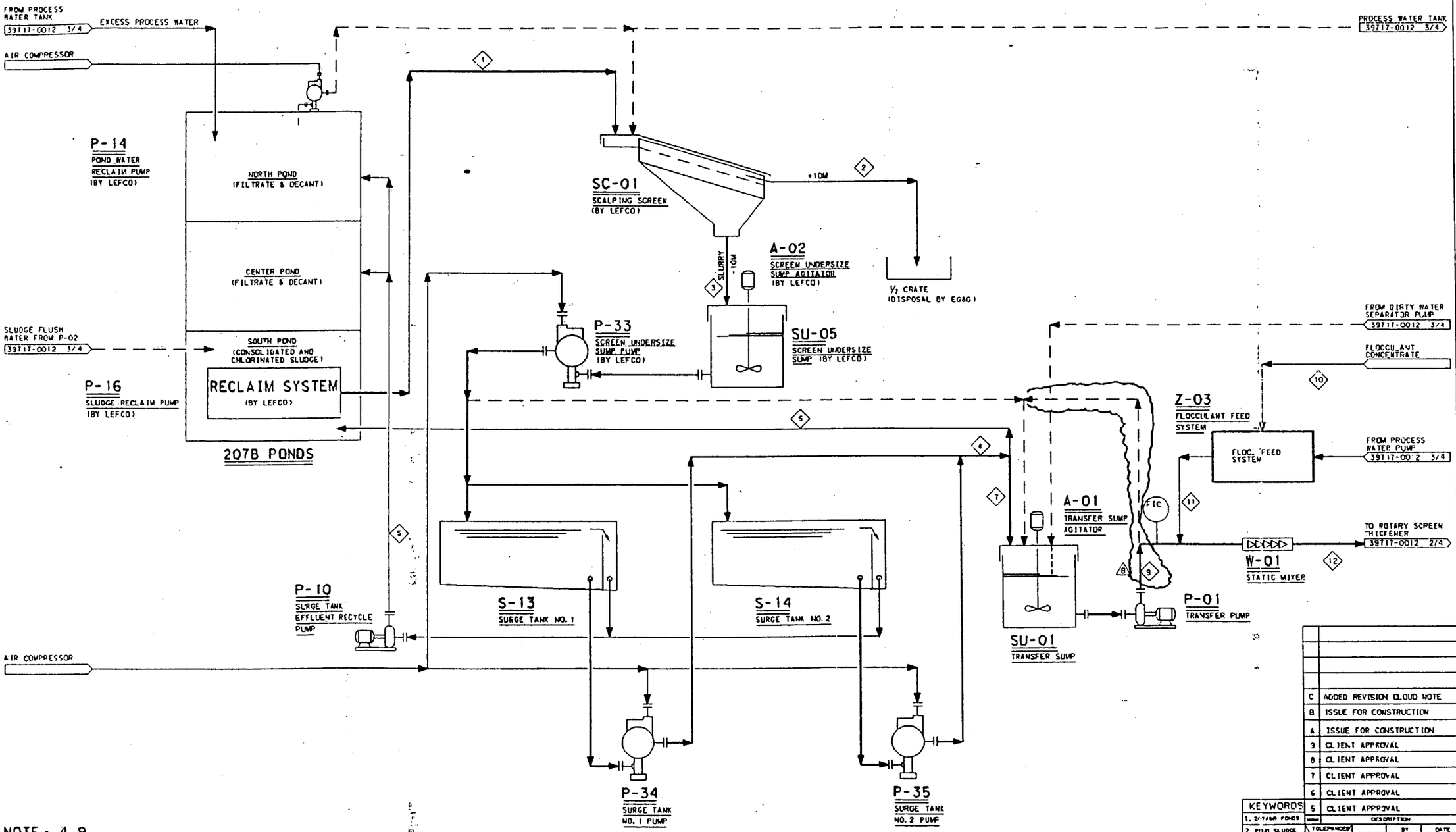
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Plant
GOLDEN, COLORADO

SOLAR POND/PONDCRETE STABILIZATION PROJECT
POND SLUDGE PROCESS FLOW DIAGRAM
POND 207 A&B CASTING STATION

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	39717-0012	A	4 OF 4

COMPUTER GENERATED



NOTE : 4,9

DESCRIPTION	STRM NO. / UNITS	1	2	3	4	5	6	7	9	10	11	12
TOTAL FLOW	STPH	20.61	0.008	20.60	10.25	10.36	1.55	8.81	8.79	0.0015	0.76	9.55
SOLIDS FLOW	STPH	0.62	0.003	0.62	0.62	0.00	0.10	0.52	0.54	0.0015	0.00	0.54
LIQUID FLOW	STPH	19.99	0.005	19.98	9.63	10.36	1.55	8.09	8.25	0.00	0.76	9.01
TOTAL FLOW	GPM	80.0	0.03	80.0	39.2	40.8	6.3	32.9	33.6	-	3.0	36.6
SOLIDS WT%	WT%	3.00	38.27	2.99	6.00	0.00	6.00	6.00	6.19	100.00	0.00	5.69
SOLIDS S. G.	-	2.10	2.10	2.10	2.10	-	2.10	2.10	2.10	-	-	2.10
[illegible]		[illegible]	[illegible]	[illegible]	1.05	1.01	1.05	1.05	1.05	-	1.01	1.04

NO.	ISSUE	BY	CHKD	APPD
C	ISSUE FOR CONSTRUCTION	DRB	WCH	HH
B	ISSUE FOR CONSTRUCTION	DRB	WCH	HH
A	ISSUE FOR CONSTR.	DRB	WCH	HH
9	CLIENT APPROVAL	DRB	WCH	HH
8	CLIENT APPROVAL	DRB	WCH	HH
7	CLIENT APPROVAL	DRB	WCH	HH
6	CLIENT APPROVAL	DRB	WCH	HH
5	CLIENT APPROVAL	DRB	WCH	HH

HALLIBURTON NUS Environmental Corporation

PART	QUAN.	DESCRIPTION	MATERIAL

NOTES:

1. ALL EQUIPMENT ITEM NUMBERS ON THIS DRAWING HAVE "830" PREFIX.
2. PIPING WITHIN SECONDARY CONTAINMENT WILL BE SINGLE WALL, OTHERWISE DOUBLE-WALL.
3. — — DENOTES INTERMITTENT OR OPTIONAL FLOWS.
4. STPH - SHORT TONS PER HOUR.
5. THIS DWG SHOWS MAJOR/CERTIFICATION CONTROL CONCEPTS ONLY.
6. ALL FLOWS ARE FOR TREATING THE CONSOLIDATED CONTENTS FROM PONDS 207A & 207B.
7. SECONDARY CONTAINMENT DETAILS WILL BE SHOWN ON P&ID'S.
8. DILUTION WATER TO POND 207C NOT SHOWN.
9. MATERIAL BALANCES ARE BASED ON 3% SOLIDS FEED FROM POND 207B-S AND 20% SOLIDS FEED TO CEMENTATION. (REF. MATERIAL BALANCES FOR PONDS 207A/B PROCESSING ISSUE: 6, REV. B).
10. INTERMITTENT FLOW. MAT'L BALANCE REFLECTS CONT. AVG. FLOW.

(cloud) INDICATES WHAT HAS CHANGED SINCE LAST ISSUE OF THE DRAWING.

NO.	DESCRIPTION	DATE	BY	CHKD	APPD	JOB NO.
C	ADDED REVISION CLOUD NOTE	08/23/92				JR-1198
B	ISSUE FOR CONSTRUCTION	07/24/92				JR-1198
A	ISSUE FOR CONSTRUCTION	07/24/92				JR-1198
9	CLIENT APPROVAL	07/14/92				JR-1198
8	CLIENT APPROVAL	05/22/92				JR-1198
7	CLIENT APPROVAL	04/27/92				JR-1198
6	CLIENT APPROVAL	04/15/92				JR-1198
5	CLIENT APPROVAL	03/30/92				JR-1198

KEYWORDS
1. 207A&B PONDS
2. POND SLUDGE
3. STABILIZATION
4. RECLAIM
5. FLOW DIAGRAM
BLDG/FACILITY
ROOM/AREA
DWG CONTROL NO.

TOLERANCES UNLESS NOTED OTHERWISE: DECIMAL ± ; ANGLE ± ; REMOVE BURRS AND SHARP EDGES; MOST ASSEMBLY

SCALE: NONE

	BY	DATE
DESIGNED	DPB	03/13/92
DRAWN	RL	03/30/92
CHECKED	WCH	04/24/92
APPROVED	DPB	07/24/92

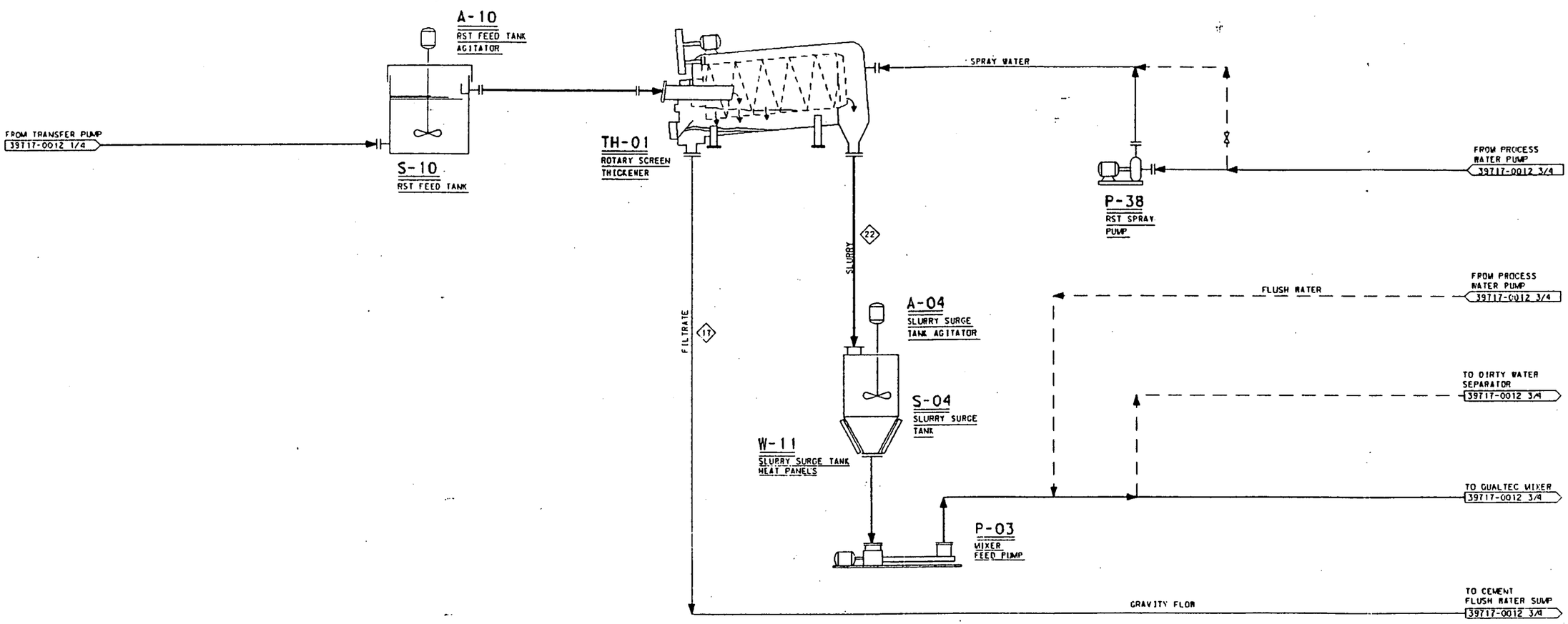
QUALITY LEVEL
APPROVED DPP
APPROVED DOE

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Plant
GOLDEN, COLORADO

SOLAR POND/CONCRETE STABILIZATION PROJ.
POND SLUDGE-PROCESS FLOW DIAGRAM
PONDS 207 A&B SLUDGE RECLAIM SYSTEM

SIZE	DRAWING NUMBER	ISSUE	SHEET
C	39717-0012	C	1 of 4



PART	QUAN.	DESCRIPTION	MATERIAL

NOTES:

1. ALL EQUIPMENT ITEM NUMBERS ON THIS DRAWING HAVE "930" PREFIX.
2. PIPING WITHIN SECONDARY CONTAINMENT WILL BE SINGLE WALL. OTHERWISE DOUBLE-WALL.
3. — — — DENOTES INTERMITTENT OR OPTIONAL FLOWS.
4. STPH - SHORT TONS PER HOUR.
5. THIS DRW SHOWS MAJOR/CERTIFICATION INSTRUMENTS ONLY.
6. ALL FLOWS ARE FOR TREATING THE CONSOLIDATED CONTENTS OF 207A & 207B PONDS.
7. SECONDARY CONTAINMENT DETAILS WILL BE SHOWN ON P&ID'S.
8. DILUTION WATER TO POND 207C NOT SHOWN.
9. MATERIAL BALANCES ARE BASED ON 3% SOLIDS FEED FROM POND 207B-S AND 20% SOLIDS FEED TO CEMENTATION. (REF. MATERIAL BALANCES FOR PONDS 207A/B PROCESSING ISSUE: 6, REV. 6).
10. INTERMITTENT FLOW. MAT'L BALANCE REFLECTS CONT. AVG. FLOW.

NOTE : 4,9

DESCRIPTION	STRM NO. / UNITS	⟨1⟩	⟨2⟩
TOTAL FLOW	STPH	10.92	2.58
SOLIDS FLOW	STPH	0.03	0.52
LIQUID FLOW	STPH	10.49	2.06
TOTAL FLOW	GPM	41.4	9.1
SOLIDS WT%	WT%	0.26	20.0
SOLIDS S. G.	-	2.10	2.10
SLURRY S. G.	-	1.01	1.13

NO.	ISSUE	BY	CHK'D	APP'D
A	ISSUE FOR CONSTR.	DRB	RCH	HH
9	CLIENT APPROVAL	DRB	RCH	HH
8	CLIENT APPROVAL	DRB	RCH	HH
7	CLIENT APPROVAL	DRB	RCH	HH
6	CLIENT APPROVAL	DRB	RCH	HH
5	CLIENT APPROVAL	DRB	RCH	HH

HALLIBURTON NUS Environmental Corporation

A	ISSUE FOR CONSTRUCTION	07/24/92					JR-1198
9	CLIENT APPROVAL	07/14/92					JR-1198
8	CLIENT APPROVAL	05/18/92					JR-1198
7	CLIENT APPROVAL	04/27/92					JR-1198
6	CLIENT APPROVAL	04/15/92					JR-1198
5	CLIENT APPROVAL	03/30/92					JR-1198
NO.	DESCRIPTION	DATE	RFP			DOE CLASS	JOB NO.

KEYWORDS
1. POND SLUDGE
2. 207A&B PONDS
3. STABILIZATION
4. DEWATERING
5. FLOW DIAGRAM
BLDG/FACILITY
ROOM/AREA
DWG SOURCE/DR. NO.

	BY	DATE
DESIGNED	DRB	03-13-92
DRAWN	RL	03-30-92
CHECKED	RCH	04-24-93
APPROVED	HH	04-24-92

TOLERANCES UNLESS NOTED OTHERWISE: DECIMAL ± ; ANGLE ± ; REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY
SUBMITTED
SCALE: NONE
APPROVED RFP
APPROVED DOE

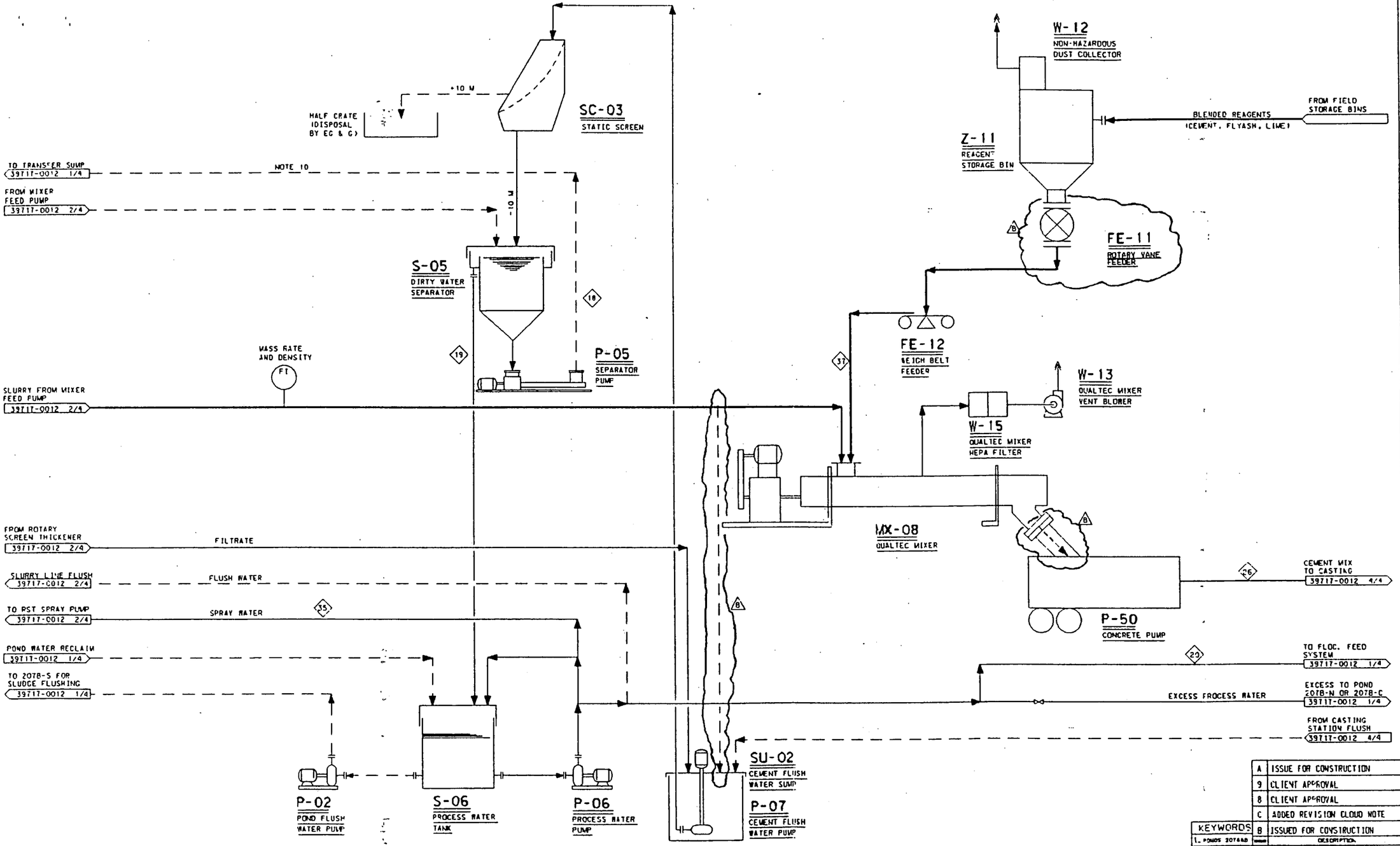
U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Plant
GOLDEN, COLORADO

SOLAR POND/PONDCRETE STABILIZATION PROJ.
POND SLUDGE - PROCESS FLOW DIAGRAM
PONDS 207 A&B CONDITIONING AND DEWATERING

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	39717-0012	A	2 OF 4

COMPUTER GENERATED
CADD: PEDBDR.0



NOTE: 4,9

DESCRIPTION	STRM NO.	18	19	20	26	35	37												
	UNITS																		
TOTAL FLOW	STPH	0.18	10.34	0.76	7.50	3.56	4.92												
SOLIDS FLOW	STPH	0.03	-	0.00	5.43	0.00	4.92												
LIQUID FLOW	STPH	0.15	10.34	0.76	2.07	3.56	0.00												
TOTAL FLOW	GPM	0.7	40.8	3.0	16.0	14.0	-												
SOLIDS WT%	WT%	15.01	0.00	0.00	72.46	0.00	100.00												
SOLIDS S. G.	-	2.10	-	-	2.75	-	2.85												
FLUIDS S. G.	-	1.10	1.01	1.01	1.97	1.01	-												

NO.	ISSUE	BY	CHKD	APPD
C	ISSUE FOR CONSTRUCTION	DRB	WCH	HH
B	ISSUE FOR CONSTRUCTION	DRB	WCH	HH
A	ISSUE FOR CONSTR.	DRB	WCH	HH
9	CLIENT APPROVAL	DRB	WCH	HH
8	CLIENT APPROVAL	DRB	WCH	HH
7	CLIENT APPROVAL	DRB	WCH	HH
6	CLIENT APPROVAL	DRB	WCH	HH
5	CLIENT APPROVAL	DRB	WCH	HH

HALLIBURTON NUS Environmental Corporation

PART	QUAL	DESCRIPTION	MATERIAL

NOTES:

1. ALL EQUIPMENT ITEM NUMBERS ON THIS DRAWING HAVE "430" PREFIX.
2. PIPING WITHIN SECONDARY CONTAINMENT WILL BE SINGLE WALL, OTHERWISE DOUBLE-WALL.
3. — — DENOTES INTERMITTENT OR OPTIONAL FLOWS.
4. STPH - SHORT TONS PER HOUR.
5. THIS DWG SHOWS MAJOR/CERTIFICATION INSTRUMENTS ONLY.
6. ALL FLOWS ARE FOR TREATING THE CONSOLIDATED CONTENTS OF 207A & 207B PONDS.
7. SECONDARY CONTAINMENT DETAILS WILL BE SHOWN ON P&ID'S.
8. DILUTION WATER TO POND 207C NOT SHOWN.
9. MATERIAL BALANCES ARE BASED ON 3% SOLIDS FEED FROM POND 207B-S AND 20% SOLIDS FEED TO CEMENTATION. (REF. MATERIAL BALANCES FOR PONDS 207A/B PROCESSING ISSUE: 6, REV. 6).
10. INTERMITTENT FLOW. MAT'L BALANCE REFLECTS CONT. AVG. FLOW.

INDICATES WHAT HAS CHANGED SINCE LAST ISSUE OF THE DRAWING.

NO.	DESCRIPTION	DATE						JOB NO.
A	ISSUE FOR CONSTRUCTION	07/24/92						JR-1198
9	CLIENT APPROVAL	07/14/92						JR-1198
8	CLIENT APPROVAL	05/18/92						JR-1198
C	ADDED REVISION CLOUD NOTE	10/23/92						JR-1198
B	ISSUED FOR CONSTRUCTION	09/24/92						JR-1198

KEYWORDS
1. PONDS 207A&B
2. POND SLUDGE
3. PUG MILL
4. CASTING
5. FLOW DIAGRAM
BLDG/FACILITY
ROOM/AREA
ORIG. ECONO/CIRC. NO.

TOLERANCES UNLESS NOTED OTHERWISE: FRACT. ±, ANGLE ±, DEC. ±
REMOVE BURRS AND SHARP EDGES
NEXT ASSEMBLY
SCALE: NONE

	BY	DATE
DESIGNED	DPB	03/13/92
DRAWN	RL	03/23/92
CHECKED	WCH	04/24/92
APPROVED	HH	04/24/92

SUBMITTED
APPROVED PPP
APPROVED DOE

U.S. DEPARTMENT OF ENERGY
ROCKY FLATS OFFICE GOLDEN, COLORADO

Rocky Flats Plant
GOLDEN, COLORADO

SOLAR POND/PONDCRETE STABILIZATION PROJ.
POND SLUDGE PROCESS FLOW DIAGRAM
PONDS 207-A/B PUG MILL AND CASTING

SIZE	DRAWING NUMBER	ISSUE	SHEET
D	39717-0012	C	3 of 4