

**ARCS I WORK ASSIGNMENT NUMBER 030-1143
EPA CONTRACT NO. 68-W9-0034
FOSTER WHEELER ENVIRONMENTAL CORPORATION**

DRAFT

**FIELD OPERATIONS PLAN
PILOT-SCALE TREATABILITY STUDIES
NEW BEDFORD HARBOR HOT SPOT SEDIMENTS
New Bedford, Massachusetts**

VOLUME II OF V - IONICS RCC DETAILED DEMONSTRATION PLAN

MARCH 1996

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VOLUME II OF V - IONICS RCC DETAILED DEMONSTRATION PLAN

PILOT-SCALE TREATABILITY STUDIES:

- **Ionics RCC B.E.S.T. Extraction Process & CRTI Solvated Electron PCBs Destruct Process**
- **Geosafe In-Situ Vitrification Process**
- **Thermal Desorption & PCBs Destruct Process - TBD**

MARCH 1996

DRAFT

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VOLUME II
VENDOR SIGN-OFFS

Ionics RCC (& CRTI)

TABLE OF CONTENTS

VOLUME I - OVERALL PILOT-SCALE TEST PROGRAM

1.0	INTRODUCTION	I-1
1.1	Site Background	I-1
1.2	Site Location and Description	I-2
1.3	Site Investigations	I-3
2.0	SITE MANAGEMENT PLAN	I-8
2.1	Project Organization and Scope of Work	I-8
2.1.1	B.E.S.T. Extraction Process and Solvated Electron PCBs Destruct Process Pilot Study	I-8
2.1.2	The Geosafe ISV Process Pilot Study	I-12
2.1.3	TBD	I-12
2.2	Site Access and Control	I-12
2.3	Overall Project Schedule	I-14
2.3.1	Site Mobilization	I-14
2.3.2	Vendor Mobilization, Pilot Treatability Tests, and Demobilization	I-14
2.3.3	Site Demobilization and Waste Disposal	I-14
3.0	SUMMARY OF PILOT-SCALE TEST PLANS	I-15
3.1	Test Objectives	I-15
3.2	Ionics RCC	I-15
3.2.1	Background	I-15
3.2.2	Proposed Pilot-Scale Tests and Schedule	I-16
3.2.3	Bench-Scale Solidification/Stabilization Tests on Ionics RCC Treatment Residuals	I-16
3.3	Geosafe	I-16
3.4	TBD	I-16
4.0	SITE MOBILIZATION AND DEMOBILIZATION	I-18
4.1	Site Preparation and Utilities	I-18
4.2	Feed Excavation and Pretreatment	I-18
4.3	On-Site Laboratory	I-20
4.3.1	Mobilization of On-Site Laboratory	I-20
4.3.2	On-Site Laboratory Procedures	I-20
4.3.3	On-Site Laboratory Quality Control	I-22
4.4	Determination of Feed Sediment Characteristics	I-22
4.4.1	Feed Sediment Sampling	I-23
4.4.2	Feed Sediment Sample Identification	I-25
4.4.4	On-Site Area	I-26
4.5	Site Demobilization and Decontamination	I-26
4.5.1	On-Site Laboratory	I-26
4.5.2	Field Monitoring Equipment	I-26
4.5.3	Waste Disposal	I-26
4.5.4	Treatment Plants	I-26
4.5.5	Cleanup of Treatability Study Area	I-26
4.5.6	Utilities	I-26

TABLE OF CONTENTS

5.0	QUALITY ASSURANCE PROJECT PLAN	I-27
5.1	Introduction	I-27
5.2	Project Descriptions	I-27
5.3	Quality Control Organization and Responsibilities	I-27
5.4	Data Quality and Quality Assurance Objectives	I-27
5.4.1	Data Quality Objectives	I-27
5.4.2	Quality Assurance Objectives	I-28
5.5	Sampling Quality Control Procedures	I-29
5.5.1	Field Quality Control Samples	I-29
5.5.2	Sample Collection Documentation	I-30
5.5.3	Sampling Equipment Decontamination	I-31
5.6	Sample Custody, Transport and Handling	I-31
5.6.1	Sample Custody	I-31
5.6.2	Sample Handling, Presentation, Container Requirements and Holding Time	I-32
5.6.3	Sample Packaging and Shipping	I-32
5.6.3.1	Low Level PCBs Sample Packaging Procedures	I-32
5.6.3.2	High Level PCBs Sample Packaging Procedure	I-35
5.6.3.2.1	Sample Packaging Requirements for Sediments	I-35
5.6.3.2.2	Sample Packaging Requirements for Shipments of PCBs Oil	I-37
5.7	Calibration Procedures and Frequency	I-38
5.7.1	Field Operations	I-38
5.7.2	Laboratory Operations	I-39
5.8	Laboratory Procedures	I-39
5.8.1	Analytical Methods	I-39
5.8.2	Documentation of Laboratory Work	I-42
5.9	Data Reduction, Validation, Evaluation and Reporting	I-43
5.9.1	Data Reduction and Validation	I-43
5.9.2	Data Evaluation	I-44
5.10	Internal QA/QC Checks	I-45
5.10.1	QA Audits of Internal QC Checks	I-45
5.10.2	Acceptance Criteria	I-45
5.10.3	Analytical Laboratory	I-46
5.10.4	Field Activities	I-46
5.11	Performance and System Audits	I-46
5.11.1	Performance Audits	I-46
5.11.2	System Audits	I-46
5.12	Preventive Maintenance	I-47
5.12.1	Sampling and Analytical Equipment	I-47
5.12.2	Support Equipment	I-47
5.13	Specific Routine Procedures to Assess Data Precision, Accuracy and Completeness	I-47
5.14	Corrective Action	I-49
5.14.1	Audit and Nonconformance Reports	I-50
5.14.2	Corrective Action	I-50
5.14.3	Stop-Work Order	I-50

TABLE OF CONTENTS

5.14.4	Stop-Work Corrective Action	I-50
5.14.5	Cause and Action to Prevent Recurrence	I-50
5.15	Field Changes Procedures	I-50
5.15.1	Quality Assurance Reports	I-51
6.0	REGULATORY COMPLIANCE	I-52
7.0	IONICS RCC DETAILED DEMONSTRATION PLAN (VOL. II)	II-1
7.1	Introduction	II-1
7.1.1	Project Overview	II-1
7.1.2	Test Plan and Objectives	II-1
7.1.4	Schedule	II-2
7.2	Process and Equipment Description	II-6
7.2.1	Process Introduction	II-6
7.2.2	B.E.S.T. Pilot Plant	II-10
7.2.2.1	Description of the B.E.S.T. Pilot Plant	II-10
7.2.2.2	B.E.S.T. Pilot Plant Test Operations	II-12
7.2.3	CRTI Solvated Electron PCBs Destruct Process Pilot Unit	II-20
7.2.3.1	Description of the Solvated Electron PCBs Destruct Process Pilot Plant	II-20
7.2.3.2	Solvated Electron Process Standard Operating Procedures	II-21
7.3	Sampling and Analysis Plan	II-25
7.3.1	Sampling Design	II-25
7.3.1.1	Study Objectives	II-25
7.3.1.2	Define the Boundaries of the Study	II-26
7.3.1.3	Data Inputs	II-26
7.3.1.4	Limits of Acceptability on Field Data Uncertainty	II-26
7.3.1.5	Optimal Design	II-27
7.3.2	Data Collection and Field Sampling Activities	II-27
7.3.2.1	Field Measurements and Data Collection	II-27
7.3.2.2	Field Sample Collection for Chemical Analyses	II-30
7.3.2.3	RCC Sample Identification	II-31
7.4	Ionics RCC Mobilization and Demobilization	II-39
7.4.1	B.E.S.T. Pilot Plant Mobilization	II-39
7.4.2	CRTI Pilot Plant Mobilization	II-40
7.4.3	B.E.S.T. Pilot Plant Demobilization	II-40
7.4.4	CRTI Pilot Plant Demobilization	II-42
7.5	Waste Handling and Disposal	II-43
7.5.1	Waste Streams/Waste Minimization	II-43
7.5.2	Waste Handling Summary	II-44
7.5.3	Leaks or Accidental Discharge of Process Streams Containing PCBs	II-45
7.6	Ionics RCC/CRTI Operations Safety Review	II-46
7.7	Report Preparation	II-47
7.8	References	II-48
8.0	GEOSAFE DETAILED DEMONSTRATION PLAN (VOL. III)	III-1
9.0	TBD DETAILED DEMONSTRATION PLAN (VOL. IV)	IV-1

TABLE OF CONTENTS

FIGURES

Figure 1-1	Site Location Map	I-5
Figure 1-2	Fishing Closure Areas	I-6
Figure 1-3	New Bedford Harbor Study Areas	I-7
Figure 2-1A	Project Organization for Ionics RCC Pilot Program	I-9
Figure 2-1B	Project Organization for Geosafe	I-10
Figure 2-1C	Project Organization for TBD	I-11
Figure 2-2	Existing Site Conditions	I-13
Figure 4-1	Feed Sediment Pretreatment Sampling Point Locations	I-19
Figure 7-1	B.E.S.T. Extraction Process and CRTI PCBs Destruct Process Schematic with Sampling Point Locations	II-7
Figure 7-2	Solvated Electron PCBs Destruct Process	II-22

TABLES

Table 3-1	Pilot-Scale Tests and Schedule	I-17
Table 4-1	Utility Requirements for Pilot-Scale Treatment Systems	I-18
Table 4-2	Hot Spot Sediment Requirements	I-20
Table 4-3	Expected Sample Concentrations and Dilution Factors	I-21
Table 4-4	Feed Characteristics Sampling and Analysis	I-24
Table 5-1	Sample Container, Preservation, and Holding Time Summary	I-33
Table 7-1	Ionics RCC/CRTI Pilot Tests	II-3
Table 7-2	Pilot-Scale Tests and Schedule	II-4
Table 7-3	Primary Control Parameter Summary	II-8
Table 7-4	Total Lab and Field Sampling Frequency and Number	II-28
Table 7-5	Chemical Sampling Collection Methods, Frequency, Analyses, and Field QC Samples	II-32
Table 7-6A	Sample Locations, Number of Samples, and Laboratory Analyses (single batch)	II-37
Table 7-6B	Sample Locations, Number of Samples, and Laboratory Analyses (total study) .	II-38

ATTACHMENTS

Attachment IA	Field Technical Guidelines	I-53
Attachment IB	Standard Reporting/Tracking Forms	I-54
Attachment IC	Analyte Lists and Reporting Limits	I-56
	B.E.S.T. Pilot Plant Photo	II-9
Attachment IIA	Ionics RCC and CRTI Pilot Plant Process Data Logsheets (LS) & Sampling and Process Data Activity Sheets	II-50
Attachment IIB	Ionics RCC and CRTI Pre-Pilot Bench-Scale Test Programs	II-58
Attachment IIC	B.E.S.T. Pilot Plant Engineering Drawings	II-59

7.0 IONICS RCC DETAILED DEMONSTRATION PLAN (VOL. II)

7.1 Introduction

7.1.1 Project Overview

This five (5) volume Field Operations Plan (FOP) has been prepared as part of Work Assignment No. 030-1L43 under ARCS I Contract No. 68-W9-0034 between Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) and the U.S. Environmental Protection Agency (EPA). The five volumes are:

- FOP Volume I - Overall Pilot-Scale Test Program;
- FOP Volume II - Ionics RCC Detailed Demonstration Plan;
- FOP Volume III - Geosafe Detailed Demonstration Plan;
- FOP Volume IV - TDB Detailed Demonstration Plan; and
- FOP Volume V - Appendix A: Site Specific Health and Safety Plan.

This Volume II contains the information required to perform the pilot tests, the associated sampling, analysis, process data logging, mobilization, and demobilization of the Ionics RCC pilot units (B.E.S.T. Extraction Process and CRTI Solvated Electron PCBs Destruct Process).

THIS VOLUME II IS A SEQUEL TO VOLUME I AND, THEREFORE, VOLUME I MUST BE READ BY ALL FIELD PERSONNEL PRIOR TO CONDUCTING ANY ACTIVITIES SPECIFIED IN VOLUME II.

7.1.2 Test Plan and Objectives

Ionics RCC Study Objectives

- Evaluate and quantify the effectiveness of the B.E.S.T. process to extract contaminants (PCBs, SVOCs, and heavy metals) from the Hot Spot sediment samples and the Solvated Electron PCBs Destruct process to destroy the PCBs in the extracted organic fraction.
- Quantify the disposition of key constituents to support mass balance calculations.
- Identify potential environmental and/or engineering constraints related to the use of the B.E.S.T. process to extract contaminants from the Hot Spot sediment samples and the Solvated Electron PCBs Destruct process to destroy the PCBs in the extracted organic fraction.
- Produce data of sufficient quality such that different treatment processes can be evaluated relative to each other, and a risk assessment of treatment residuals, if required, can be conducted for the B.E.S.T. process and the Solvated Electron PCBs Destruct process.
- Evaluate the viability of the B.E.S.T. and the Solvated Electron PCBs Destruct process to be scaled-up to full-scale operations including the overall development time-frame and estimated full-scale treatment costs. In this regard, collect data and observations necessary to evaluate the projected effectiveness and feasibility of the B.E.S.T. process and the Solvated Electron PCBs Destruct process at full-scale operation. Evaluate parameters such as material handling, pretreatment requirements, material feed rates, and batch processing rates. Project full-scale economics for treatment of large volumes of sediment including costs for treatment and disposal of waste streams, site preparation, and mobilization of equipment will also be evaluated.
- Characterize the operational hazards associated with full-scale implementation of B.E.S.T. process and the Solvated Electron PCBs Destruct process.

- Evaluate the performance of the B.E.S.T process and the Solvated Electron PCBs Destruct process against the nine detailed evaluation criteria contained in the National Contingency Plan (NCP), including the ability of the B.E.S.T. process and the Solvated Electron PCBs Destruct process to reduce toxicity, mobility, and volume of the hazardous constituents.

Proposed Pilot-Scale Tests

Pilot-scale tests are shown in Table 7-1. These pilot tests will be conducted in accordance with the DDP and the Quality Assurance Project Plan (QAPP) in Section 5.0 of Volume I of the FOP to determine the ability of the pilot system to meet the study objectives.

7.1.4 Schedule

Table 7-2 presents the overall Ionics RCC pilot test programs schedule.

Table 7-1

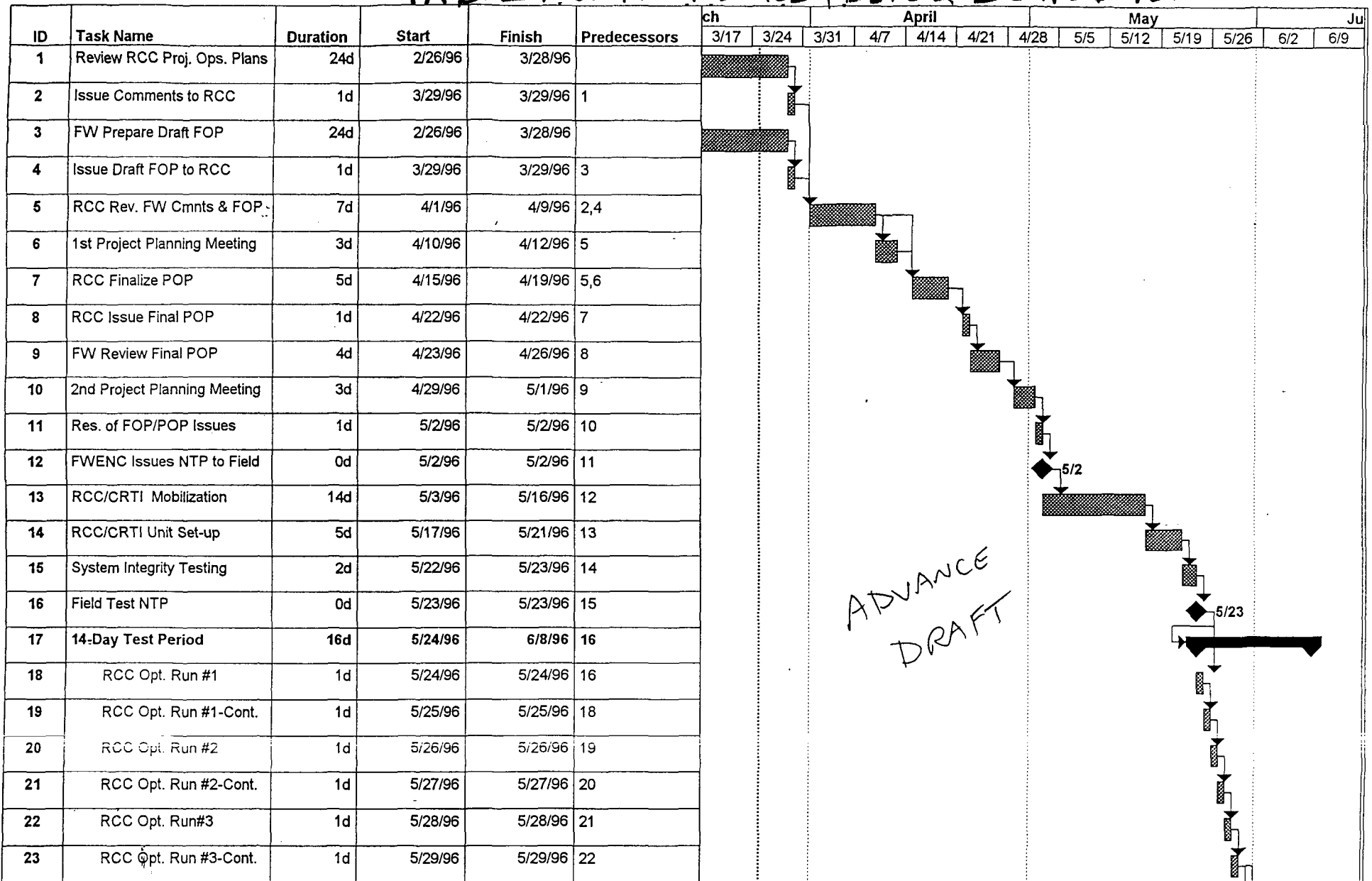
Ionics RCC/CRTI Pilot Tests

DATE	TEST DAY	IONICS BATCH NO.	CRTI BATCH NO.
5/24/96	1	E-1	
5/25/96	2	E-1	
5/26/96	3	E-2	
5/27/96	4	E-2	
5/28/96	5	E-3	
5/29/96	6	E-3	
5/30/96	7	P-1	
5/31/96	8		
6/1/96	9	E-4	C-1,C-2
6/2/96	10	E-4	
6/3/96	11	E-5	C-3,C-4
6/4/96	12	E-5	
6/5/96	13	P-2	
6/6/96	14		
6/7/96	15		C-5,C-6
6/8/96	16		

Batch Identification:

E B.E.S.T. Process extraction, sediment drying and solvent recovery
 P oil polishing and water stripping
 C CRTI PCBs Destruct

TABLE 7-2 PILOT-SCALE TESTS & SCHEDULE



Project:
Date: 3/25/96

Task

Progress

Milestone

Summary

Rolled Up Task

Rolled Up Milestone

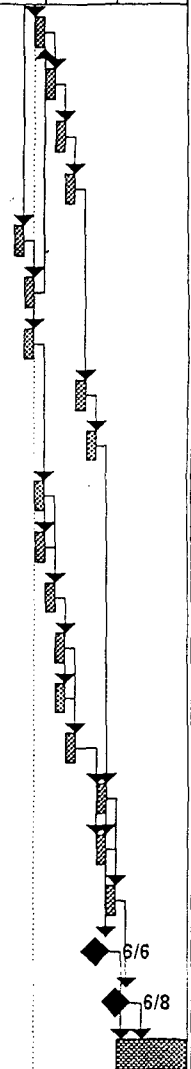
Rolled Up Progress

TABLE 7-2 CONT

ID	Task Name	Duration	Start	Finish	Predecessors	ch		April				May				Ju	
						3/17	3/24	3/31	4/7	4/14	4/21	4/28	5/5	5/12	5/19	5/26	6/2
24	RCC Ver. Run # 1	1d	6/1/96	6/1/96	23,29												
25	RCC Ver. Run #1-Cont.	1d	6/2/96	6/2/96	24												
26	RCC Ver. Run #2	1d	6/3/96	6/3/96	25												
27	RCC Ver. Run #2-Cont.	1d	6/4/96	6/4/96	26												
28	TEA Evp./Opt. Rons 1-3	1d	5/30/96	5/30/96	23												
29	Unit Decon/Set-up	1d	5/31/96	5/31/96	28												
30	Initial Oil Char./CRTI Opt.Runs	1d	5/31/96	5/31/96	28												
31	TEA Evp./Ver. Runs 1-2	1d	6/5/96	6/5/96	27												
32	Int. Oil Char./Ver. Runs 1-2	1d	6/6/96	6/6/96	31												
33	CRTI Oppt. Run #1	1d	6/1/96	6/1/96	30												
34	CRTI Opt. Run #2	1d	6/1/96	6/1/96	30												
35	Post Opt. Runs 1-2 Oil Char.	1d	6/2/96	6/2/96	33,34												
36	CRTI Opt. Run #3	1d	6/3/96	6/3/96	35												
37	CRTI Opt. Run #4	1d	6/3/96	6/3/96	35												
38	Post Opt. Runs 3-4 Oil Char.	1d	6/4/96	6/4/96	36,37												
39	CRTI Ver. Run #1	1d	6/7/96	6/7/96	32,38												
40	CRTI Ver. Run #2	1d	6/7/96	6/7/96	32,38												
41	Post Ver. Runs 1-2 Oil Char.	1d	6/8/96	6/8/96	39,40												
42	Demob. NTP for RCC U	0d	6/6/96	6/6/96	32												
43	Demob. NTP for CRTI U	0d	6/8/96	6/8/96	41												
44	Demobilization	7d	6/9/96	6/15/96	42,43												

ADVANCE DRAFT

ADVANCE
DRAFT



Project: Date: 3/25/96	Task  Progress  Milestone 	Summary  Rolled Up Task  Rolled Up Milestone 	Rolled Up Progress 
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7.2 Process and Equipment Description

7.2.1 Process Introduction

B.E.S.T. Solvent Extraction Process: The B.E.S.T. solvent extraction system utilizes triethylamine (TEA) to separate organic contaminated sludges, soils, and sediments into their organic, water, and solids fractions. The physical properties of TEA can be used to overcome solvent extraction difficulties typically encountered when handling samples with high water and organic content. A process schematic diagram of the process is presented in Figure 7-1.

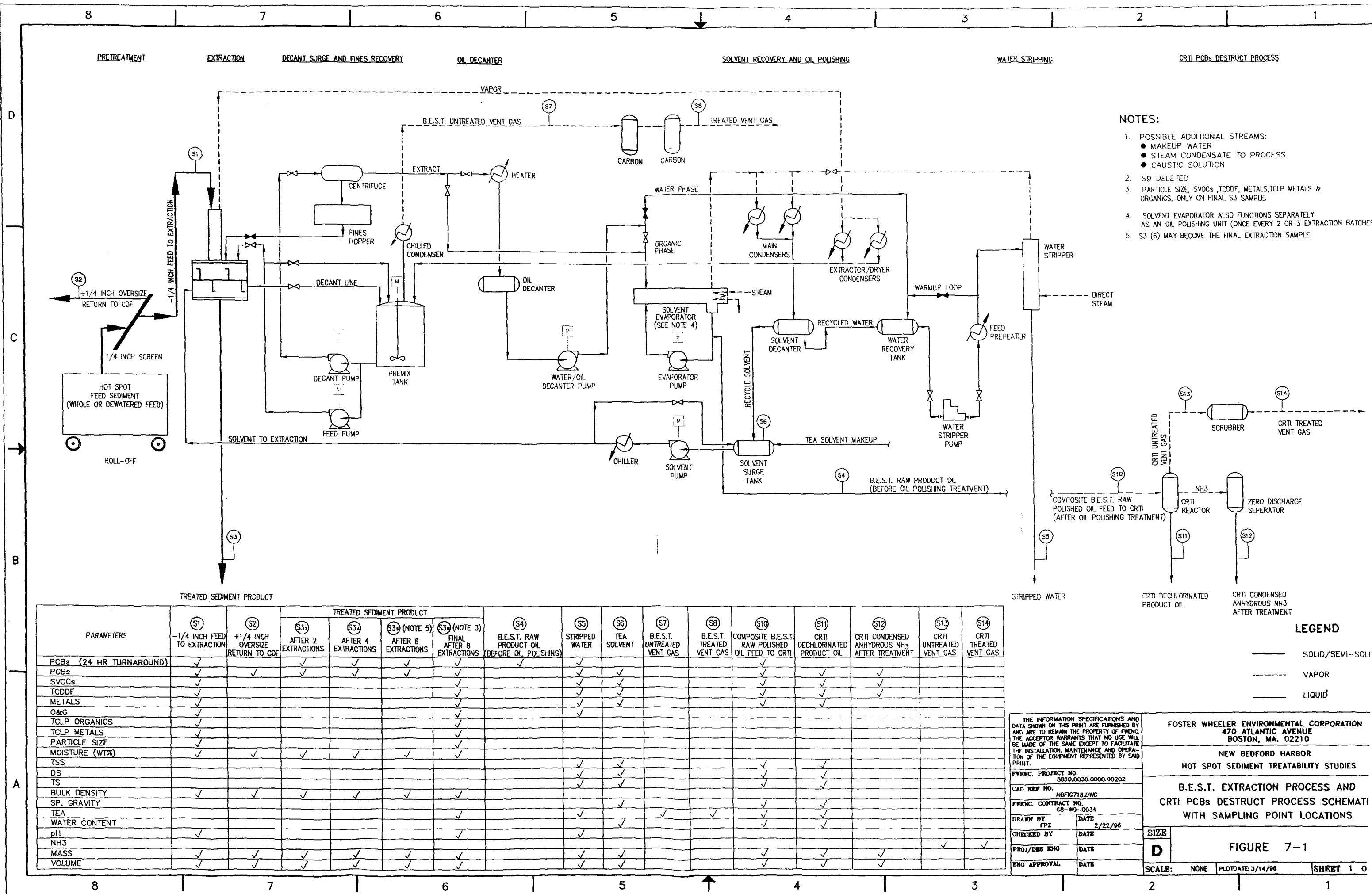
The key to the success of amine extraction is the property of inverse miscibility. At temperatures below 60°F, TEA is miscible with water. Above this temperature, TEA and water are only slightly miscible. This physical property can be exploited by using cold TEA (i.e., chilled below 60°F) to simultaneously solvate organics and water.

In the B.E.S.T. Process, this principle works by mixing the feedstock with TEA to create a single phase extract solution. The extract solution is a homogeneous solution of TEA, organics and any water in the feedstock. Unlike other solvent extraction systems where extraction efficiencies are hindered by emulsions which have the effect of partially occluding the solute, amine solvents can achieve intimate contact with solutes at nearly ambient temperatures and pressures. This allows the B.E.S.T. Process to handle feed mixtures with high water content without penalty in extraction efficiency.

Once the extraction of the feedstock is complete, the particulates are removed from the extract solution by gravity settling and/or centrifugation. Solvent is then evaporated from extracted solid residuals. The solvent and water are removed from the extract solution by evaporation and condensation. At the condensing temperature of the solvent/water mixture, the solvent and water are only partially miscible. With the specific gravity of the solvent at 0.72 as compared to water at 1.0, the solvent and water are easily separated by decantation. Trace residual solvent that is soluble in the heated water (about 2% by weight) is steam stripped from the water.

The PCBs in the recovered organic fraction will be destroyed via the CRTI Solvated Electron PCBs Destruct Process, and clean residuals discharged where appropriate. An added benefit is the simultaneous extraction of other organic contaminants found in the sediments (i.e., PAHs, SVOCs). The process parameters, which may be varied, are summarized in Table 7-3.

CRTI Solvated Electron PCBs Destruct Process: Solvated electron technology is a patented process utilizing the properties of a solution of an active metal in an ammonia based solvent to generate solvated electrons. Such a solution is capable of chemically destroying a wide range of hazardous and toxic wastes like PCBs by removing the halogen components of these materials. With a PCBs molecule, a solvated electron solution will exchange its hydrogen atoms for chlorine, rendering the molecule a benign biphenyl. The chlorine atoms combine with the active metallic element atom (usually calcium or sodium) and form a simple salt. A process flow diagram is presented in Figure 7-1.



NOTES:

- POSSIBLE ADDITIONAL STREAMS:
 - MAKEUP WATER
 - STEAM CONDENSATE TO PROCESS
 - CAUSTIC SOLUTION
- S9 DELETED
- PARTICLE SIZE, SVOCs, TCDDF, METALS, TCLP METALS & ORGANICS, ONLY ON FINAL S3 SAMPLE.
- SOLVENT EVAPORATOR ALSO FUNCTIONS SEPARATELY AS AN OIL POLISHING UNIT (ONCE EVERY 2 OR 3 EXTRACTION BATCHES)
- S3 (6) MAY BECOME THE FINAL EXTRACTION SAMPLE.

LEGEND

- SOLID/SEMI-SOLID
- VAPOR
- LIQUID

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BOSTON, MA. 02210

NEW BEDFORD HARBOR
HOT SPOT SEDIMENT TREATABILITY STUDIES

B.E.S.T. EXTRACTION PROCESS AND
CRTI PCBs DESTRUCT PROCESS SCHEMATIC
WITH SAMPLING POINT LOCATIONS

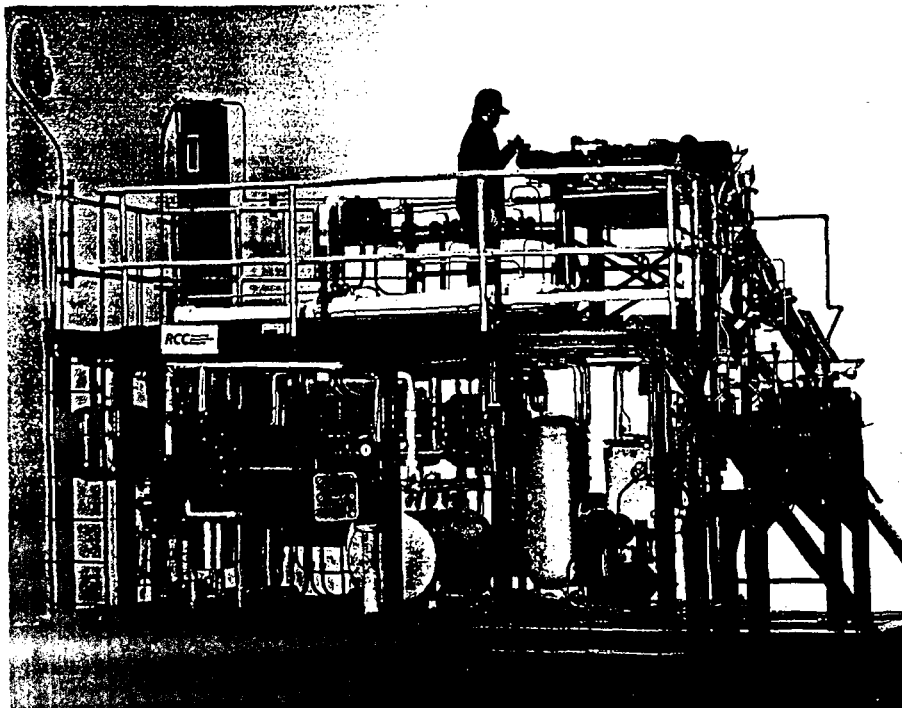
FIGURE 7-1

SCALE: NONE PLOT DATE: 3/14/96 SHEET 1 OF 1

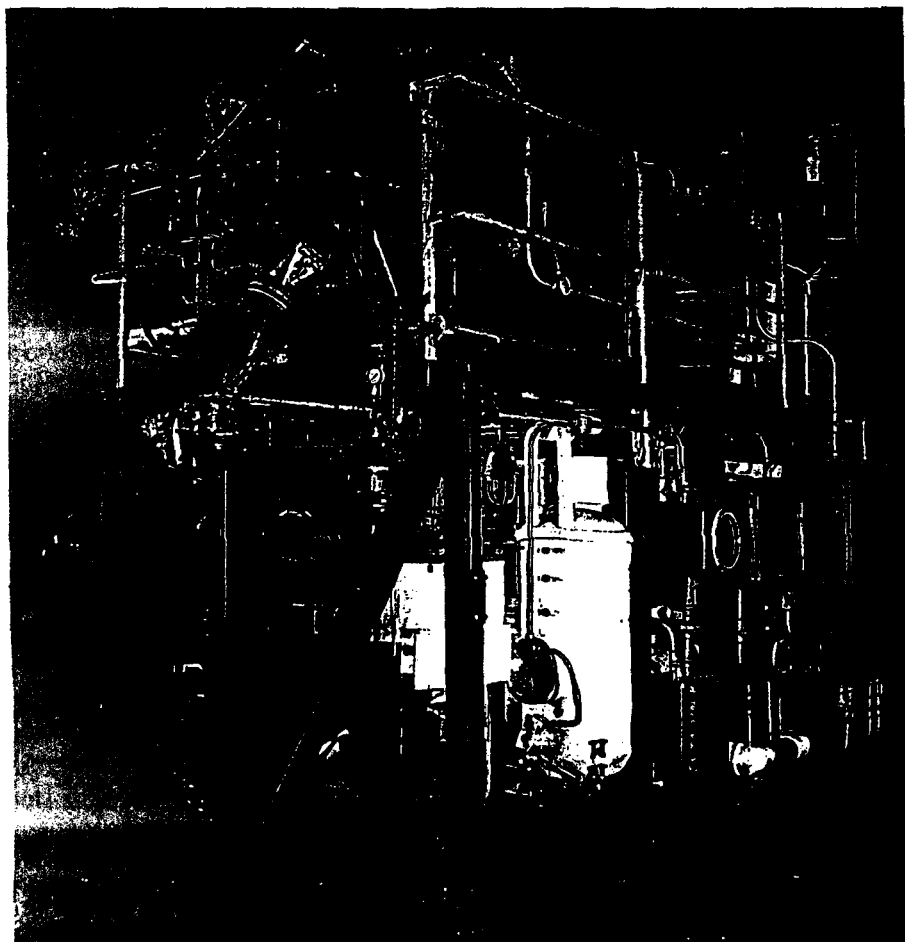
Table 7-3 Primary Control Parameter Summary

Parameter	Potential Manipulated Variables*	Expected Variable	Comments
Extraction Efficiency (extractor/dryer operation)	1. # of extraction cycles 2. Solvent/feed ratio 3. Extraction temperature 4. Extraction time	yes maybe yes maybe	Anticipate a maximum of 8 extractions Based on lab testing data Based on lab testing data Specific data not available
Extractor/Dryer Capacity	1. Volume of feed charged to E/D 2. Length of fill/extraction/decant cycle 3. Length of drying cycle	maybe maybe yes	Based on achieving optimum extraction/ operating efficiency Not representative of full-scale Direct relation to full-scale
Solvent Residual in Solids	1. NaOH addition 2. Drying duration	yes yes	Addition rate - titration curve Controlled by temperature profile
Centrifuge Capture (fines removal step)	1. Centrifuge RPM (G force) 2. Bowl/scroll differential 3. Centrifuge pool depth 4. Feed rate to centrifuge	no yes no no	Set @ 2000 G's (3000 G's possible) Adjusted for maximum centrate clarity Set for maximum pool depth Fixed Value
Decanter Performance			Evaluated by analysis of samples taken

* All variables listed can be manipulated with current pilot plant configuration.



B.E.S.T. Pilot Plant.



Reverse side of pilot plant.

B.E.S.T.® Pilot Plant

Mobile field unit demonstrates the effectiveness of the B.E.S.T. process on location with on-site feeds and actual operating conditions.

Equipment:

Skid-mounted module contains all B.E.S.T. unit operations to mix, extract, centrifuge, evaporate, decant, strip and dry. Module is easily transported on highways.

Capacity:

6-10 gallons per batch

Input:

Pumpable and non-pumpable sludges, sediments or soils.

Output:

Dewatered oil
Stripped water
Dry solids

Site requirements:

20' x 50' process area.
Industrial air and electricity.
(If needed, all utilities can be supplied by RCC utility skid.)

Operational:

March 1989

RCC Resources
Conservation
Company

3006 Northup Way
Bellevue, Washington
98004-1407

Phone: 206 828-2400
Telex: 350166 RCC SEA
Fax: 206 828-0526

7.2.2 B.E.S.T. Pilot Plant

7.2.2.1 Description of the B.E.S.T. Pilot Plant

General: The B.E.S.T. Pilot Plant is a solvent extraction system capable of processing contaminated sediments, sludges, and soils. The pilot test system's main function is to demonstrate the process fundamentals through the use of scaled-down versions of actual equipment components, namely, the extractor/dryer, the solid bowl centrifuge, decanters, and evaporation units. It allows on-site testing of contaminated feedstocks in larger quantities than is practical to process in laboratory glassware and generates operational data for each unit operation when processing a specific waste. A photograph of the B.E.S.T. Pilot Plant is provided on the next page.

Pilot Plant Operations: The pilot plant, like the proposed full scale B.E.S.T. solvent extraction systems, is designed for batch operation of the extraction cycles. While each of the major process operations can be operated in a batch mode, some unit process operations (such as evaporation and centrifugation) are normally operated continuously. The pilot plant has a nominal feed volume of 1 cubic foot (7½ gallons) of material per batch run. Three operators per shift will normally be employed for system operation, process control and sampling, and safety considerations.

For purposes of system description, the pilot plant operations have been divided into the following sections: (1) Feed Preparation; (2) Extraction; (3) Solvent Recovery and Oil Polishing; and (4) Solids Drying.

Feed Preparation: Foster Wheeler Environmental will provide Hot Spot sediment feed from the site in roll-off containers. When Ionics RCC arrives on site, Ionics RCC will take custody of the Hot Spot sediment roll-offs and prepare the material for testing (screening to < ¼ inch). Upon completion of testing, Ionics RCC will return custody of the excess feed and all other waste materials produced during the test to Foster Wheeler Environmental.

Initial Cold Extraction Cycles: The extraction process is illustrated in Figure 7-1. The initial cold extraction cycles take place in the premix tank. The premix tank is a 59 gallon capacity cylindrical tank. Within the tank there is a propeller mixer and bottom scraper. Cooling coils surround the tank to keep the initial extraction cycle temperatures low.

At the beginning of the first extraction cycle, the screened feed and a predetermined quantity of caustic are added to the premix tank. The tank is then sealed and purged with inert nitrogen gas. Following the purge, the tank is filled with chilled solvent. Usually 6 gallons of sediment and 30 gallons of chilled solvent are used. The actual quantities used will be determined by bench-scale treatability testing. The feedstock-chilled solvent mixture is agitated for 5 to 10 minutes, and then allowed to settle. The minimum settling time will be established during bench-scale treatability testing. When the majority of the solids portion of the mixture has settled, the extract solution is decanted from above the settled solids.

Following removal of the extract solution, additional feedstock and TEA may be added to the premix tank to allow the quantity of solids in the tank to accumulate to levels which will be suitable for subsequent extraction cycles in the extractor/dryer. Several of these feed/TEA additions and extraction cycles followed by settling and decanting of the extract solution may be required to accumulate sufficient solids. When sufficient solids have accumulated to permit proper operation of the extractor/dryer, the premix tank is filled to the 30 gallon level and while mixing, the slurry is transferred to the extractor/dryer.

Subsequent Warm/Hot Extraction Cycles: In each subsequent extraction cycle, the extractor/dryer, which holds the solid residual from the previous extraction, is filled with solvent. If interstage solids samples are needed for analysis, a portion of the mixture in the extractor/dryer is withdrawn from a sample valve during agitation of the next extraction cycle. The mixture in the extractor/dryer is agitated for 5 to 30 minutes and is then allowed to settle. The extract solution is decanted and sent to the premix tank. The extract solution is centrifuged, if necessary, and the centrate is routed to the solvent evaporator. The centrifuged solids are collected in the solids chute and returned to the extractor/dryer prior to the next extraction cycle. The total number of extraction cycles required for a particular feedstock may vary. Feedstock processing requirements will be predetermined on a preliminary basis by bench-scale treatability test results. Pilot plant performance results will provide data to determine the actual number of extraction cycles required.

Solvent Recovery and Oil Polishing: Solvent recovery is illustrated in Figure 7-1. The extract solution is pumped to the solvent evaporator, where the TEA/water/organic mixture is heated to its boiling point. Further heating evaporates the low boiling azeotrope of solvent and water (90/10 mixture). Evaporation continues until either the water or the solvent is depleted. At that point, the temperature of the boiling liquid rises until it reaches the boiling point of pure water or pure TEA, whichever remains.

Evaporation continues at the higher temperature until most of the water or solvent is removed. The vapor formed during evaporation is directed to the main condenser. The condensed vapor forms a heterogeneous condensate consisting of a solvent phase above a heavier water phase. This mixture is directed to the solvent decanter, where the water and solvent phases are separated by decanting. The solvent decanter is maintained at about 120°F so that the water and TEA are not miscible, thus maintaining the 2-phase system with reduced solvent solubility in water.

The recovered solvent is recycled back to solvent storage. The recovered water drains by gravity into the water receiver where it is stored until water stripping operations are performed. Ultimately, the water is steam stripped to remove residual TEA.

The organics that remain behind in the solvent evaporator will still have traces of TEA that must be removed. The polishing of organics to remove TEA is only accomplished if the quantity of organics present is sufficient. If the amount of organics is low, or the organics are not free-flowing at normal temperature, it is left in the TEA as a diluent to assure homogeneity of the organics. Sampling of the concentrated organic phase is accomplished by withdrawing organics from a sample valve during recirculation of the organics. The polishing cycle in the solvent evaporator involves two steps: organic rehydration; and final polishing.

The organics are rehydrated by adding water to the system. The water will vaporize and entrain any residual solvent in its low-boiling azeotrope state. Water facilitates removal of solvent due to the solvent's high affinity for water. The point of solvent depletion in the organics is determined by monitoring the overhead vapor temperature that will rise to the boiling point of water. Final polishing is then continued until the majority of the water is also removed, which has been determined to be normally assured when the bottoms temperature reaches about 250°F.

Solids Drying: The solids remaining in the extractor/dryer after the last extraction cycle are ready for drying. Drying of the solids is done in the same extractor/dryer vessel and depicted in Figure 7-1. The extractor/dryer is equipped with a steam jacket and direct steam injection ports. To dry the extracted solids, steam is first supplied only to the steam jacket to indirectly heat the extractor/dryer and its contents to about 170°F. Then water and/or steam is injected into the extractor/dryer vessel. The entire

drying process is done with the extractor/dryer mixing paddles rotating. This increases the heat transfer and reduces the drying time required. The solvent and steam form an azeotrope that is removed from the extractor/dryer, and is directed to the extractor/dryer condenser. After all except trace amounts of the TEA have been removed, the temperature of the vapor rises to the boiling point of water. The drying is continued past this point for a short time to ensure that as much of the residual TEA as possible is removed. The steam condensate left in the solids from the direct injection of steam will leave the solids with about 10% water content, by weight, to minimize dusting. After the drying process is complete, the solids are removed through the discharge port on the bottom of the extractor/dryer. A portion of the solids will be sampled for laboratory analysis. The remainder will be collected and retained for later analysis, if necessary. The vapor that has been directed to the extractor/dryer condenser during the drying cycle is condensed. The condensate is directed to the premix tank along with any solids that may carry-over during the drying process. The solvent is then reclaimed through the normal recovery path as described above. Any solids that are captured are accounted for at the end of the batch process.

Water Stripping: Solvent recovery from the water stream is illustrated in Figure 7-1. Decanted water in the water receiver tank contains around 2% TEA by weight which is removed from the water by steam stripping. Prior to stripping the TEA from the decant water, a predetermined amount of caustic soda is added. This is to insure that the TEA is in the volatile (molecular) form, rather than in an ionized form. The caustic is added to the water receiver tank and the tank contents are mixed thoroughly to raise the pH of the water.

Steam is added to the bottom of the vertical steam stripping column to heat the column to the desired temperature. Feed water is then pumped through the feed preheater where it is heated to slightly above the solvent's azeotropic boiling point. The hot feedwater then enters the top of the column where a portion of it flashes upon entering. The non-vaporized portion of the feedwater runs down the column to the top tray and thence to all subsequent trays where it is stripped of residual solvent by upflowing steam. Water stripped bottoms are returned to the water receiver tank during start-up. When steady state is reached, the water stripper bottoms stream is rerouted to be discharged. This discharged stripped water is stored in suitable storage containers for later analysis. The solvent azeotrope vapors generated are returned to the water stripper condenser and the recovered solvent is recycled.

7.2.2.2 B.E.S.T. Pilot Plant Test Operations

This section contains a summary of pertinent operating instructions. A description is provided of check-out requirements, start-up requirements, operational procedures, and sample and analysis requirements which must be conducted during pilot testing. For reference, a complete set of piping and instrument drawings (PIDs) is included in Attachment IIC.

Pilot Plant Preparations

Low Pressure Air Supply: Before any power can be activated to any systems on either skid, the low pressure air seal system must be activated. This system will keep fugitive TEA vapor out of the electrical equipment.

1. Open the low pressure air supply valve to the in-line air dryer. Turn on the compressor to the air dryer. Open the supply valve from the air dryer to the main skid. The low point condensate drain on the air dryer must be cracked open to remove condensed water from the air dryer.
2. Check the refrigeration compressor box for positive air flow. Check the electrical breaker box for positive air flow.

Electrical System Activation:

1. Before power is turned on the main skid, open the main skid breaker box and check that all breakers are shut. Close the main skid breaker box.
2. Verify positive air pressure exists on the refrigerator compressor box and on the main skid breaker box.
3. Check to make sure that both 440 volt and 208 volt supply breakers are shut. Then activate power to the main skid.

Steam System Start-Up:

1. Make sure steam is available to the main skid. Slowly open the main skid steam inlet valve. Drain the condensed steam out of the lines by cracking open one or more of the low pressure steam system drains.
2. Verify that all steam pressure reducers are operating correctly. Crack open a drain or non-operating load downstream from each pressure reducer, and then monitor the steam pressure drop in the system.

Auxiliary Skid Systems Start-Up: The tempered cooling water system must be heated and allowed to stabilize before waste processing operations begin. The tempered cooling water system is maintained at approximately 105°F to prevent excessive subcooling of the condensed liquids. Tempered cooling water system start-up:

1. Ensure the drain valve is shut.
2. Fill the holding tank with water and the appropriate amount of antifreeze.
3. Open the pump suction valve and shut the recirculation valve.
4. Open the return valve from all three condensers. Open the return valve from the solvent decanter cooling coils.
5. Start the pump by turning the switch to the "hand" position and pressing the start button. This also allows the cooling fan to start if the temperature of the tank exceeds 105°F.
6. Heat up the holding tank to at least 90°F by slowly opening the steam supply valve to the water heater. This is a manual control system. When the temperature of the water in the holding tank is between 90°F and 100°F, secure the steam supply valve.

Solvent System Start-Up:

1. Precautions:
 - a. Verify the solvent storage tank level. For initial start-up, if the solvent inventory is below 90%, the tank should be topped with additional solvent. Follow solvent handling safety procedures when transferring solvent.
 - b. Fill the solvent storage tank by pumping TEA into the fill fitting. Ensure solvent storage drum is properly grounded during solvent transfer.
 - c. The filling operation should always be performed with the electrical system activated so that the high level warning light is operational. If the solvent storage tank high level warning light should come on during solvent addition, immediately stop and secure any filling operations to the tank. The high level warning light is activated when the solvent level in the tank is just below the vent.
 - d. Shut all drains on the solvent storage tank before the initial fill. Cap the drain on the tank.

- e. Whenever there is TEA in the solvent system, the drainage system must be configured to retain spills.
 - f. When there is TEA in the solvent system and the pump is secured between operations, such as overnight, shut the isolation valve between the tank and the pump. This eliminates possible sources of leakage while the system is in standby.
 - g. Whenever there is TEA in the solvent system, a nitrogen bleed must be maintained to the vent system.
 - h. Whenever solvent transfer is in progress, or the solvent system is operating, the emergency shower located on the pilot plant must be verified to be in operation.
2. Start-Up Checklist:
- a. Shut the TEA manifold valves. Cap the fittings where lines have been disconnected.
 - b. Verify that the fill connection valve is shut and the line is capped.
 - c. Open the isolation valve between the solvent storage tank and the pump suction.
 - d. Verify that the TEA sample valve on the auxiliary skid (from the TEA cooling coil) is shut and that the connections to the auxiliary skid are properly installed.
 - e. Open the supply valve sending TEA to the auxiliary skid for cooling.
 - f. When starting the pump, monitor the system, carefully so that any leaks will be detected quickly.
 - g. Start the solvent pump. Turn the switch to the "hand" position and push the start button. Standby to secure the pump in case of a leak or spill.

Refrigeration System: The refrigeration compressor will not operate unless the solvent pump is running. There is also an interlock that keeps the compressor from running when there is high or low Freon pressure.

1. Start the refrigeration system by turning the switch to the "on" position. This activates the entire system, including the compressor.
2. If there is a period where little or no heat load is on the refrigeration system, then a false load can be introduced to keep the system operating normally. This is done by opening the false loading bypass valve on the discharge side of the compressor. Open the valve, which is a pressure regulating valve, by removing the cap and turning the set screw clockwise. Adjust the amount of false loading by adjusting the set point of the valve. When the false load is no longer required, be sure to shut the valve by removing the cap and turning the set screw counterclockwise.
3. Prior to processing feedstock, the solvent in the solvent storage tank should be precooled to 10°F or lower.

Nitrogen System: The nitrogen system is used to purge air from the extractor/dryer and premix tank prior to addition of TEA, to seal the centrifuge during its operation, and to blanket the process vessels whenever TEA is in the system.

1. Connect the nitrogen bottle to the inlet manifold. Open the supply on the bottle pressure regulator and the inlet valve on the nitrogen inlet manifold. Shut all the other inlet valves not in service on the manifold.
2. Establish a nitrogen blanket on the solvent system by opening the valve to the vent header on the nitrogen supply manifold. Set the flow of nitrogen at 5 to 10 SCFH.
3. During centrifuge operation, open the valve to the centrifuge on the nitrogen supply manifold. Nitrogen flow to the centrifuge is regulated based on the differential pressure indication on the centrifuge seal assembly.

4. Immediately prior to filling the extractor/dryer with solvent, purge the extractor/dryer with nitrogen. Open the valve to the extractor/dryer on the nitrogen supply manifold and set the flow at >100 SCFH. After a minimum of five minutes, secure the nitrogen purge.
5. After the completion of solids drying, purge the extractor/dryer with nitrogen before opening the top hatch.

Feed Preparation: The feed will be introduced to the extractor/dryer in predetermined batches. Each type of feedstock will be screened to minus (-) ¼ inch and homogenized.

The feed material will be screened in a vibrating shaker screen to remove material that is greater than ¼ inch in size. The material collected from the shaker will be composited and homogenized prior to sampling. The prepared feed will then be placed in containers (typically five gallon pails) for use during feed loading operations.

Extraction

Initial Cold Extraction Cycles:

1. Before filling the premix tank with feedstock, check the following items:
 - a. Shut the decant isolation valves on the site of the premix tank.
 - b. Verify the premix tank is clean. Do not put any tools or your hands into the premix tank until power to it is disconnected.
 - c. Ensure the feed pump suction valve on the bottom of the premix tank is shut.
2. Fill two five gallon buckets up to the four gallon mark so that eight gallons are ready for use. Weigh the eight gallons of feedstock and record it on the data sheet. Add the feedstock to the premix tank through the feed lock hopper. Then add caustic soda to the premix tank to pH adjust the feedstock if necessary. The caustic soda dosage will be based on laboratory testing. Close the feed port and check that all joints in the feed lock hopper are sealed.
3. Purge the premix tank with nitrogen by opening the supply valve on the nitrogen supply header and the inlet valve on the top of the feed lock hopper. Adjust the flow of nitrogen to >100 SCFH and purge the premix tank for a minimum of five minutes.
4. Fill the premix tank with chilled solvent:
 - a. Check-shut or shut the solvent fill isolation valve to the premix tank on top of the tank.
 - b. Check-shut or shut the valve on the decant line from the extractor/dryer to where it enters the premix tank, isolating the line from the mix tank.
 - c. Check-open or open the supply valve on the solvent header to the premix tank. The line should become cold, indicating flow of solvent.
 - d. Open the solvent supply isolation valve on the top of the premix tank. The line should become cold, indicating flow of solvent.
 - e. Monitor the solvent level. When the level of solvent in the premix tank reaches the top, the high level probe will be activated. This will happen after six to ten minutes of filling. Shut the solvent supply isolation valve on the top of the premix tank. The flow of solvent is now secured.
5. Turn on the premix tank mixer. Record the initial temperature and time on the extraction data sheets. Continue to record data on the extraction data sheets. Continue mixing for 15 to 30 minutes. Secure the mixer.

Decantation of Extract Solution from Solids in Premix Tank:

1. Allow the mixture in the premix tank to settle. The settling duration will be determined by bench-scale treatability testing. Open the decant isolation valve on the side of the premix tank.
2. Prepare the centrifuge to receive extract solution from the premix tank. Begin decantation by opening the decant line isolation valve on the side of the premix tank.
3. Secure decanting by shutting the valve on the premix tank decant line, isolating the premix tank from the decant pump.

Solids Transfer:

1. When a sufficient quantity of solids has accumulated in the premix tank, they are combined with solvent and pumped to the extractor/dryer for subsequent extractions.
2. Transfer solvent to the premix tank per instruction 4 (initial cold extraction cycles) above. When the level in the premix tank reaches 30 gallons, secure filling the premix tank with solvent.
3. Turn on the mixer in the premix tank. Ensure solvent flushing supply lines to the feed pump seal are open. Check shut the sample valve on the feed pump suction line. Open the feed pump suction valve.
4. Align the feed pump to discharge to the premix tank. Start the feed pump by turning the switch to the "hand" position and pushing the start button. Adjust flows to the seal assembly as necessary.
5. Before filling the extractor/dryer with feedstock, check the following items:
 - a. Close the steam injection line isolation valves at the bottom of each side of the extractor/dryer.
 - b. Close the decant isolation valve on the side of the extractor/dryer. Ensure the bottom discharge port is locked closed.
 - c. Verify the extractor/dryer is clean. Do not put any tools or your hands into the extractor/dryer until power to it is disconnected.
6. Align the feed pump discharge to the extractor/dryer. Monitor the level in both the premix tank and the extractor/dryer. When the contents of the premix tank have been transferred to the extractor/dryer, secure the feed pump and shut the feed pump suction valve. Secure flows to the feed pump seal assembly.
7. Additional cold extractions may be performed as necessary using the premix tank as described above. If no further cold extractions are required, proceed to conducting warm/hot extractions in the extractor/dryer.

Additional Extraction Cycles:

1. No additional feed or caustic is added to the extractor/dryer. Purge the extractor/dryer with nitrogen by opening the supply valve on the nitrogen supply header and the inlet valve on the top of the extractor/dryer. Adjust the flow of nitrogen to > 100 SCFH and purge the extractor/dryer for a minimum of two minutes.
2. If necessary, fill the extractor/dryer with chilled solvent:
 - a. Check-shut or shut the decant isolation valves on the extractor/dryer. Check-shut or shut the valve on the decant line from the extractor/dryer to where it enters the premix tank, isolating the line from the premix tank.
 - b. Check-open or open the supply valve on the solvent header to the extractor/dryer.
 - c. Open the solvent fill isolation valve to the decant line. The system is now lined up for solvent to the extractor/dryer except for the decant isolation valve on the extractor/dryer.

- d. Open the decant isolation valve on the side of the extractor/dryer. The line should become cold, indicating flow of solvent.
- e. Monitor the solvent level. When the level of solvent in the extractor/dryer reaches the top, the high level probe will be activated. This will happen after six to ten minutes of filling. Shut the decant isolation valve on the side of the extractor/dryer. The flow of the solvent is now secured. Shut the solvent fill isolation valve.
3. Turn on the extractor/dryer paddles and apply indirect steam to the jacket as necessary. Record the initial temperature and time on the extraction data sheets. Continue to record data on the extraction data sheets. Continue mixing for 15 to 30 minutes. Secure the extractor/ dryer paddles. Secure steam to the jacket when the desired temperature is reached.
4. If samples are desired, collect a sample by opening the extractor/dryer isolation valve and opening the sample valve on the decant line. The sample collected will represent the contaminant concentration in the mixture following the previous extraction cycle (i.e., the solids sample taken during agitation on the fifth extraction cycle would be the fourth extraction cycle solids sample).

Decantation of Extract Solution from Solids in Extractor/Dryer:

1. No additional feed or caustic is added to the extractor/dryer. Purge the extractor/dryer with nitrogen by opening the supply valve on the nitrogen supply header and the inlet valve on the top of the extractor/dryer. Adjust the flow of nitrogen to > 100 SCFH and purge the extractor/dryer for a minimum of two minutes.
2. If necessary, fill the extractor/dryer with chilled solvent:
 - a. Check-shut or shut the decant isolation valves on the extractor/dryer. Check-shut or shut the valve on the decant line from the extractor/dryer to where it enters the premix tank, isolating the line from the premix tank.
 - b. Check-open or open the supply valve on the solvent header to the extractor/dryer.
 - c. Open the solvent fill isolation valve to the decant line. The system is now lined up for solvent to the extractor/dryer except for the decant isolation valve on the extractor/dryer.
 - d. Open the decant isolation valve on the side of the extractor/dryer. The line should become cold, indicating flow of solvent.
 - e. Monitor the solvent level. When the level of solvent in the extractor/dryer reaches the top, the high level probe will be activated. This will happen after six to ten minutes of filling. Shut the decant isolation valve on the side of the extractor/dryer. The flow of the solvent is now secured. Shut the solvent fill isolation valve.
3. Turn on the extractor/dryer paddles and apply indirect steam to the jacket as necessary. Record the initial temperature and time on the extraction data sheets. Continue to record data on the extraction data sheets. Continue mixing for 15 to 30 minutes. Secure the extractor/ dryer paddles. Secure steam to the jacket when the desired temperature is reached.
4. If samples are desired, collect a sample by opening the extractor/dryer isolation valve and opening the sample valve on the decant line. The sample collected will represent the contaminant concentration in the mixture following the previous extraction cycle (i.e., the solids sample taken during agitation on the fifth extraction cycle would be the fourth extraction cycle solids sample).

Decantation of Extraction Solution From Solids in Extractor/Dryer:

1. Allow the mixture in the premix tank to settle. The settling duration will be determined by bench-scale treatability testing. Open the decant isolation valve on the site of the premix tank. Fully open the solvent fill isolation valve to the decant line for one second, then shut it. This will pump fresh solvent into the extractor/dryer for one second and clear away any solids surrounding

- the decant port inside the extractor/dryer.
2. Prepare the premix tank to receive solvent from the extractor/dryer. If the premix tank already has solvent in it from a previous decant on the same feedstock, then no preparations are required. If the premix tank is empty, then the feed pump shall be secured and the special valve on the bottom of the premix tank shut. Verify that the sample valve on the suction of the feed pump is shut. Verify that the six inch sample throwback valve on the top of the premix tank is shut. Verify that the premix tank inspection cover plate is secured.
3. Decant the solvent into the premix tank by opening the extractor/dryer decant valve at the extractor/dryer. Allow the solvent to flow from the extractor/dryer to the premix tank.
4. Secure decanting by shutting the valve on the extractor/dryer decant line at the premix tank, isolating the premix tank from the decant line.

Centrifugation:

1. Any suspended solids in the premix tank are now separated from the solvent by centrifugation, if necessary. Verify that the centrifuge inlet flush line isolation is shut. Start the premix tank mixer by turning the switch to the hand position and pushing the start button. If the centrifuge is secured, then the system must be started up according to item 2. If the centrifuge is already running, then skip steps 2 and 3 and proceed with the centrifugation per step 4.
2. Start up the centrifuge if it is not already running. Line up the centrate to return to the premix tank. Start the bowl by turning the switch to the "hand" position and pushing the start button. When the bowl is up to speed, then start the Reeves drive. Refer to the BIRD Centrifuge Manual for further instruction on the use of the centrifuge. Whenever the centrifuge is secured, the scroll speed must be turned down to the "1" position.
3. Start a nitrogen bleed to the centrifuge bowl seal of 1-2 psig as read on the gage installed on the centrifuge seal.
4. Verify that the solids receiving chamber is in place. Line up the centrate return as per one of the following choices:
 - a. Back to the premix tank: Open the isolation valve from the centrate clarifier outlet to the premix tank.
 - b. To the solvent evaporator: Open the isolation valve from centrate pump to the solvent evaporator. Align the centrate clarifier outlet to the suction of the centrate pump.
5. Line up the decant pump to the centrifuge by opening a pump suction valve and checking shut the suction line sample valve. Start the decant pump by turning the switch to the "hand" position and pushing the start button. Verify flow by observing the sightglass on the decant pump suction and on the centrate outlet of the centrifuge. Start the centrate pump if necessary by turning the switch to the "hand" position and pushing the start button. When the centrate pump is running, periodically monitor the back-pressure on the centrate filter. Replace the filter if greater than a 2 psig rise is noted.
6. When the premix tank is empty, secure the decant pump and the centrate pump. It is not necessary to secure the centrifuge unless centrifugation operations are to be secured for an extended period of time.
7. If the centrifuge is no longer needed, secure it by slowly returning the scroll setting to "1". Lineup the centrate to return to the premix tank. Allow the centrifuge to run for two more minutes, then secure the Reeves Drive and the bowl drive. Also, secure nitrogen flow to the bowl seal.
8. During the centrifugation process, maintain the data required on the evaporation logs.

Subsequent Warm/Hot Extraction Cycles: Additional extractions may be anticipated for certain feedstocks. The actual number of additional extraction cycles to be conducted will be identified by bench-scale treatability testing in Ionics RCC's lab in Bellevue. Those test procedures are set forth in Attachment IIB. The subsequent extraction cycles are carried out the same as the first, with the following exceptions:

1. No additional feedstock needs to be introduced into the extractor/dryer. The solids in the bottom of the vessel have more solvent introduced, as per instruction 4 (initial cold extraction cycles) above. Continue with the procedure from that point. Collect desired samples as required.
2. The temperature of the extraction will be confirmed in Ionics RCC's lab in Bellevue.
3. No additional caustic is added.
4. Decant the solvent off the top of the solids as per decantation in premix tanks above. Centrifuge the decant solvent mixture. DO NOT overfill the premix tank, its decant capacity is 50 gallons. The high level warning light comes on at 37 gallons.

Solvent Recovery:

1. Blow down solvent evaporator steam lines if not already hot.
2. Start the solvent evaporator recirculation pump. Line up the vent system for solvent recovery. Line up the solvent decanter to recycle recovered solvent and send water to the water receiver tank.
3. Begin heating by supplying steam to the external heater. Maintain the data sheet on solvent recovery.
4. Once the overhead temperature reaches 185°F (solvent rich), check open the solvent decanter bypass valve.
5. Once the level in the solvent evaporator is reduced to 60 liters, stop steam supply to the evaporator jacket and external heater, but maintain recirculation flow.
6. If polishing organics, continue heating the organics while adding small portions of water to form the TEA/water azeotrope. When the TEA is removed, as evidenced by an evaporator overhead temperature of 212°F, continue heating the organics to approximately 250°F, as read on the evaporator recirculating pump outlet. After transfer of the polished organics, secure heat to the evaporator and secure the recirculating pump.

Solids Drying: Once all subsequent extraction cycles are complete, dry the solids in the extractor/dryer as follows:

1. Make sure the dryer vapor line is open and aligned for drying operations.
2. Make any necessary additions to the extractor/dryer (water, caustic, etc.).
3. Start extractor/dryer paddles.
4. Blow down steam lines to jacket then begin heating the jacket.
5. When the temperature of the solids in the extractor/dryer reaches 180°F and increasing, start direct steam injection into the extractor/dryer.
6. Monitor the overhead temperature and motor amps. Continue drying for ten minutes past the time when the overhead temperature reaches 212°F. When drying is complete, secure the direct injection and indirect heating steam. Isolate the extractor/dryer overhead condenser from the extractor/dryer.
7. If further treatment is required, add additional treatment materials (caustic, acid, etc.) and continue with agitation and/or heating as required until the desired solids quality is achieved.

8. Purge the dryer with nitrogen before opening. Once the dryer temperature drops to 200°F with the plows still operating, open the dryer bottoms hatch to unload solids. Verify that the pH of the solids (in deionized water) is at least ten to insure that the TEA residual will be low. If the pH is less than ten, more caustic should be added to the next batch of feedstock and more caustic and water are added to the low pH solids batch. The solids are then redried and saved for analysis.

Water Stripping: Once all of the feed is extracted and the water receiver contains sufficient water for stripping, proceed to recover solvent from the decant water in the water receiver tank as follows:

1. Obtain a 250 ml sample of decant water and determine the caustic requirements by the following method: Evaporate about 10% of the sample in an open beaker. If the pH is > 10, no caustic is required. If the pH is < 10, quantitatively add caustic to raise the pH to about 11, reconstitute the sample volume with deionized water, and repeat the determination.
2. Add the amount of caustic required to the water receiver as determined above.
3. If the use of anti-foam is indicated from glassware testing, predilute 1 ml of anti-foam with 99 ml of deionized water and add the solution to the anti-foam feed pump suction reservoir.
4. Record water receiver tank level/volume.
5. Circulate the water in the water receiver tank through the pump.
6. At the same time as step 5 above, supply steam to the water stripper preheater and supply direct steam to the water stripper. Set bottoms piping to return bottoms to the water receiver tank.
7. Once steam flow is uniform in the column, switch valves to begin feed to the water stripper at approximately 250 ml/min.
8. Once the hot feed temperature is maintained at 207°F or above, the overhead temperature is kept above 207°F, and the bottoms temperature reads 212°F, then the water stripper is considered stable. Bottoms water can be considered product water now. Verify that the pH of the effluent is at least 10 to ensure the TEA residual will be low. If the pH is less than 10, add more caustic to the water receiver tank. Once this pH is verified, direct the bottoms water storage vessel for retention and analysis.
9. Continue until the water receiver tank is empty. If additional water is added to the tank during the stripping process, then additional caustic must also be added.

7.2.3 CRTI Solvated Electron PCBs Destruct Process Pilot Unit

7.2.3.1 Description of the Solvated Electron PCBs Destruct Process Pilot Plant

General: The pilot unit is designed to perform treatability studies on relatively small amounts of contaminated solid and liquid materials (or their surrogates) at field sites, and has successfully completed a number of such operations. For this application, the unit will be configured to accept and treat liquid wastes in batches of approximately one to three gallons each. The patented Solvated Electron PCBs Destruct Process treats halogenated compounds by chemically removing the halogen atom using the properties of solvated electron solutions, in this case a solution of calcium or sodium in anhydrous ammonia. The dissolved active metal liberates massive amounts of free radicals, which selectively combine with the chlorine atoms of polychlorinated biphenyls, leaving a benign biphenyl and metal salt. The process operates under pressure, such that the ammonia remains liquid in the reactor (pressure ranges from ambient to approximately 300 psig during the process steps). At the end of the batch cycle, ammonia vaporizes from the reactor and is recondensed in the Zero Discharge Separator Vessel by adjusting the coolant temperatures in the two vessels.

Unit Operations: Waste feed materials are fed into the reactor vessel either manually or mechanically. The vessel is sealed, and anhydrous ammonia is added to the vessel in an amount determined to be sufficient for waste intermingling and dissolving the reactive metal. At this point, the waste/ammonia mixture is stirred, and afterwards reactive metal is added in either granular or rod form. The metal begins to dissolve instantly. Solution conductivity and vessel pressure rise are indicative of the commencement of the solvating process. Although there is usually a characteristic dark blue coloration in the solution, chemical destruction of the PCBs molecules does not require this visual effect. After the reaction is complete, the ammonia is removed by taking advantage of temperature and pressure differences between the reactor vessel and the separation vessel, which may also be assisted by heating and/or cooling each vessel. Once ammonia has been removed, pressure reduces to ambient and the treated materials may be removed from the reactor vessel either manually or mechanically.

Feed Preparation: No pretreatment is usually required for waste streams. Although the literature reports competing reactions in the solvating process, Commodore's tests have thus far discovered only but two-high moisture content (> 35%), and ketones such as acetone. Dewatering and ketone/acetone drying are required if these materials are present in prohibitive amounts. One property of liquid ammonia beneficial to its use in the Solvated Electron PCBs Destruct Process technology is its ability to wet soils, effectively breaking adhesive bonding of clumped materials. Lumps of clay are quickly reduced to basic particle sizes, forming an intimately mixed slurry. Although oils are not readily dissolved in ammonia, mixing action of the RV provides contact required for the destruction of PCBs in these materials. For the New Bedford Harbor tests, it is expected that waste oil materials will be received in a TEA matrix.

Solvent Recovery: Anhydrous ammonia is used as the solvating medium for dissolving the reactive metal, and does not participate in any chemical reactions other than providing a medium to generate the solvated electrons. It is recovered for reuse by a combination of decanting and distillation. The ammonia is not contaminated by PCBs during the process. With the exception of minor losses, all the ammonia fluid is recovered and recycled.

7.2.3.2 Solvated Electron Process Standard Operating Procedures

Refer to the piping and instrumentation diagram, Figure 7-2. Initial conditions are all vessels empty and at ambient pressure. The following procedures assume wastes to be treated are liquid or slurry matrices, not solid materials. Wherever pressure, temperature, conductivity, or visual "checks" or "observations" are noted in the operational steps, these shall be recorded in the data log sheets (Attachment IIA) unless otherwise specified.

System Start-Up, Readiness Checks:

1. Check that all power switches are off (mixing motor, cabinet light, seal oil pump motor). Check and record system temperatures and pressures (should be ambient). Check that all system valves (vessels, seal oil tank, interconnecting piping) are in the closed position except one ¼" needle valve at the top of RV and ZDSV (RV3 and ZV3). These valves should be wide open to ensure ambient pressure within the vessels. Check that all vessel ports not in service are properly plugged. Lock the cabinet support casters.
2. Connect 110 vac power to the junction box in the upper left corner of the cabinet.
3. Connect a pressure regulator to a full tank of dry nitrogen, and pipe the low pressure side to the variable pressure regulator of the seal oil system, using the flexible high pressure hose provided. Adjust both pressure regulators (gas cylinder tank, and seal oil, VPR1) to their lowest pressure points.

4. Place one gallon of seal fluid in the seal oil tank. Mark level of fluid on sight glass using a soft pencil or equivalent marking device.
5. Open the nitrogen tank supply valve fully. Adjust the gas cylinder tank pressure regulator low side pressure to 300 psig. Open the seal oil tank pressurizing gas supply line valve (SV1). Adjust the seal oil variable pressure regulator (VPR1) to achieve 5 psig at the seal oil tank.
6. Open the seal oil pump supply (SV2) and discharge (SV3) valves. Start the seal oil pump and visually check for proper operation and seal oil flow. Stop the pump.
7. Connect a cylinder of anhydrous ammonia to the ammonia supply valve (NV1) at the bottom of the cabinet. The tank should be positioned horizontally. Do not open the tank valve or feed valves (NV1-NV6).

Waste Batch Processing:

1. Charge-Connect the waste feed tank to RV1 at the open end of valve. Check that the RV vent valve (RV3) is fully open, and that RV2 and RV5 are fully closed.
2. Open RV1 slowly and allow waste feed to enter RV by gravity flow or by (peristaltic pump may also be used). Fill RV to the one gallon mark on the RV sight glass. Close valves RV1 and RV3.
3. Start the seal oil pump and check for proper operation.
4. Open the anhydrous ammonia cylinder supply valve. Slowly open valves NV1, NV2, and NV4. Crack valve NV5 (or NV3) and allow anhydrous ammonia to adiabatically expand into the RV, while watching the RV temperature and pressure gages. Fill to the two gallon mark on the RV sight glass. STOP FILLING OPERATION (CLOSE NV5 OR NV3 AND NV2) IF THE PRESSURE APPROACHES 300 PSIG, AND PROCEED TO STEP 5.
5. Partially fill the RV jacket with approximately one gallon of methanol. Place small pieces of dry ice in the methanol jacket, lowering the temperature and pressure of the ammonia in the RV. When pressure declines to below 100 psig, continue ammonia filling operation as in step 4 until proper level is achieved. Close valves NV1, NV2, NV4, NV5, and the ammonia cylinder supply valve.
6. Start the mixer motor and mix combined waste/ammonia for approximately two minutes while observing RV temperature and pressure. The pressure should not be allowed to exceed 150 psig, and may be controlled by cooling with dry ice. Stop mixer.
7. Open ball valve MV2 and insert the amount of reactive metal specified by the Test Plan into piping between valves MV1 and MV2. Close valve MV2. Open valve MV1. Tap piping lightly to ensure metal discharges into RV.
8. Start mixer while observing RV temperature and pressure, and watch for solvating indications in the sight glass and the conductivity indicator. If additional metal is required, stop mixer and repeat step 6 as instructed by the Test Director.
9. When the Test Director is satisfied the process has successfully treated the waste material batch, stop the mixer and allow the materials to quiesce for two minutes.

Material Removal:

1. Check the RV sight glass and note volume of treated material/ammonia mixture.
2. Check the ZDSV pressure and temperature (should be ambient). Partially fill the ZDSV jacket with one gallon of methanol, and place small pieces of dry ice in jacket.
3. Open valve ZV4 fully. Slowly open valve RV5 and observe (do not record) pressure equalization between the two vessels.

4. Remove the methanol from RV's jacket. As heat transfers to RV, ammonia will distill from it to ZDSV and condense in the latter. This process may be assisted by filling the RV jacket with hot water. When the temperature of the treated materials rises above ambient by 20°F, all recoverable ammonia will have transferred ZDSV. Close ZV4 and RV5.
5. If desired, a liquid ammonia sample may be taken from ZDSV by installing a "getter" at the ZV9 valve sampling manifold. The getter collects approximately 100 cc's of liquid ammonia, which is allowed to slowly vent to atmosphere. The getter is then rinsed three times with 10-15 ml of hexane and extracted in accordance with sampling procedures described in the QAPP or sampling plan for WW operation.
6. After the ammonia has been transferred to ZDSV, and the pressure in RV is essentially ambient, the treated material is removed through NV7/ZV7 by opening both NV3 and NV7 and analyzed for PCBs or other materials. Stop the seal oil pump.
7. Batch treatment may continue by repeating steps B1 through B3, substituting the following for steps 4 and 5. Slowly open valve NV6. Slowly open valve NV5 and allow anhydrous ammonia to adiabatically expand into the RV, while watching the RV temperature and pressure gages. Fill to the 2 gallon mark on the sign glass. STOP FILLING OPERATION (CLOSE NV5 AND NV6) IF THE PRESSURE APPROACHES 300 PSIG, AND COOL RV AS FOLLOWS. Partially fill the RV jacket with approximately one gallon of methanol. Place small pieces of dry ice in the methanol jacket, lowering the temperature and pressure of the ammonia in the RV. When pressure declines to below 100 psig, continue ammonia filling operation as in this step until proper level is achieved (not greater than 1" below the top of the sight glass). Close valves NV5 and NV6. Makeup ammonia, if required, may be added from the ammonia cylinder by following steps B4 and B5. Continue with steps 6 through 8, and steps C1 through C6.

System Decontamination: If treated materials are sampled and analyzed as non-detect for PCBs, no decontamination is necessary for this material. The system will be cleaned prior to transport by completing the steps of this Section.

1. After treated materials have been removed in accordance with the above instructions, close all RV valves. Chill the ammonia cylinder by placing in a bath of cold water. Warm the ZDSV by filling its jacket with hot water, allowing the pressure to rise to approximately 300 psig. Open the ammonia cylinder supply valve and valves NV1, NV2, and NV4. Slowly open valve NV6 and allow vapor pressure in ZDSV to force liquid ammonia into the ammonia cylinder. When sight glass observation indicates no liquids remain in ZDSV, close valves NV1, NV2, NV4, NV6, and the ammonia cylinder supply valve.
2. Slowly open valve ZV3 and allow the small amount of ammonia gas therein to escape.
3. Drain all seal fluid from the seal fluid tank.
4. Disconnect the nitrogen cylinder from VPR1.
5. Check system pressures in RV (should be ambient). Remove the mixer motor flange bolts and remove mixer motor, rinsing the paddle wheel and shaft three times with a terpene based material (such as ReEntry Solvents KNI-2000 or equivalent).
6. Open fully and remove valves RV1 through RV5 and NV5 from RV, together with interconnecting piping. Plug port openings. Using RV as a collection vessel, pour a triple volume of terpene based solvent through valve bodies. Swab valves and piping dry.
7. Triple rinse the interior of RV with terpene based solvent.
8. Drain rinse materials from RV into a 30 gallon DOT drum suitable marked for storage and wipe interior surface of RV with paper towels.
9. Reinstall valves and piping, and wipe all exterior surfaces of pilot plant and installed equipment with towels containing a terpene-based solvent.
10. Dispose solid cleaning materials in a DOT drum suitable marked for storage.
11. Complete cleaning certification report.

7.3 Sampling and Analysis Plan

7.3.1 Sampling Design

The purpose of this section is to develop specifications and procedures regarding sample collection, preparation and laboratory analysis. The sampling design described below was developed by following a data quality objectives (DQOs) development process based on the EPA's *Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process* (EPA QA/G-4, Interim Final, 1993) (EPA, 1993a).

These DQO development steps provide the organization for this section of the FOP: definition of study objectives, assumptions and constraints of the study, field data inputs to the study, limits on acceptable field data uncertainty, development of quantitative (mass balance) data, and optimal design. In the final step, an optimal sampling design is derived which is responsive to objectives, assumptions, constraints, and uncertainties stated in the first four steps.

This sampling and analysis plan is developed for use during pilot-scale testing of the Ionics RCC B.E.S.T. Solvent Extraction Process and CRTI Solvated Electron PCBs Destruct Process and is intended to specifically address activities associated with this process. Sampling procedures that pertain to site mobilization and to the other pilot study processes are given in the individual sampling and analysis plans (Vol. I, Section 3.0, Vol. II, Vol. III and Vol. IV). Quality control procedures that will be employed, including chain-of-custody documentation, decontamination, and analytical methodology are discussed in the QAPP (Section 5.0, Vol. I). These QC procedures will apply to all pilot study activities unless specifically stated otherwise in the individual SAPs.

7.3.1.1 Study Objectives

The first step in the DQO development process involves concisely defining the objectives of the Ionics RCC and CRTI pilot-scale treatability study. In support of the project goal of finding a viable and safe non-incineration treatment technology to destroy or treat the toxic constituents (primarily PCBs and metals) of the Hot Spot sediment, while working to maximize community involvement, the specific pilot-scale treatability study test objectives include the following:

- Evaluate and quantify the effectiveness of the B.E.S.T. process to extract contaminants (PCBs, SVOCs, and heavy metals) from the Hot Spot sediment samples and the Solvated Electron process to destroy the PCBs in the extracted organic fraction.
- Quantify the disposition of key constituents to support mass balance calculations.
- Identify potential environmental and/or engineering constraints related to the use of the B.E.S.T. process to extract contaminants from the Hot Spot sediment samples and the Solvate Electron process to destroy the PCBs in the extracted organic fraction.
- Produce data of sufficient quality such that different treatment processes can be evaluated relative to each other, and a risk assessment of treatment residuals, if required, can be conducted for the B.E.S.T. process and the Solvated Electron PCBs Destruct process.

- Evaluate the viability of the B.E.S.T. process and the Solvated Electron PCBs Destruct process to be scaled-up to full-scale operations including the overall development time-frame and estimated full-scale treatment costs. In this regard, collect data and observations necessary to evaluate the projected effectiveness and feasibility of the B.E.S.T. process and the Solvated Electron PCBs Destruct process at full-scale operation. Evaluate parameters such as material handling, pretreatment requirements, material feed rates, and batch processing rates. Projected full-scale economics for treatment of large volumes of sediment including costs for treatment and disposal of waste streams, site preparation, and mobilization of equipment will also be evaluated.
- Characterize the operational hazards associated with full-scale implementation of B.E.S.T. process and the Solvated Electron PCBs Destruct process.
- Evaluate the performance of the B.E.S.T. process and the Solvated Electron PCBs Destruct process against the nine detailed evaluation criteria contained in the National Contingency Plan (NCP), including the ability of the B.E.S.T. process and the Solvated Electron PCBs Destruct process to reduce toxicity, mobility, and volume of the hazardous constituents.

7.3.1.2 Define the Boundaries of the Study

The second step in the DQO development process for sampling design involves describing the spatial and temporal boundaries defining where and when samples should be collected. To evaluate the B.E.S.T. Solvent Extraction Process and CRTI Solvated Electron PCBs Destruct Process for Hot Spot sediments, samples will be collected at predetermined locations from feed, vent streams, and product materials for each process operation. This process will be tested using the Ionics RCC and CRTI pilot study unit on-site during a 14 day period. Sampling locations, analyses and pilot study schedules are discussed in the following sections.

7.3.1.3 Data Inputs

The third step in the DQO process for sampling design involves identifying the major inputs and specifying those inputs requiring data. This helps ensure that the field program will provide the most useful information possible to support the study objectives (DQO Step 1), within specified constraints (DQO Step 2). The data inputs necessary to achieve the objectives of the pilot-scale treatability study are chemical and physical properties and overall mass balance of materials. Data inputs are specified in the following sections.

7.3.1.4 Limits of Acceptability on Field Data Uncertainty

Step 4 in the DQO development process for sampling design involves specifying the acceptable limits on the uncertainty in estimating the data inputs. The data summarized in Step 3 will include specific chemical, physical, and mass determinations which involve analytical and mass weight uncertainty. The primary sampling objective for the pilot-scale study is to have individual samples represent the range of variation and sediment characteristics so that the capability of the processes can be assessed for a variety of operating conditions. The data must be sufficiently accurate for the purposes of determining the effectiveness of the treatment technologies relative to each other, and the potential risk to human health and the environment. To assess the potential uncertainty involved from sampling and analysis, samples collected to determine mass balance and destruction removal efficiency will be collected in duplicate, where economically reasonable, from each process batch. Variability within and between batches will be assessed as a part of the data evaluation process. Mass balance data will be obtained from weigh scales that are calibrated for every test batch.

7.3.1.5 Optimal Design

The fifth step in the DQO process involves identifying the most resource-effective sampling design for generating data that will satisfy the objectives, assumptions, and constraints specified in steps 1 to 4. The components of the sampling design include sampling locations and sampling effort. The optimal design is described below.

7.3.2 Data Collection and Field Sampling Activities

The data collected to determine mass balance, destruction/removal efficiency, and overall performance of the treatment process are described in this Section. Figure 7-1 illustrates the sampling locations and analyses. Table 7-4 summarizes the sampling locations, the total number of batches for that particular aspect of treatment, the number of samples collected for each batch, and the total number of samples for the treatment process. The following subsections describe the field data measurements and the collection of samples for chemical analyses that will be taken in support of mass balance and destruction/removal efficiency calculations. A tentative schedule of daily activities, including the measurements and samples that will be collected each day is included in Attachment IIA. The field process data logsheets (LS) that will be used to document field measurements are also included in Attachment IIA. Table 7-5 details the sampling procedures, collection frequency, analyses, and field quality control samples that will be taken for chemical analysis and Tables 7-6A and 7-6B itemize the chemical samples and analyses that be taken during the study. Tables 7-5, 7-6A and 7-6B are included at the end of this section.

7.3.2.1 Field Measurements and Data Collection

Mass balance data will be obtained at each sampling point to define the capacity (or throughput) of the pilot-scale system. These data will also be used in conjunction with chemical and physical laboratory data to evaluate destruction/removal efficiency and overall disposition of contaminants. Data will be used to determine the operating parameters and requirements for full-scale operation. A tentative schedule of daily activities including the required measurements is included in Attachment IIA of this document. Process data sheets will be used to document field measurements. These data sheets are provided in Attachment IIA of this document and are discussed below.

Process Data

<u>Logsheets #</u>	<u>Description</u>
LS-1	Process Operation Chronology - Site activities and process operations will be documented on a 30 minute basis. Activities as listed on the daily schedule, including data measurements and sample collection times will be recorded. References to other data sheets or logbooks may be made to clarify the specific activities.
LS-2	Monitoring Checklist for Process Operations - Daily and single event calibrations, electrical power, and steam and TEA consumption will be recorded.
LS-3	Feed Preparation (Screening) - Measurements of volume and mass of feed material will be taken before and after screening. Measurements will be recorded and bulk density calculated.
LS-4	Feed Preparation (Loading and Neutralization) - Measurements of the mass and volume of feed material and the addition of caustic soda will be monitored and recorded.
LS-5	Extraction - Conditions before, during, and after <u>each solvent extraction cycle</u> will be recorded. The volume of solvent used will be calculated.

Table 7-4 Total Lab and Field Sampling Frequency and Number (Ref. Figure 7-1)

Sample ID	Description	Sampling Frequency*			Type of Sample	Comments
		Per Batch	Total Batches	Total Samples		
B.E.S.T. EXTRACTION & SOLVENT RECOVERY BATCHES						
S1	Composite of grab samples from feed sediment per batch	2	5	10		Duplicate samples except for PCBs isomers & TCLP
S2	+ ¼ inch oversize whole sediment, composite of grab samples from ¼ inch screen (total of all batches)	2	1	2		
S3(2)	Interstage treated solids after 2 extractions, composite of grab samples per batch	2	5	10		
S3(4)	ibid - 4 extractions per batch	2	5	10		
S3(6)	ibid - 6 extractions per batch	2	3	6		Assume interstage for 3 batches (only)
S3(8)	Final treated solids after 8 extractions, composite of grab samples per batch	2	5	10		Assume "Final" for 3 batches at S3(8) and 2 at S3(6)
S4	B.E.S.T. raw un-polished product oil, grab sample at end of batch	1	5	5		Feed to oil polisher will be a composite of all 5 - S4 oils
S6	Solvent grab samples, one at beginning of study and one at the end of each batch	1	7	8		5 solvent recovery & 2 oil polish batches
S7	B.E.S.T. untreated vent gas, at least one per day (twice per extraction batch, twice per solvent recovery batch & twice per oil polish)	2	12	24		drager tubes, sampling is based on RCC statement that N2 blanketing/venting is used for all process steps and is the safest way to operate
S8	B.E.S.T. treated vent gas samples, at least one per day (twice per extraction batch, twice per solvent recovery batch & twice per oil polish)	2	12	24		drager tubes, sampling is based on RCC statement that N2 blanketing/venting is used for all process steps and is the safest way to operate

Table 7-4 cont'd

Sample ID	Description	Sampling Frequency*			Type of Sample	Comments
		Per Batch	Total Batches	Total Samples		
B.E.S.T. OIL POLISHING AND WATER STRIPPING BATCHES						
S10	Composite raw polished oil (grab sample of composite)	2	2	4		S10 is feed to CRTI unit
S5	Stripped water, grab sample at end of batch, each polishing/stripping batch equals 2 or 3 extraction batches	2	2	4		
CRTI BATCHES						
S11	CRTI dechlorinated product oil, grab sample at end of batch	2	6	12		2 PCBs analyses and 1 for all other analyses
S12	CRTI condensed NH ₃ after treatment, grab sample at end of batch	1	6	6		
S13	CRTI untreated vent gas samples, two per batch at start and end of venting cycle	2	6	12		Drager tubes
S14	CRTI treated vent gas samples, two per batch at start and end of venting cycle	2	6	12		Drager tubes

* Excluding QA/QC, MS/MDS, etc.

- LS-6 Solids Drying - Conditions will be measured and recorded during the solids drying process. The weight and volume of treated solids will be recorded and the bulk density calculated.
- LS-7 Evaporation/Solvent Recovery (or Oil Polishing) - Conditions during both the solvent recovery and oil polishing processes will be monitored and recorded for each batch. The volume and mass of solvent or oil will be recorded before and after each batch.
- LS-8 Dehydration - Conditions will be monitored and recorded during each dehydration process.
- LS-9 Decant Water Stripping - Conditions will be monitored and recorded during the decant water stripping process. Volumes and flow rates of feed materials, steam, and recovered water will be measured and recorded.
- LS-10 Field Vent Gas Measurements - Gas vapor detection tubes (Drager or equivalent) will be used to determine the concentration of TEA and ammonia emitted from the vent streams of the RCC and CRTI steps of the process. Results will be recorded.
- LS-11 CRTI Process Data Sheet - A summary of the measurements taken during each batch run will be recorded.
- LS-12 Ionics RCC Batch Summary A. Extraction/Solvent Recovery Batch (or B. Oil Polishing/Water Stripping Batch) - A summary of the measurements taken during each batch will be recorded. This will include the weights of feed and recovered materials from each of the process steps.

These data sheets are intended to provide the data required to develop mass balances, utility requirements, temperature profiles, etc. that determine the process performance, capacity, and assist in scale up to full scale application.

7.3.2.2 Field Sample Collection for Chemical Analyses

The field samples and associated quality control samples that will be collected during the Ionics/RCC and CRTI pilot study program and the method for collection are described in Table 7-5. Sample numbering and labeling are discussed below. Sample containers, preservatives, holding times, decontamination procedures, field documentation requirements, and a description of the analytical methods are given in Section 5 (Vol. I, QAPP) of this FOP.

Samples collected for mass balance and destruction removal calculation purposes will be taken from each batch (note that the physical operation of the unit will result in different numbers of batches for the different steps). Where economically reasonable, the samples will be collected in duplicate to assess variability within the batch and to minimize the possibility of losing an entire data point. Sample results that will be used for supporting data, including PCBs isomers, TCLP, TEA, and physical parameters, will be analyzed as a single sample for each batch. Samples that are expected to be well homogenized, such as the CRTI oil samples, will be collected as single samples from each batch. These are expected to contain high levels of PCBs (30 percent) and very small sample volumes will be needed for analysis. It is expected that sufficient volume will be available from a single sample, should reanalysis be needed.

Field duplicate samples will not be repeated if the sample was collected in duplicate. Duplicate samples will be collected for each matrix and analysis during one batch, as shown in Tables 7-5, 7-6A and 7-6B. Additional volume will be collected for MS/MSD analysis as specified in the tables. In several instances, the concentration of the sample is expected to be very high (30 percent PCBs). This type of matrix is

not suitable for MS/MSD analyses as the spiked compounds are likely to be diluted out of range. Measures of accuracy for these samples will be based on performance evaluation (PE) sample results and laboratory blank spike results. PE samples will be shipped to the laboratory(ies) at a frequency of approximately one PE sample for every 20 samples (see Table 7-6B). Where possible, the PE sample matrix and concentration will be similar to the samples (soil or oil/low or high). In cases where this is not possible, available PE samples will be shipped for the analysis.

7.3.2.3 RCC Sample Identification

Each sample collected to evaluate the RCC/CRTI pilot process will be identified using the following:

- R - identifies the sample as related to the Ionics RCC and CRTI processes
- E## - the extraction batch the sample is associated with, batches will be numbered (01, 02, 03, etc.) sequentially by the field team
- P## - the oil polishing/water stripping batch the sample is associated with, batches will be numbered (01, 02) sequentially by the field team
- C## - the CRTI oil treatment batch the sample is associated with, batches will be numbered (01, 02, 03, etc.) sequentially by the field team
- The sampling point where the sample is collected from (refer to Table 7-4) (i.e., S1, S2)
- Whether the sample is a composite from several cycles or whether it is a grab (C, or G)
- Which extraction cycle the sample was collected from, where applicable, in parentheses

An example, sample identification would be: RE03-S3G(4), a grab sample of treated sediment collected after four extraction cycles from the third extraction batch of the Ionics RCC/CRTI process.

Duplicate samples will be designated D and field QC will be identified with an abbreviation and the date (FB051696), when collected, as described in Section 4.4.2, Vol. I).

Table 7-5 Chemical Sampling Collection Methods, Frequency, Analyses, and Field QC Samples

Sample Location ¹⁴	Collection Method and Frequency	Analyses	Field Quality Control
S1 -1/4 inch Feed Sediment to extraction	Composite samples will be prepared by homogenizing a minimum of five grab samples in a stainless steel bowl, using a wooden (disposable) or stainless steel spoon or spatula. Samples will be collected in duplicate from each composite from each of five batches.	Duplicates will be taken for: - On-site ¹ - RAS ² - PCDD/PCDF ³ - O & G ⁴ A single sample will be taken from each batch for: - TCLP ⁵ - grain size ⁶ A single sample will be taken from each of two batches (biases toward the optimized batches) for: - PCBs isomers ⁷	A duplicate and an MS/MSD from one batch (biased toward optimization batch) will be collected for: - TCLP - grain size (dup only) One split sample from one batch (biased toward the first batch) will be analyzed for: - fast TAT PCBs ¹³
S2 + 1/4 inch oversize return to CDF	One composite sample for this study (from all batches) will be prepared by homogenizing a minimum of five grab samples collected from the + 1/4 inch screen oversize.	Duplicate samples will be analyzed for: - On-site - RAS organic only	Will be included with soil SDG. No specific field QC required.
S3(x) Interstage treated solids, x denoting the number of extraction cycles.	Composite samples will be prepared as described for S1. Aliquots will be taken in duplicate from each composite. Samples will be collected at the end of every two extraction cycles during each of the five batches.	Duplicate samples from each sampling event (every 2 cycles) will be analyzed for: - On-site	One split sample and MS/MSD for ten on-site samples (expect 10 for the study) will be sent for: - fast TAT PCBs Bias split sample toward an early (first) batch.

Sample Location ¹⁴	Collection Method and Frequency	Analyses	Field Quality Control
S3 (x) Final Cycle x=8 for three of the batches and x=6 for two of the batches	Composite samples will be prepared as described for S1. Aliquots will be taken in duplicate from each composite.	Duplicate samples from the final sampling event (after 8 or 6 cycles) will be analyzed for: - On-site - RAS - PCDD/PCDF - O & G One sample from each batch will be analyzed for: - TCLP - TEA ⁸ - grain size One sample from each of two batches (biased toward the optimization batches) will be analyzed for: - PCBs isomers	MS/MSD will be collected from 3 batches for: - On-site One MS/MSD will be collected from one batch (biased toward optimization batch) for: - each analysis, except PCBs isomers and grain size. One field duplicate sample will be collected from one batch (biased toward optimization batch) for: - TCLP - TEA - grain size
S4 B.E.S.T. unpolished raw oil	One grab sample will be collected from each of five extraction batches. Contains approx. 90% TEA IT IS DESIRABLE TO COLLECT VERY SMALL PORTIONS OF THIS MATERIAL. CAN IT BE SAMPLED USING A DISPOSABLE PIPETTE?	- On-site PCBs only	One split sample will be collected from the first batch for: - fast TAT PCBs One duplicate and one MS/MSD will be collected at random from one batch.
S5 Stripped water from the oil polishing process	Duplicate grab samples will be collected from each of two oil polishing batches. Samples will be prepared in duplicate by filling one container and then filling the second (duplicate) container. BAILER? SPIGOT?	Duplicate samples will be analyzed for: - On-site pH only - RAS - PCDD/PCDF - O & G - TEA - TSS/TDS/TS	One MS/MSD will be collected from one batch, selected at random, for each analysis.

Sample Location ¹⁴	Collection Method and Frequency	Analyses	Field Quality Control
S6 TEA Solvent to Extraction (makeup of recovered)	One grab sample will be collected at the beginning of the study, at the end of each of five extraction batches and at the end of two oil polishing batches. Total of eight samples. HOW IS THIS COLLECTED? BAILER, SPIGOT?	- PCBs non-CLP⁹ - SVOC non-CLP - metals non-CLP - PCDD/PCDF - Karl Fischer¹⁰ - TSS (TDS and TS if possible)¹¹ - Specific gravity¹²	One duplicate will be collected at random from one batch for each analysis. One MS/MSD sample will be collected at random from one batch for each analysis except PCDD/PCDF, Karl Fischer, and specific gravity.
S10 COMPOSITE B.E.S.T. polished raw oil feed to CRTI process	Duplicate grab samples will be collected from each of two polishing batches. Samples will be collected prior to dividing into aliquots for CRTI feed. MATERIAL MAY BE VISCOUS AND/OR SLUDGY AT AMBIENT TEMPS. IT IS DESIRABLE TO COLLECT VERY SMALL PORTIONS OF THIS MATERIAL. HOW TO BEST SAMPLE?	Duplicate samples will be analyzed for: - On-site PCBs only - PCBs non-CLP - SVOC non-CLP - metals non-CLP - PCDD/PCDF One sample from each of two batches will be analyzed for: - PCBs isomers	Samples will be collected in duplicate. No other field QC is required.

Sample Location ¹⁴	Collection Method and Frequency	Analyses	Field Quality Control
S11 CRTI Dechlorinated product oil	Grab samples will be collected from each of six CRTI treatment batches. Samples will be collected in duplicate for on-site analysis.	Duplicate samples will be collected from each of five batches for: - On-site PCBs only One sample from each batch will be collected for: - PCBs non-CLP - SVOC non-CLP - metals non-CLP - PCDD/PCDF One sample will be collected from each of two batches (biased toward optimized batches) will be analyzed for: - PCBs isomers	One duplicate and one MS/MSD will be collected from one batch (selected at random) for each analysis except for PCBs isomers.
S12 CRTI Condensed ammonia after treatment	One grab sample will be collected from each of six CRTI batches. NEEDS WORK, HOW DO WE COLLECT THIS SAMPLE?	One sample from each batch will be analyzed for: - PCBs non-CLP - SVOC non-CLP - PCDD/PCDF	One duplicate and one MS/MSD will be collected from one batch (selected at random) for: - each analysis.

Notes: Additional discussion of the analytical methods is provided in Section 5.0 (QAPP) - Volume I of FOP.

- ¹ On-site - on-site laboratory will analyze for PCBs, pH, and percent moisture, unless otherwise noted.
- ² RAS - Analysis for pesticides, PCBs, SVOC, and metals through the EPA CLP program.
- ³ PCDD/PCDF - Analysis for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofurans by subcontractor laboratory.
- ⁴ O&G - Analysis for gravimetric oil and grease using methylene chloride as the extraction solvent.
- ⁵ TCLP - TCLP leachate will be analyzed by a subcontractor laboratory for SVOCs, PCBs, and metals using EPA CLP protocol.
- ⁶ Grain size analysis using ASTM Method D422.
- ⁷ PCBs Isomers - Total mono through decachlorinated biphenyls GC/MS by a subcontractor laboratory.
- ⁸ TEA - Analysis for triethylamine (TEA) by a subcontractor laboratory.

- 9 Non-CLP - Analysis of unusual matrices (not soil or water) for the CLP analyte lists using modified CLP methodology.
- 10 Karl Fischer - Analysis for moisture content of TEA using Karl Fischer titration.
- 11 TSS/TDS/TS - Analysis for total suspended, dissolved, and total solids. Aqueous matrices will be analyzed for all three. Solvents and solvent mixtures may only be analyzed for TSS.
- 12 Specific gravity using ASTM Method _____ by a subcontractor laboratory.
- 13 Fast TAT PCBs - Off-site analysis for PCBs to confirm on-site laboratory results. Results will be requested within 48 hours.
- 14 Unlisted samples:
- S7 B.E.S.T. untreated vent gas - Drager tube field analysis only for TEA.
- S8 B.E.S.T. treated vent gas - Drager tube field analysis only for TEA.
- S9 Deleted
- S13 CRTI untreated vent gas - Drager tube field analysis only for NH₃.
- S14 CRTI treated vent gas - Drager tube field analysis only for NH₃.

Table 7-6A SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND LABORATORY ANALYSES (single batch)

[illegible]

(1) non-CLP PCB = Fast turnaround for soil matrices to confirm on-site laboratory results. Analysis of non-routine matrices (i.e., not soil or water).

(2) PCB isomers = Analysis for total mono through decachlorobiphenyl isomers. Only will be analyzed during two batches.

(3) non-CLP SVOC = Analysis for SVOCs in non-routine matrices.

(4) PCDD/F = Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

(5) O&G = Oil and grease/gravimetric using methylene chloride as the extraction solvent.

(6) non-CLP metals = Analysis for metals in non-routine matrices.

(7) TCLP = TCLP leaching and subsequent analysis for PCBs, SVOCs, and metals.

(8) TEA = Analysis for TEA in various matrices.

(9) MS/MSD are recorded as a single sample for initial round and as two samples for sample counting purposes

Table 7-6B SAMPLE LOCATIONS, NUMBER OF SAMPLES, AND LABORATORY ANALYSES (total study)

Sampling Point	Description/Media	No. of Batches	Chemical Parameters															Physical Parameters		
			PCB On-site	pH on-site	%mois/sol on-site	PCB non-CLP(1)	PCB isomers(2)	PCB RAS	SVOC RAS	SVOC non-CLP (3)	PCDD/F (4)	O&G (5)	metals RAS	metals non-CLP(6)	TCLP (7)	TEA(8)	water content	TSS/DS/TS (liquid)	specific gravity	grain size
S1	-1/4 inch Feed/Sediment to Extraction	5	10	10	10	1	2	10	10		10	10	10		5				5	
	Duplicate	1												1					1	
	MS/MSD(9)	1	2	2	2			2	2			2	2		2					
S2	+ 1/4" sediment oversize - return to CDF	1	2	2	2			2	2											
S3	Treated Sediment - soil in TEA (final will be dry soil)																			
S3(2)	2 extractions	5	10	10	10															
S3(4)	4 extractions	5	10	10	10															
S3(6)	6 extractions (Final for 2 batches)	3	6	6	6															
S3(8)	8 cycles / final	5	10	10	10	1	2	10	10		10	10	10		5	5			5	
	Duplicate	1												1	1				1	
	MS/MSD	1	6	6	6	2		2	2		2	2	2		2	2				
S6	TEA Solvent - initial & after 5 ext. & 2 pol. batches	8				8				8	8			8			8	8	8	
	Duplicate	1				1				1	1			1			1	1	1	
	MS/MSD	1				2				2				2				2		
S4	B.E.S.T. unpolished raw oil (4%PCB/90%TEA)	5	5			1														
	Duplicate	1	1																	
	MS/MSD	1	2																	
S5	Stripped water from polishing batch	2		4				4	4		4	4	4			4		4		
	MS/MSD	1		2				2	2		2	2	2			2		2		
S10	Composite B.E.S.T. raw polished oil - feed to CRTI	2	4			4	2			4	4			4						
S11	CRTI Dechlorinated oil	6	12			6	2			6	6			6						
	Duplicate	1				1				1	1			1						
	MS/MSD	1				2				2	2			2						
S12	CRTI Condensed NH3 - after treatment	6				6				6	6									
	Duplicate	1				1				1	1									
	MS/MSD	1				2				2	2									
PE	Performance Evaluation Sample		4			2		2	2	2	3		2	2						
	Total:		84	62	56	40	8	34	34	35	62	30	32	26	16	14	9	17	9	12

(1) non-CLP PCB = Fast turnaround for soil matrices to confirm on-site laboratory results. Analysis of non-routine matrices (i.e., not soil or water).

(2) PCB isomers = Analysis for total mono through decachlorobiphenyl isomers. Only will be analyzed during two batches.

(3) non-CLP SVOC = Analysis for SVOCs in non-routine matrices.

(4) PCDD/F = Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

(5) O&G = Oil and grease/gravimetric using methylene chloride as the extraction solvent.

(6) non-CLP metals = Analysis for metals in non-routine matrices.

(7) TCLP = TCLP leaching and subsequent analysis for PCBs, SVOCs, and metals.

(8) TEA = Analysis for TEA in various matrices.

(9) MS/MSD are recorded as a single sample for initial round and as two samples for sample counting purposes

7.4 Ionics RCC Mobilization and Demobilization

7.4.1 B.E.S.T. Pilot Plant Mobilization

Site Preparation: Figure 2-2 is a preliminary site layout plan that will be utilized during testing at the New Bedford Harbor Superfund Site in New Bedford, MA. As illustrated in the 80' x 120' pilot layout plan, sufficient space will be needed to set-up the B.E.S.T. Pilot Plant and a support trailer. A 50-foot perimeter line extending outwardly from the outline of the B.E.S.T. Pilot Plant process equipment will be adopted per fire and/or electrical code requirements for physical separation of solvent-containing process equipment from other electrical equipment.

The Pilot Plant consists of two portable skids mounted on a 8 x 48 foot "low boy" trailer. The main skid (20 ft. x 8 ft.) contains all of the B.E.S.T. Process equipment including the extractor/dryer, the centrifuge, tanks, pumps and heat exchangers required to process contaminated sludges, sediments, and soils. All electrical equipment is Class 1, Group C or D, Division 1-rated. The system is designed to prevent solvent emissions. A second, smaller skid (10 ft. x 8 ft.) contains several utility systems to support the operation of the main process skids. The utility skid includes a refrigeration unit and a tempered cooling system. Steam, nitrogen, and instrument air will be provided separately. Figure 2-2 illustrates the general arrangement of the two skids as they site on the trailer. Also illustrated are the secondary spill containment pan under the process skid and a tertiary spill containment basin under the entire trailer.

Utility connections to Ionics RCC's power distribution panel will be provided by USACE. Site utility requirements include electrical power at 480 volts @ 225 amps, potable water at an estimated 3,000 gallons for the 14 day test program, and facilities to accept return cooling water and steam condensate. The streams discharged do not contact the waste materials being processed.

Ionics RCC personnel will be mobilized to the test site approximately one day prior to arrival of the pilot plant to arrange for any additional equipment that may be required during the set-up period.

Pilot Plant Set-Up: Ionics RCC personnel will supervise and conduct all phases of pilot plant set-up and operation. The set-up phase will be considered complete when all process components have been installed as a complete unit and each piece of equipment has been operated on an individual basis. System Safety (HAZOP) and integrity is checked by operating each component with clean water. This phase is expected to require approximately three days.

All components removed for shipping will be assembled and all interconnections made. Utilities will be connected and checked out.

Operational checkout will begin after it has been determined that all equipment has been properly installed. After all functions have been tested as an operating unit, solvent will be loaded into the pilot plant to again verify system safety and integrity and complete checkout using solvent. This normally takes about two days.

7.4.2 CRTI Pilot Plant Mobilization

CRTI/Ionics to Prepare

7.4.3 B.E.S.T. Pilot Plant Demobilization

Decontamination: The decontamination plan for the pilot plant after exposure to PCBs follows. This plan is also applicable for any hazardous contaminant. The steps of this plan must be performed in the order specified to prevent cross contamination. Many steps must be run concurrently to prevent overfilling of process vessels.

During the decontamination process, a sample of recycled TEA will be tested for PCBs. This will confirm that the recycled TEA is not contaminated with PCBs.

Extractor/Dryer: Fill the extractor/dryer with TEA to the normal TEA fill lines. Wash the inside by turning on the paddles for five minutes. Decant the TEA to the empty premix tank. Disconnect the steam injection line from the bottom of the extractor/dryer on the decant side (disconnect downstream of the isolation valve). Drain the remaining 8 gallons or so of TEA into carboys. The use of carboys that have already been contaminated with PCBs is desired. Return this TEA to the evaporator directly.

After purging with nitrogen, fill the extractor/dryer again and wash for five more minutes. Decant the TEA to the premix tank again. The premix tank should be full now. Drain the remaining 8 gallons of TEA into carboys. The use of carboys that have already been contaminated with PCBs is desired. Return this TEA to the evaporator directly.

Fill the extractor/dryer for the third time and wash for five more minutes. When the premix tank is empty, decant the TEA to the premix tank again. Take a grab sample of the TEA for later PCBs testing to confirm that the extractor/dryer is decontaminated. Drain the remaining 8 gallons of TEA into carboys. Return the TEA to the evaporator directly. The extractor/dryer has now been rinsed three times with clean TEA.

Premix Tank and Centrifuge: Run the mixer and decant pump, then start to centrifuge the TEA. Line up the centrate return back to the premix tank for the first five minutes. Fill the premix tank with more TEA from the third rinse of the extractor/dryer as room becomes available. Continue centrifugation until the extractor/dryer and premix tank are empty. Fill the premix tank with clean TEA, by the premix tank fill line, until the high level warning light comes on (with the mixer off).

Turn on the mixer and decant pump and centrifuge the new TEA in the premix tank. Line up the centrifuge centrate return back to the premix tank for the first five minutes. Sample TEA for later analysis for PCBs to confirm that the premix tank and centrifuge are decontaminated. When the premix tank is empty, secure the mixer and decant pump. Flush the centrifuge head by opening the head flush valve for one minute. This sends clean TEA to the centrifuge plows and discharge nozzle. Secure the centrifuge.

Drain the feed pump and lines by draining the low point sample into a carboy. Return the TEA to the evaporator. The premix tank has now been rinsed with 75 gallons of TEA from the extractor/dryer, which will have less than 50 ppm PCBs in it, and 37 gallons of clean TEA. A normal batch of TEA processed through the premix tank is 25 gallons, so the tank is effectively being rinsed more than four times.

Centrate Tank and Pump: The centrate tank will fill during the centrifugation step, so pumping TEA to the evaporator must start before the tank overfills. Pump one gallon through the sample tap also to rinse it out. Pour the TEA removed back into the evaporator. Check the evaporator level to make sure it is not overfilled. If necessary, evaporate some of the TEA.

When all the TEA from the centrifuge has been pumped to the evaporator, secure the centrate pump. The TEA from the end of the drain sequence shall be sampled, and the sample tested for PCBs to confirm that the centrate tank has been decontaminated. Drain the TEA from the sample line on the inlet to the evaporator and return it to the evaporator.

Evaporator: All the contaminants introduced in the pilot plant will not be in the evaporator. Evaporate the TEA down to a level of about 50 liters. Drain the TEA into the contaminated TEA barrel. Add about six gallons of clean TEA to the evaporator. Run the recirculation pump for five minutes to clean out the piping. Drain the evaporator again into the contaminated TEA barrel. Add six gallons of TEA again, mix for five minutes, and drain. Add six gallons of TEA, for the third time, mix for five minutes, and drain. Sample the third rinse of PCBs analysis to confirm that the evaporator is decontaminated. The PCBs collection point has now been rinsed three times.

TEA Removal: Remove residual TEA from the water stripper, if used, by steaming the column. When the water stripper is clean, shut the vent isolation valve to keep TEA vapor out.

Remove the inventory of TEA in the solvent storage tank by pumping it through the fill connection, into barrels. When the solvent tank empties, secure the solvent pump. Drain the TEA cooling loop into the storage tank now by opening the sample/vent line on the auxiliary skid. Open the premix tank cooling coil line isolation valve. Shut the sample/vent on the auxiliary skid and start the pump again. When no more TEA will pump out, secure the pump and drain the TEA out of low point drains.

Fill the solvent tank with 20 gallons of water. Start the solvent pump and pump water through all the TEA systems. Make sure the refrigeration system is secured before sending water to the TEA cooling loop. Pump the water from the solvent system into the evaporator. Line up the solvent drain from the solvent decanter to a carboy instead of to the solvent storage tank. Evaporate the TEA out of the water, collecting it in a carboy, which can be returned to the clean TEA barrel. Leave the TEA lineup this way for the rest of the clean-up to collect the recovered TEA separately.

Remove all the TEA from the extractor/dryer by directly injecting steam for 10 minutes. Open the decant valves to allow steam to sweep the TEA in the lines into the mixer. Make sure the extractor/dryer condenser is isolated from the evaporator and water stripper condensers. When finished steaming the extractor/dryer, shut the vent isolation valve to keep TEA vapor out of the extractor/dryer.

Shut the decant valves from the extractor/dryer. Fill the premix tank to the top with water by hooking a hose into the low point sample tap in the feed line. Run the mixer and feed pump in recirculation for five minutes, then start to centrifuge the water. Send the centrate back to the premix tank for the first minute. Continue centrifugation until the premix tank is empty.

Check the level of the centrate tank to make sure it is not overfilled during the centrifugation of the water in the premix tank. Allow the centrate tank to fill to the top with water before starting to pump the water into the evaporator. Pump about one gallon of water through the sample line and return it to the evaporator. Continue pumping water from the centrate tank to the evaporator until the centrate tank is empty.

Apply jacket/coil and heat exchanger steam to the evaporator to remove the residual TEA in the water. Caustic addition may be necessary to get all the TEA out of the water. When the temperature of the liquid in the evaporator reaches 212°F, for 10 minutes, all the TEA will be gone. Drain the water to a barrel.

Drain the water/TEA legs out of the bottom of the solvent decanter and put them in the waste TEA drum. The bulk of the TEA is now removed from the pilot plant.

External Surfaces: Any surfaces that are contaminated with PCBs will be cleaned by swabbing with solvent. Hexane/Methanol mixed in a 50/50 ratio will normally be utilized. This will be done at this time contamination occurs.

At the end of the final pilot plant internal cleaning, all equipment external surfaces will be cleaned with a steam cleaner. All PCBs contamination will have been previously removed, so water runoff from steam cleaning should not be contaminated with PCBs. However, the wash water will be collected and tested for PCBs.

Equipment Removal: Dismantling of the pilot plant begins following completion of the decontamination process. All necessary components are removed, packed on the trailer, and secured for shipment. This phase is expected to take about five days. Ionics RCC project personnel will conduct this operation and supervise outside contractors, as necessary. Equipment will normally be stored at Ionics RCC's laboratory facility in Bellevue, Washington between treatability testing projects.

The B.E.S.T. pilot plant is cleaned and decontaminated after each project. However, before disposing components of the pilot plant at time of removal from service, wipe tests shall be conducted to confirm that PCBs contamination is below 10 mg/100 cm² on process equipment surfaces.

7.4.4 CRTI Pilot Plant Demobilization

Decontamination: CRTI/Ionics to Prepare

Equipment Removal: CRTI/Ionics to Prepare

7.5 Waste Handling and Disposal

7.5.1 Waste Streams/Waste Minimization

Operation of the pilot plant will provide "product" streams of solids, water, and organics as described in previous sections and quantities summarized below. In addition, some non-product wastes or secondary blowdown streams have been identified and will be handled as described below. In any case, the amount of waste materials generated during a pilot-scale demonstration is not in any way representative of the amount of waste materials generated during full-scale operation.

Ionics RCC will store treated sediment generated during the pilot-scale tests inside the exclusion zone in containers provided by USACE. Some materials will be stored inside the building immediately adjacent to the exclusion zone. A suitable work zone will be designated for material storage. All containers will be properly labeled as specified in Foster Wheeler Environmental's Sampling Design Plan (SDP). Ionics RCC will store wastewater generated during the pilot-scale tests in containers or tanks supplied by USACE in an area near the pilot unit. Ionics RCC will package, label and properly segregate all pilot plant waste streams. These waste streams will include decontamination wastes, waste solvent, and waste personal protective equipment. These wastes will be submitted to Foster Wheeler Environmental at the end of testing. A list of waste streams and the required size of disposal containers is presented below under waste handling summary.

Steam Condensate From Steam Traps: Condensate from steam traps is non-hazardous clean water from the pilot plant auxiliary boiler. This water will never be in contact with any process waste streams. The total quantity of condensate will not normally exceed 150 gallons per day.

Boiler Blowdown: Occasional blowdown from the 9 HP boiler will be required to prevent scaling on the heating elements. This blowdown will not normally exceed 5 gallons per day. All makeup water to the boiler is obtained from the potable water supply.

Stormwater:

- Secondary Containment Stormwater: Rain collected in the secondary containment pan below the pilot plant will be accumulated and stored in 55 gallon drums. This water will be cleaned by carbon filtration. The filtered water will be added directly to the tertiary containment water after the PCBs level is verified to be below acceptable levels.
- Tertiary Containment Stormwater: Rain and snow melt in the tertiary containment will be collected and handled as described above.

Vent: The atmospheric vent discharge from the system is necessary to eliminate non-condensable gases from the various condenser systems in order to prevent reduction of heat transfer efficiency. Normally this vent gas will consist primarily of nitrogen pure gas, and traces of oxygen and other atmospheric gases. Solvent will normally be condensed by the refrigerated vent condenser. However, to assure that organic vapors are removed with an efficiency of 95% or greater per 40 CFR Section 61.242-11, an activated carbon scavenger will be located on the vent outlet.

7.5.2 Waste Handling Summary

During the pilot test, all wastes generated will be labeled and segregated per Foster Wheeler Environmental direction. All wastes will remain on site near the pilot plant until transfer to USACE for disposal. The waste anticipated to be produced are as follows:

1. Investigative derived wastes (IDW): PCBs contaminated trash, personal protective equipment (PPE), plastic, etc., will be combined and stored in 55 gallon steel drums. This material will be referred to as PCBs contaminated trash. Ionics RCC anticipates approximately two, 55 gallon steel, open head drums of IDW. The Solvated Electron Process IDW is expected to contribute about 30 pounds to the total IDW.
2. Used TEA: There should be about six (6), 55 gallon steel, closed head drums of used TEA.
3. Product solids, product organics, and excess feed: There will be one 20 gallon steel, open head drum of product solids per batch, for a total of 5 drums. There will be one 20 gallon steel, closed head drum for each organic product for a total of 2 drums. The excess feed material will remain in the containers in which it is supplied to the pilot unit, presumably, 5 gallon plastic, open head pails. This excess feed material may be returned to its original container supplied by Foster Wheeler Environmental.
4. Aqueous wastes: This includes all the water collected in the tertiary containment, product stripped water, condensate, and boiler blowdown. This will be collected in a tank on site. The amount generated will be dependent on weather conditions as well as the amount of non-contact water produced by the steam boiler outside the exclusion zone.
5. Secondary containment water: The rainwater and snow melt which collect in secondary containment (stainless steel pan) will be processed through a carbon filter and then stored in 55 gallon steel, closed head drums. The stored water will be combined with other aqueous wastes after analysis for PCBs.
6. Decontamination wastes: Decontamination waste will be produced from decontamination of the pilot unit. The decontamination waste will consist of approximately 10% solids, 5% TEA, and 85% water. The decontamination wastes may be decanted to produce an aqueous phase and a solids phase. Decontamination waste is expected to be twelve, 55 gallon steel, open head drums.
7. Carbon canisters: Carbon canisters are employed in the pilot plant vent system to remove any TEA vapors escaping the primary vent condenser. A smaller carbon canister is used to filter secondary containment pan water. Ionics RCC expects two (2), 50 gallon plastic carbon canisters to be expended.
8. The Solvated Electron Process decontamination fluid (terpene based solvent) will be collected in one 30 gallon drum. The wipes used to clean the interior surfaces will be combined with the IDW listed above.
9. CRTI condensed NH_3 after treatment (Ionics RCC to advise if this is a disposable material).

7.5.3 Leaks or Accidental Discharge of Process Streams Containing PCBs

A secondary containment pan below the entire pilot plant is provided to contain unexpected discharges of process streams. Material will be removed from the secondary containment pan and returned in the process. The volume of secondary containment available is approximately twice the volume of all material in the process unit.

Tertiary containment is provided by a raised edge membrane surface around the entire processing unit.

7.6 Ionics RCC/CRTI Operations Safety Review

To be completed upon receipt of Ionics responses to letter dated March 26
on HASP and Operations Safety Comments from Foster Wheeler Environmental

7.7 Report Preparation

After the conclusion of testing, Ionics RCC will prepare a draft and final pilot-scale treatability study report. The overall focus of the report will be on: the steps necessary to bring the technology/process to commercial-scale application; the engineering and controls related issues that must be addressed in designing, fabrication, and implementing the technology to ensure that the treatment unit will work as designed and will also provide for worker and community health and safety; and the costs to implement this technology at a site with similar conditions. The report shall include the following information:

1. A discussion of the viability of full-scale processes and/or processes.
2. Anticipated scale-up activities (design and fabrication) which will be required to be made prior to the technology becoming "commercially available".
3. Potential operational hazards (mechanical and emissions) that could exist during full-scale operations.
4. The estimated cost of a full-scale treatment operation to treat a site similar to the Hot Spot sediments being treated as part of this pilot-scale treatability study. The estimate will be based on a waste profile similar to that experienced during the pilot-scale treatability study and a volume of 15,000 cubic yards of sediment. Costs will be for the treatment component only, but will include both capital and operational costs as they relate to the following items:
 - a. Specialized handling of the sediments in terms of moisture content, process additives, particle size limitations.
 - b. The costs of the individual reagent/additives including the material plus the required process related equipment.
 - c. Cost of sediment processing per ton of feed sediment on both a wet- and dry-weight basis.
 - d. Cost of post-processing steps and procedures to facilitate handling (e.g., moisture addition or dewatering) and/or potential regulatory compliance (e.g., pH adjustment and/or potentially stabilizing the solid phase residuals to prevent leaching).
 - e. The component of the capital costs (e.g., 20 percent) which would be allocated to a single project of similar size to the Hot Spot sediments.

Foster Wheeler Environmental will incorporate the above report into the overall Treatability Study Report.

7.8 References

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Attachment IIA

Ionics RCC and CRTI Pilot Plant
Process Data Logsheets (LS)
&
Sampling and Process Data
Activity Sheets

Attachment IIA

Ionics RCC and CRTI Pilot Plant

Process Data

Logsheets (LS)

SAMPLING & PROCESS DATA
ACTIVITY SHEETS

PROCESS DATA LOGSHEETS (LS)

LS-1. PROCESS OPERATIONS

CHRONOLOGY
IONICS RCC AND CRTI TECHNOLOGIES

Client _____ Feed _____ Date _____

Time

0500 - 0530
0530 - 0600
0600 - 0630
0630 - 0700
0700 - 0730
0730 - 0800
0800 - 0830
0830 - 0900
0900 - 0930
0930 - 1000
1000 - 1030
1030 - 1100
1100 - 1130
1130 - 1200
1200 - 1230
1230 - 1300
1300 - 1330
1330 - 1400
1400 - 1430
1430 - 1500
1500 - 1530
1530 - 1600
1600 - 1630
1630 - 1700
1700 - 1730
1730 - 1800
1800 - 1830
1900 - 1930
1930 - 2000
2000 - 2030
2030 - 2100
2100 - 2130
2130 - 2200
2200 -

PROCESS DATA LOGSHEETS

LS-2, MONITORING CHECKLIST FOR

PROCESS OPERATIONS IONICS RCC AND CRTI TECHNOLOGIES

I. DAILY CHECKLIST

A. CALIBRATION

Time

Result

1. All weigh scales
2. pH meter (3 points)
3. (OTHER)

B. Utilities & Chemicals Consumption-BATCH#

1. Power meter

Reading at Start of Batch#
End of Batch

2. Steam Consumption
Water Level Start
END

3. TEA Consumption
Level at Start
End

II. ONE TIME CALIBRATIONS

1. Power meter (By Power Co.)
2. Key Tank Levels (incl. solvent surge decanter tanks, premix tank, water rec. tk)
3. Thermometer & Temp. Indicators
4. Key Flow meters
5. Pressure Indicators

Comments

P - D - C

LS-4. FEED PREPARATION

Loading and Neutralization

Project _____

Date _____

Feedstock _____

Initials: _____

Batch # _____

Extraction # _____

Screened Feed Mass

(SR)

Bucket (1)
Gross _____ lbs
Tare _____ lbs
Net _____ lbs

Bucket (2)
Gross _____ lbs
Tare _____ lbs
Net _____ lbs

Bucket (3)
Gross _____ lbs
Tare _____ lbs
Net _____ lbs

Total net wt. _____ lbs.

Approximate volume _____ gal.

Bulk density _____

Caustic Soda Addition

(with feed stock)

(a)

(_____) lbs * (0.454 kg/lb) * (_____) ml/kg = _____ ml

using _____ % NaOH

Comments

(a) Ionics to provide dosage
data calculation.

LS-5, EXTRACTION

Date _____

Initials:

Extraction #

OF

liters

min.

Why NOT CONTINUOUS?

[illegible]

P - D - L

LS-6. SOLIDS DRYING

Project _____

Date _____

Feedstock _____

Initials: _____

Batch # _____

Caustic Addition (Sheet 4 ?)

Time									
Overhead Temp. F (4)									
Solids Temp. F (10)									
Dryer Power High / Low									
Injection Steam On / Off									
Injection Steam Inlet (PSIG)									
Injection Steam Outlet (PSIG)									
Jacket Steam Pres. (PSIG)									
Jacket Condensate Flow (mls/min)									

Product Solids:

(S3) *

Gross Weight

Tare

Net prod. solids

lbs

lbs

lbs

Bulk Density Volume
lbs/gal gal

Comments

* INTERSTAGE (ie. solvent-laden)
sediment will be sampled
during extraction cycles. No
wt, bulk density, or moisture %
will be recorded.

P - D - L

LS-7. EVAPORATION ~~FOR~~ SOLVENT RECOVERY
OIL POLISHING

Project _____

Date _____

Feedstock _____

Initials: _____

Batch # _____

Page _____ of _____

Time									
Overhead Temp. F (4)									
Evaporator Liquid F (6)									
Solvent Decanter F (7)									
Solvent Temp. F (8)									
Cooling Water Temp. (F)									
Water Reciever Level (liters)									
Solvent Tank Level (liters)									
Evaporator Level (liters)									
Reflux Rate (GPH)									
Steam Coil Pres. (PSIG)									
Steam Coil Flow (mls/min)									
Oil Polish HTR. Pres. (PSIG)									
Oil Polish HTR. Flow (mls/min)									
Centrifuge On / Off									
Centrate Path (evap, p/m tank, N/A)									

S4 - RAW PRODUCT OIL (Before Polishing) _____ Volume-liters
S10 - RAW POLISHED OIL COMPOSITE _____ Liters

Comments _____

	empty	full
Sample bottle wt:		

P - D - L

LS-8. DEHYDRATION LOG

Project _____

Date _____

Feedstock _____

Initials: _____

Batch # _____

Extraction # _____

Time										
Solvent Tank Level (liters)										
Evaporator Level (liters)										
Water reciever Level (liters)										
Combined Level (liters)										
Overhead Temp. F (4)										
Solids Temp. F (10)										
Solvent Temp. F (8)										

Remarks:

When do we run Dehydration?

P - D - C

Date _____

Initials:

START

Time injection steam started _____
Time feed introduced to column _____
Time start collecting prod. water _____

Total production
Time for 100 units
Time cost per unit

[illegible]

LS-10

Process Data Sheet
for
Field Vent Gas Analyses

Date: _____

Sampler-Drager Detector Tubes:

GAS/VAPOR	MEASURING RANGE ¹	MODEL NO.	TLV ⁴
Ammonia	5-700 ppm	TM-4613	25 ppmv
TEA	5-60	TM-5450	1

Time	Sample ID	Stream Description	Batch ID No.	Contaminant Concentration ppmv		Comment
				TEA ¹	NH ₃ ²	
	S7-1 ³	BEST untreated vent gas				
	S7-2					
	S8-1	BEST treated vent gas				
	S8-2					
	S13-1	CRTI untreated vent gas				
	S13-2					
	S14-1	CRTI treated vent gas				
	S14-2					
	TEA calibration check at _____ ppm					
	NH ₃ calibration check at _____ ppm					

- Note: ¹ TEA concentration level for corrective action _____ ppmv.
² NH₃ concentration level for corrective action _____ ppmv.
³ Sample ID: S7-1 is first S7 sample taken, etc.
⁴ TLV - Threshold Lower Value

LS-11 CRT1 PROCESS DATA SHEET 7
~~CMDU2 MANUAL DATA LOG~~ AB

TEST: Run Number Matrix Mass, g
 Run Date Calcium Mass, g
 Beginning Run Time Ammonia Vol., ml
 Ambient Temperature ... Pre-mix Time.....

PROCESS:

Step #	Elapsed Time	Pres., PSIG	Temp., °F	1/R, Mhos
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

RESULTS: Total Contact Time
 Beginning PCB Concentration, ppm
 Ending PCB Concentration, ppm.....

P - 12 - L

LS-12 IONICS RCC BATCH SUMMARY

A. EXTRACTION/SOLVENT RECOVERY BATCH#
B. OIL POLISHING/WATER STRIPPING BATCH#

Project _____

Date Begin _____

Feedstock _____

Date Complete _____

Carbon Filter

Installation Wt. _____ lbs

Removal Wt. * _____ lbs

*Is carbon adsorption performance monitored by weight gain?

Solvent Decanter

Preload _____ liters

Removed TEA _____ liters

Removed Water _____ liters

Centrate Filter

Installed Wt. _____ grams

Size _____

Removed Wt. _____ grams

Removed _____

Solvent Use

(S6)

Load _____ lbs

Unload _____ lbs

How is this recorded?

Feed Loaded

(S1)

Sediment _____ lbs

or
(S4)

Raw Unpolished Oil _____

Caustic Load

_____ mls

Treated Products Recovered:)

(S3)

Solids _____ lbs

(S5)

Stripped

Water _____ lbs

(S10)

Polished

Oil _____ lbs

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST EXTRACTION & SEDIMENT DRYING DATE: _____

BATCH NO.: E-1

TEST DAY NO.: 1

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)* - scales - pH meter - other	X											
4. UTILITIES & CHEMICALS (LS-2) - power reading, KWH. - steam (water level), ht - makeup TEA tank level, ht		X X X								X X X		
5. FEED PREP (LS-3) <u>Loading & Neutralization</u> - S1 feed net wt. - each extraction no. () - caustic add.		X - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -		
6. EXTRACTION (LS-5) <u>Each Extraction</u> - TEA fill time - TEA tank level - N ₂ flow & time - solvent temp. - OVHD temp. - ext./dryer temp.		- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -		
7. SOLIDS DRYING (LS-6) - S3 treated sediment, net. wt.										X		

BATCH NO. E-1TEST DAY No. 1

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
8. SAMPLING												
- S6 solvent feed TEA		X								X		
- S1 feed		X										
- S3 ₂ treated sediment			X									
- S3 ₄			X									
- S3 ₆				X								
- S3 ₈				X								
- S4 unpolished raw oil										X		
- S7* untreated vent gas		X								X		
- S8* treated vent gas		X								X		

Notes: ^a LS refers to Process Data Logsheet.

* See Field Vent Gas Logsheet LS-10.

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST SOLVENT RECOVERY DATE: _____

BATCH NO.: E-1 TEST DAY NO.: 2

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X											
4. UTILITIES & CHEMICALS (LS-2)		X								X		
5. EVAPORATION SOLVENT RECOVERY (LS-7) - OVHD temperature - evaporation liquid temperature - solvent decanter - etc.		-- AS REQ'D --										
6. SAMPLING - S6 solvent - S7* - S8*		-- ASSUME CONTINUOUS VENTING --									X	
7. TREATED SEDIMENT S3 on-site analysis		-	-	-	-	-	-	-	-			

* see LS-10

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST EXTRACTION & SEDIMENT DRYING DATE: _____

BATCH NO.: E-2

TEST DAY NO.: 3

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2) ^a - scales - pH meter - other	X											
4. UTILITIES & CHEMICALS (LS-2) - power reading, KWH - steam (water level), ht - makeup TEA tank level, ht		X X X								X X X		
5. FEED PREP (LS-3) <u>Loading & Neutralization</u> - S1 feed net wt. - each extraction no. () - caustic add.		X										
6. EXTRACTION (LS-5) <u>Each Extraction</u> - TEA fill time - TEA tank level - N ₂ flow & time - solvent temp. - OVHD temp. - ext./dryer temp.												
7. SOLIDS DRYING (LS-6) - S3 treated sediment, net. wt.										X		

BATCH NO. E-2TEST DAY No. 3

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
8. SAMPLING												
- S6 solvent feed TEA		X								X		
- S1 feed		X										
- S3 ₂ treated sediment			X									
- S3 ₄			X									
- S3 ₆				X								
- S3 ₈				X								
- S4 unpolished raw oil										X		
- S7* untreated vent gas		X								X		
- S8* treated vent gas		X								X		

Notes: ^a LS refers to Process Data Logsheet.

* See Field Vent Gas Logsheet LS-10.

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST SOLVENT EXTRACTION DATE: _____

BATCH NO.: E-2 TEST DAY NO.: 4

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X	X										
4. UTILITIES & CHEMICALS (LS-2)		X								X		
5. EVAPORATION SOLVENT RECOVERY (LS-7) - OVHD temperature - evaporation liquid temperature - solvent decanter - etc.					AS REQ'D							
6. SAMPLING - S6 solvent - S7* - S8*					ASSUME CONTINUOUS VENTING					X		
7. TREATED SEDIMENT S3 on-site analysis												

* see LS-10

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST EXTRACTION & SEDIMENT DRYING DATE: _____

BATCH NO.: E-3 TEST DAY NO.: 5

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)* - scales - pH meter - other	X											
4. UTILITIES & CHEMICALS (LS-2) - power reading, KWH. - steam (water level), ht - makeup TEA tank level, ht		X X X								X X X		
5. FEED PREP (LS-3) <u>Loading & Neutralization</u> - S1 feed net wt. - each extraction no. () - caustic add.		X — —	— — —	DATA AS REQ'D								
6. EXTRACTION (LS-5) <u>Each Extraction</u> - TEA fill time - TEA tank level - N ₂ flow & time - solvent temp. - OVHD temp. - ext./dryer temp.		— — —	— — —	DATA AS REQ'D								
7. SOLIDS DRYING (LS-6) - S3 treated sediment, net. wt.										X		

BATCH NO. E-3TEST DAY No. 5

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
8. SAMPLING												
- S6 solvent feed TEA		X								X		
- S1 feed		X										
- S3 ₂ treated sediment			X									
- S3 ₄			X									
- S3 ₆				X								
- S3 ₈				X								
- S4 unpolished raw oil										X		
- S7* untreated vent gas		X								X		
- S8* treated vent gas		X								X		

Notes: * LS refers to Process Data Logsheet.

* See Field Vent Gas Logsheet LS-10.

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST SOLVENT RECOVERY DATE: _____

BATCH NO.: E-3 TEST DAY NO.: 6

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X											
4. UTILITIES & CHEMICALS (LS-2)		X										
5. EVAPORATION SOLVENT RECOVERY (LS-7) - OVHD temperature - evaporation liquid temperature - solvent decanter - etc.												
6. SAMPLING - S6 solvent - S7* - S8*												
7. TREATED SEDIMENT S3 on-site analysis												

* see LS-10

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST OIL POLISHING & WATER STRIPPING DATE: _____

BATCH NO.: P-1 TEST DAY NO.: 7

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X											
4. UTILITIES & CHEMICALS (LS-2)		X								X		
5. EVAPORATION/OIL POLISHING (LS-7) - OVHD temperature - evaporation temperature - etc.		DATA AS REQ'D										
6. DECANT WATER STRIPPING (LS-9) - water receiver level - flow rate - etc.												
7. SAMPLING - S10 raw polished oil composite - S7* - S8* - S5 stripped water - S6 (more recovered solvent)		ASSUME CONTINUOUS VENTING									X X X	

* see LS-10

PROCESS STEPS: NO PROCESSING
SYSTEM CLEANOUT DATE: _____

TEST DAY NO.: 8

REV. A
D96-009
03/28/96

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST EXTRACTION & SEDIMENT DRYING DATE: _____

BATCH NO.: E-4

TEST DAY NO.: 9

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)* - scales - pH meter - other	X											
4. UTILITIES & CHEMICALS (LS-2) - power reading, KWH. - steam (water level), ht - makeup TEA tank level, ht		X X X								X X X		
5. FEED PREP (LS-3) <u>Loading & Neutralization</u> - S1 feed net wt. - each extraction no. () - caustic add.		X - -	- -	- -	- -	- -	- -	- -	- -	- -		
6. EXTRACTION (LS-5) <u>Each Extraction</u> - TEA fill time - TEA tank level - N ₂ flow & time - solvent temp. - OVHD temp. - ext./dryer temp.		- -	- -	- -	- -	- -	- -	- -	- -	- -		
7. SOLIDS DRYING (LS-6) - S3 treated sediment, net. wt.										X		

BATCH NO. E-4TEST DAY No. 9

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
8. SAMPLING												
- S6 solvent feed TEA		X								X		
- S1 feed		X										
- S3 ₂ treated sediment			X									
- S3 ₄			X									
- S3 ₆				X								
- S3 ₈				X								
- S4 unpolished raw oil											X	
- S7* untreated vent gas		X									X	
- S8* treated vent gas		X									X	

Notes: ^a LS refers to Process Data Logsheet.

* See Field Vent Gas Logsheet LS-10.

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: CRTI PCBs DESTRUCT DATE: _____

BATCH NO.: C-1 TEST DAY NO.: 9

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
												Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. UTILITIES & CHEMICALS (LS-11) - TBD												
4. PCBs DESTRUCT UNIT (LS-11) - TBD												
5. SAMPLING - S11 dechlorinated oil - S12 liquid NH ₃ - S13* untreated vent gas - S14* treated vent gas						X X						

* see LS-10

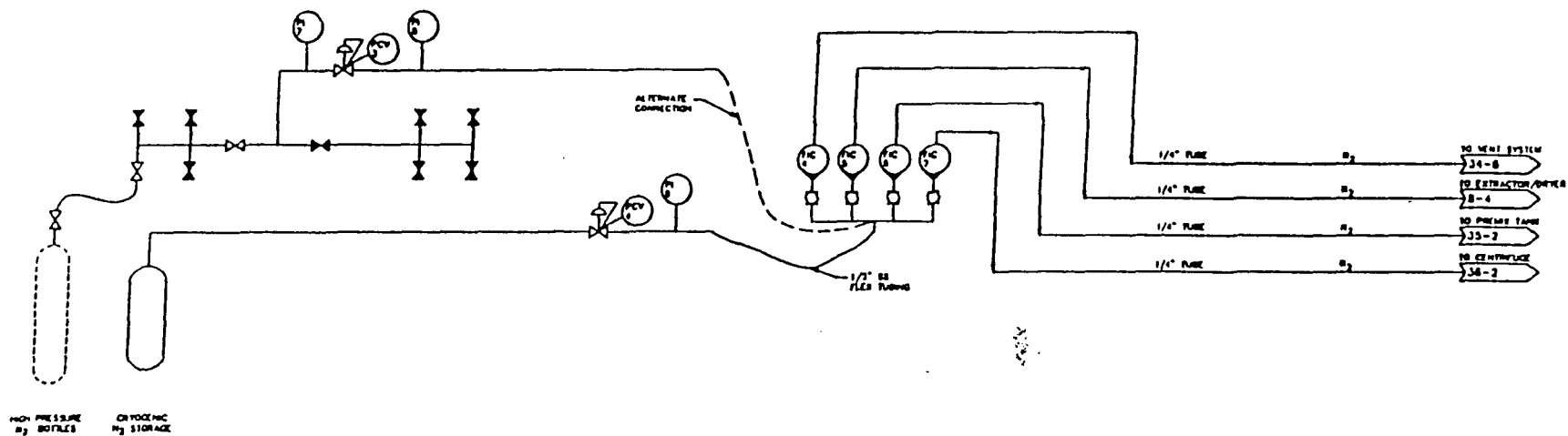
SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST SOLVENT RECOVERY DATE: _____

BATCH NO.: E-4 TEST DAY NO.: 10

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X											
4. UTILITIES & CHEMICALS (LS-2)		X										
5. EVAPORATION SOLVENT RECOVERY (LS-7) - OVHD temperature - evaporation liquid temperature - solvent decanter - etc.		- - AS RECD - -										
6. SAMPLING - S6 solvent - S7* - S8*										X		
7. TREATED SEDIMENT S3 on-site analysis												

* see LS-10



REVISIONS <table border="1"> <thead> <tr> <th>REV</th> <th>DATE</th> <th>BY</th> <th>CHKD</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>										REV	DATE	BY	CHKD	DESCRIPTION	1					WORKING COPY This drawing is the property of Resources Conservation Company and is not to be distributed outside the company without written permission. It is to be used only for the purpose for which it was prepared. It is not to be used for any other purpose without the written consent of Resources Conservation Company.										<table border="1"> <thead> <tr> <th>REV</th> <th>DATE</th> <th>BY</th> <th>CHKD</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>										REV	DATE	BY	CHKD	DESCRIPTION	1				
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P. & I. O.
NITROGEN SYSTEM
B.E.S.T. COMPONENT TEST APPARATUS
CUSTOMER ORDER NO.
RESOURCES CONSERVATION COMPANY

375-M4-1
PAGE 11

PROCESS STEPS: NO PROCESSING DATE: _____

BATCH NO.: C-1 & C-2 TEST DAY NO.: 10

REV. A
D96-009
03/28/96

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST EXTRACTION & SEDIMENT DRYING DATE: _____

BATCH NO.: E-5

TEST DAY NO.: 11

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)* - scales - pH meter - other	X											
4. UTILITIES & CHEMICALS (LS-2) - power reading, KWH. - steam (water level), ht - makeup TEA tank level, ht		X X X								X X X		
5. FEED PREP (LS-3) <u>Loading & Neutralization</u> - S1 feed net wt. - each extraction no. () - caustic add.		X - -	- -	- -	- -	- -	- -	- -	- -	- -		
6. EXTRACTION (LS-5) <u>Each Extraction</u> - TEA fill time - TEA tank level - N ₂ flow & time - solvent temp. - OVHD temp. - ext./dryer temp.		- -	- -	- -	- -	- -	- -	- -	- -	- -		
7. SOLIDS DRYING (LS-6) - S3 treated sediment, net. wt.										X		

Notes: ^a LS refers to Process Data Logsheet.
* See Field Vent Gas Logsheet LS-10.

BATCH NO.: C-3 TEST DAY NO.: 11

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: CRTI DATE: _____

BATCH NO.: C-4 TEST DAY NO.: 11

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
												Clean Up
1. H&S MEETING												
2. REVIEW SUMMARY OF TESTS TO PERFORM												
3. UTILITIES & CHEMICALS (LS-11) - TBD						-	-	-	-	-		
4. PCBs DESTRUCT UNIT (LS-11) - TBD						-	-	-	-	-		
5. SAMPLING - S11 dechlorinated oil - S12 liquid NH ₃ - S13* untreated vent gas - S14* treated vent gas						-	-	-	-	X X -		

* see LS-10

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST SOLVENT RECOVERY DATE: _____

BATCH NO.: E-5 TEST DAY NO.: 12

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X											
4. UTILITIES & CHEMICALS (LS-2)	X											
5. EVAPORATION SOLVENT RECOVERY (LS-7) - OVHD temperature - evaporation liquid temperature - solvent decanter - etc.		-	-	-	-	-	-	-	-	-		
6. SAMPLING - S6 solvent - S7* - S8*		-	-	-	-	-	-	-	-	X		
7. TREATED SEDIMENT S3 on-site analysis		-	-	-	-	-	-	-	-	-		

* see LS-10

PROCESS STEPS: NO PROCESSING DATE: _____

BATCH NO.: C-3 & C-4 TEST DAY NO.: 12

[illegible]

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: BEST OIL POLISHING & WATER STRIPPING DATE: _____

BATCH NO.: P-2 TEST DAY NO.: 13

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
	Start Up	Normal Batch Testing Period									Shut Down	Clean Up
1. H&S MEETING	X											
2. REVIEW SUMMARY OF TESTS TO PERFORM	X											
3. CALIBRATION (LS-2)	X											
4. UTILITIES & CHEMICALS (LS-2)		X								X		
5. EVAPORATION/OIL POLISHING (LS-7) - OVHD temperature - evaporation temperature - etc.		-	-	-	-	-	-	-	-	-		
6. DECANT WATER STRIPPING (LS-9) - water receiver level - flow rate - etc.		-	-	-	-	-	-	-	-	-		
7. SAMPLING - S10 raw polished oil composite - S7* - S8* - S5 stripped water - S6 (more recovered solvent)		-	-	-	-	-	-	-	-	X - X X		

* see LS-10

NO PROCESSING

BATCH NO.:

TEST DAY NO.: 4

[illegible]

PROCESS STEPS: CRT1 DATE: _____

BATCH NO.: C-5 TEST DAY NO.: 15

[illegible]

REV. A
D96-009
03/28/96

SCHEDULE FOR SAMPLING & PROCESS DATA ACTIVITIES
IONICS RCC/CRTI PILOT TESTS

PROCESS STEPS: CRTI DATE: _____

BATCH NO.: C-6 TEST DAY NO.: 15

ON-SITE ACTIVITIES	WORKING HOURS/DAY											
	1	2	3	4	5	6	7	8	9	10	11	12
												Clean Up
1. H&S MEETING												
2. REVIEW SUMMARY OF TESTS TO PERFORM												
3. UTILITIES & CHEMICALS (LS-11) - TBD						—	—	—	—	—		
4. PCBs DESTRUCT UNIT (LS-11) - TBD						—	—	—	—	—		
5. SAMPLING - S11 dechlorinated oil - S12 liquid NH ₃ - S13* untreated vent gas - S14* treated vent gas						—	—	—	—	X X —		

* see LS-10

PROCESS STEPS: NO PROCESSING DATE: _____

BATCH NO.: C5 & C6 TEST DAY NO.: 16

[illegible]

Attachment IIB

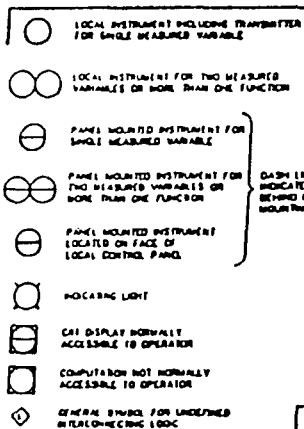
Ionics RCC and CRTI Pre-Pilot
Bench-Scale Test Programs

Attachment IIC

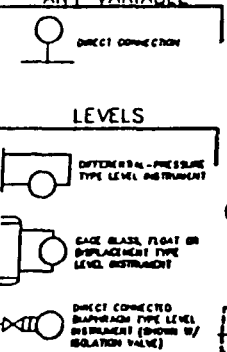
B.E.S.T. Pilot Plant
Engineering Drawings

INSTRUMENTS

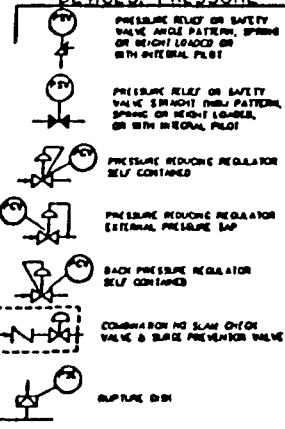
INSTRUMENTS



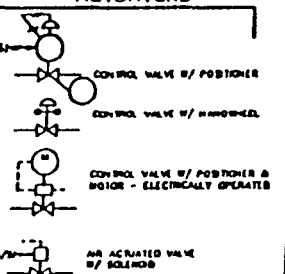
TYPICAL CONNECTION ANY VARIABLE



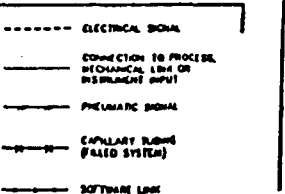
SELF ACTUATED DEVICES, PRESSURE



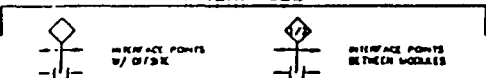
ACTUATORS



LINES

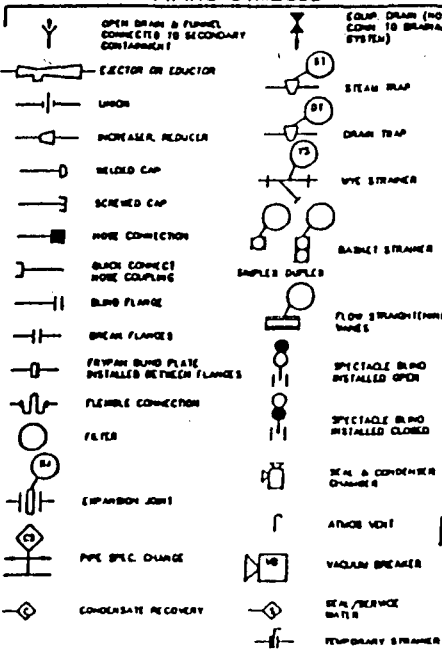


INTERFACES

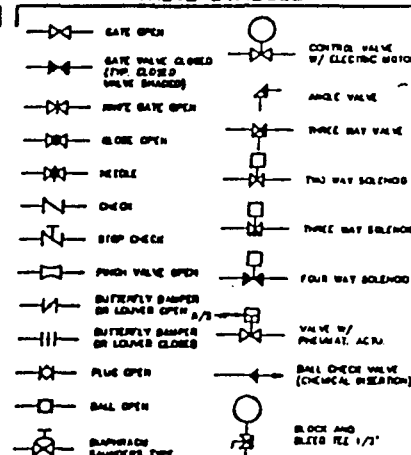


PIPING & VALVES

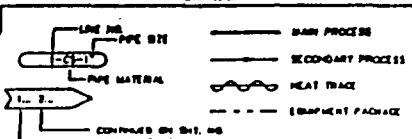
PIPING SYMBOLS



VALVE SYMBOLS



LINES



ABBREVIATIONS & MISCELLANEOUS

ABBREVIATION LEGEND

AC AIR CLOSURE
AD AIR DRAIN
A/S INSTRUMENT AIR SUPPLY
CA CHANGE SPECIFICATION
FC FAN CLOSURE ON AIR SUPPLY LOSS
FB FLOOR DRAINAGE SYSTEM
FO FLOW OPEN
H NEW EQUIPMENT INSTRUMENTS & VALVES USED WHERE REQUIRED
HC NORMALLY CLOSED
HO NORMALLY OPEN
P/S PURGE WATER SUPPLY
R/S RESISTANCE TEMPERATURE DETECTION
SV SAMPLE VALVE (1/2" SIZE UNLESS OTHERWISE NOTED)
T/C THERMOCOUPLE
V VENTED TO ATMOSPHERE
W/W WATER SUPPLY
CO DRAIN OPERATED
TDS TOTAL DISSOLVED SOLIDS
TS TENSILE SOLIDS
TDS TOTAL DISSOLVED SOLIDS
MS NOT IN SERVICE

DRIVERS

(M) ELECTRIC MOTOR
(H) HYDRAULIC MOTOR
(P) PNEUMATIC MOTOR

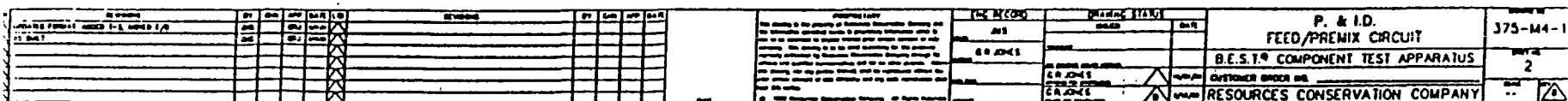
NOTES

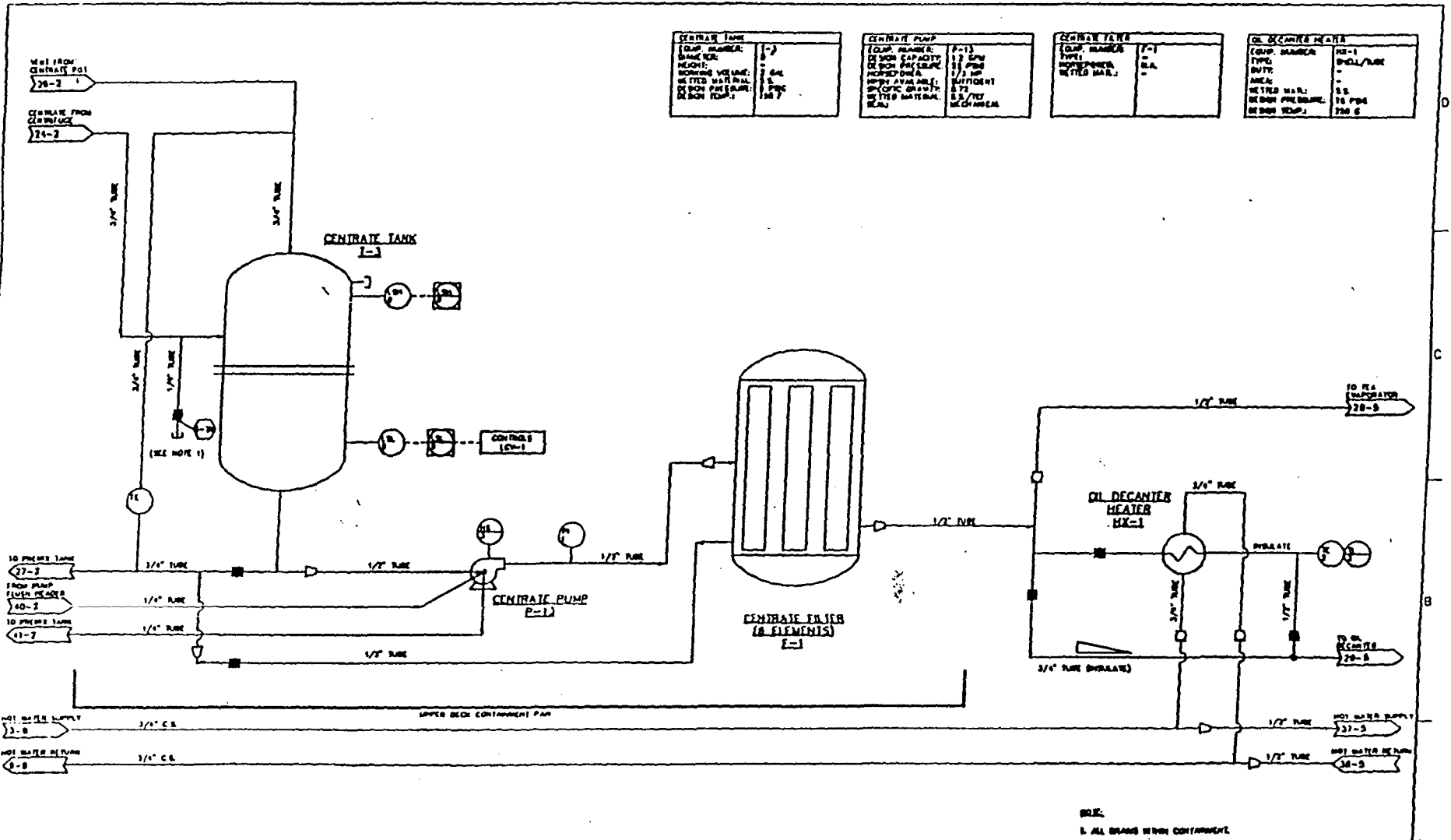
1. ALL INSTRUMENTATION SYMBOLS & IDENTIFICATION ARE PER THE INSTRUMENT SOCIETY OF AMERICA (ISA) STANDARD-LATEST REVISION AND 752 241075.
(S-1) SAMPLE LOCATION #1 (SEE FIG. B)

REVISIONS				DRAWING STANDARDS				P. & I.D. LEGEND		375-M4-1	
NO.	DATE	BY	CHKD.	NO.	DATE	BY	CHKD.	NO.	DATE	BY	CHKD.
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B.E.S.T. COMPONENT TEST APPARATUS
CUSTOMER ORDER NO.
RESOURCES CONSERVATION COMPANY

1 OF 12
--





CENTRATE TANK	
COMP. NUMBER:	E-1
NAME:	CENTRATE TANK
HEIGHT:	6' 0"
WORKING VOLUME:	50 GAL
DESIGN PRESSURE:	15 PSIG
DESIGN TEMP.:	140 F

CENTRATE PUMP	
COMP. NUMBER:	P-12
DESIGN CAPACITY:	1.2 GPM
DESIGN PRESSURE:	15 PSIG
DESIGN TEMP.:	140 F
WORK AVAILABLE:	SUFFICIENT
SPECIFIC GRAVITY:	1.2
DESIGN MATERIAL:	SS/70
DESIGN MECHANISM:	POSITIVE DISPLACEMENT

CENTRATE TANK	
COMP. NUMBER:	E-1
NAME:	CENTRATE TANK
HEIGHT:	6' 0"
WORKING VOLUME:	50 GAL
DESIGN PRESSURE:	15 PSIG
DESIGN TEMP.:	140 F

OIL DECANTER HEATER	
COMP. NUMBER:	HX-1
TYPE:	HEAT EXCHANGER
DATE:	-
AREA:	-
DESIGN PRESSURE:	15 PSIG
DESIGN TEMP.:	140 F

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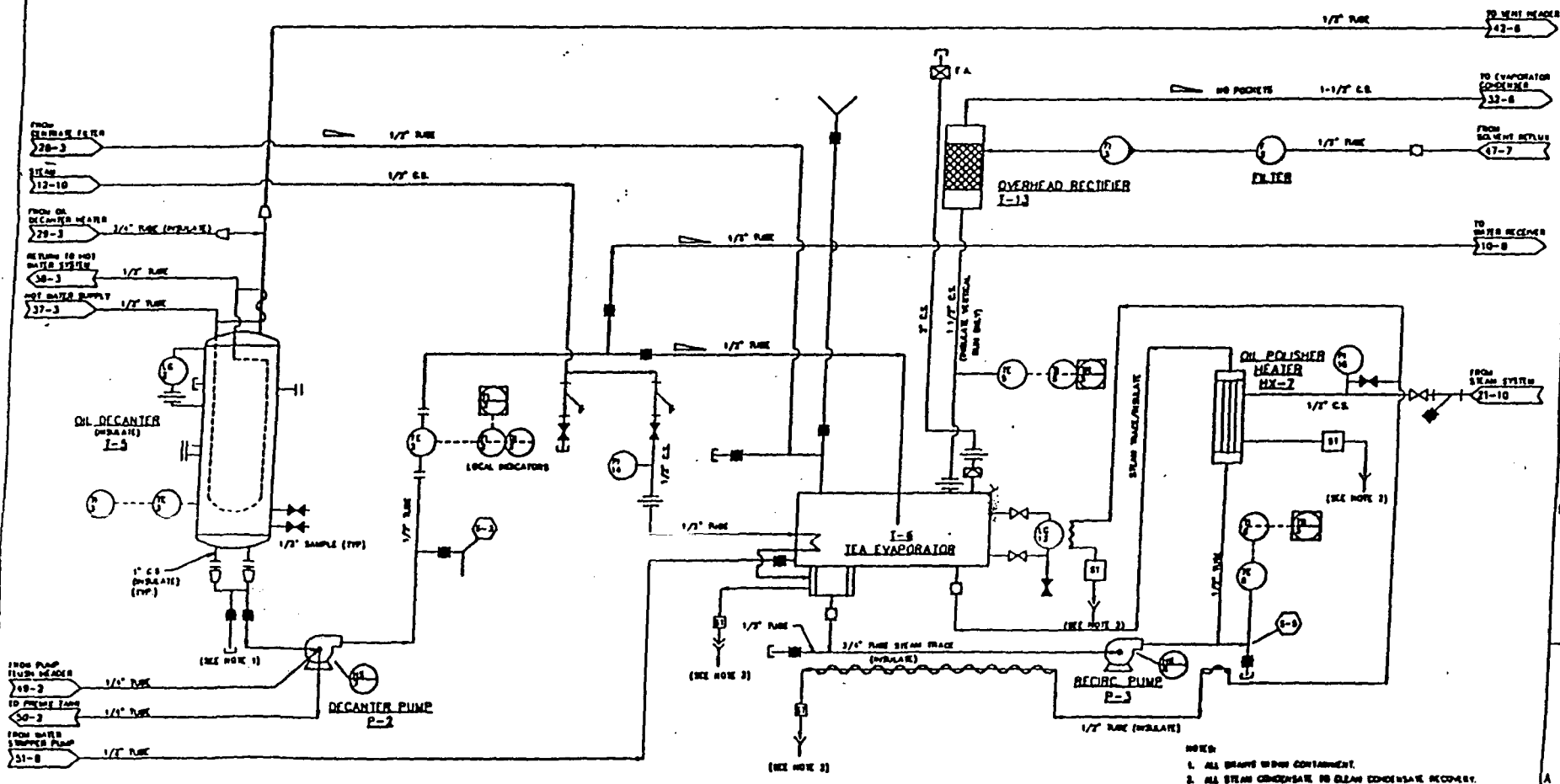
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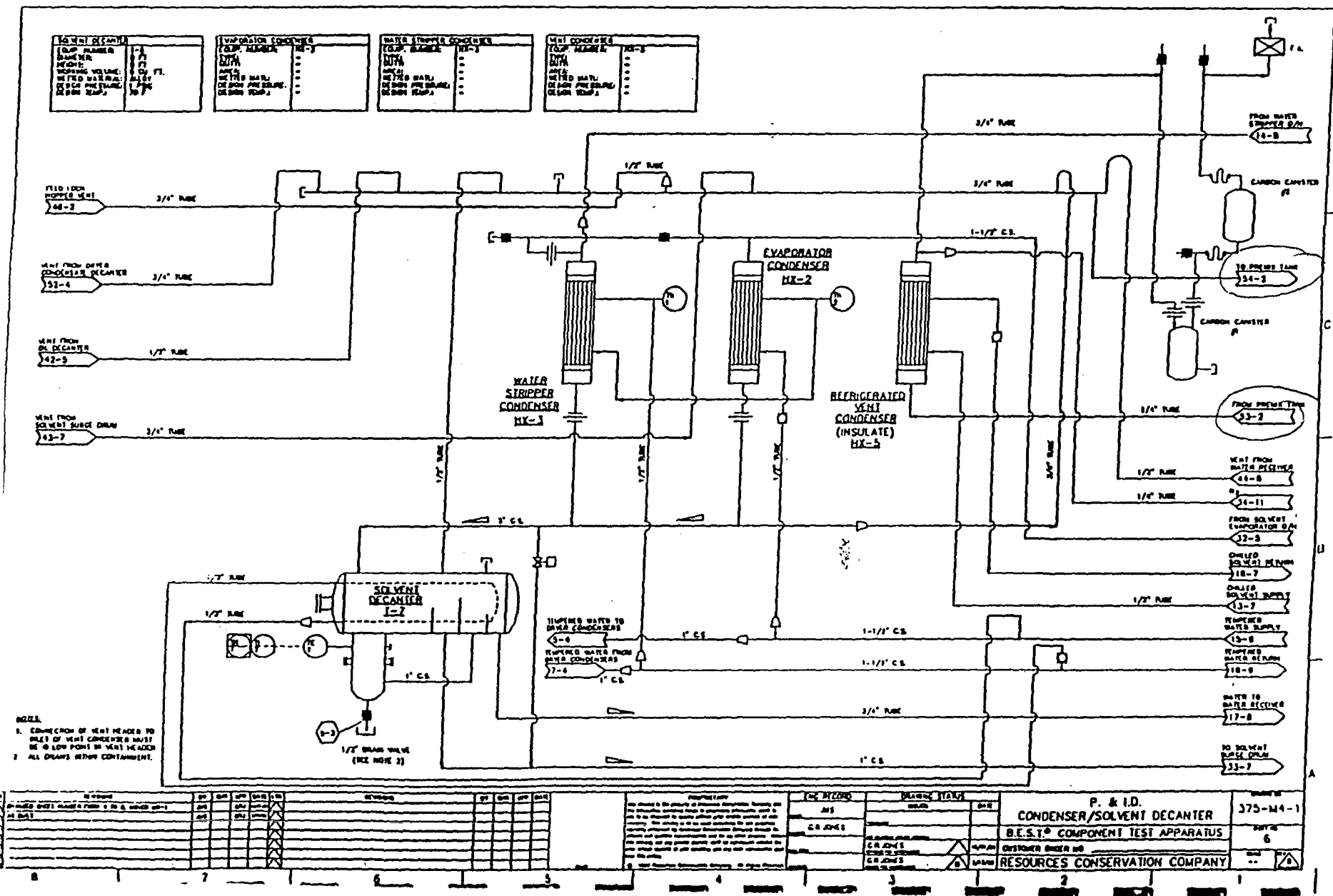
P. & I.O. CENTRATE CIRCUIT		375-M4-1
B.E.S.T.* COMPONENT TEST APPARATUS		3
CUSHING BROS INC.		
RESOURCES CONSERVATION COMPANY		

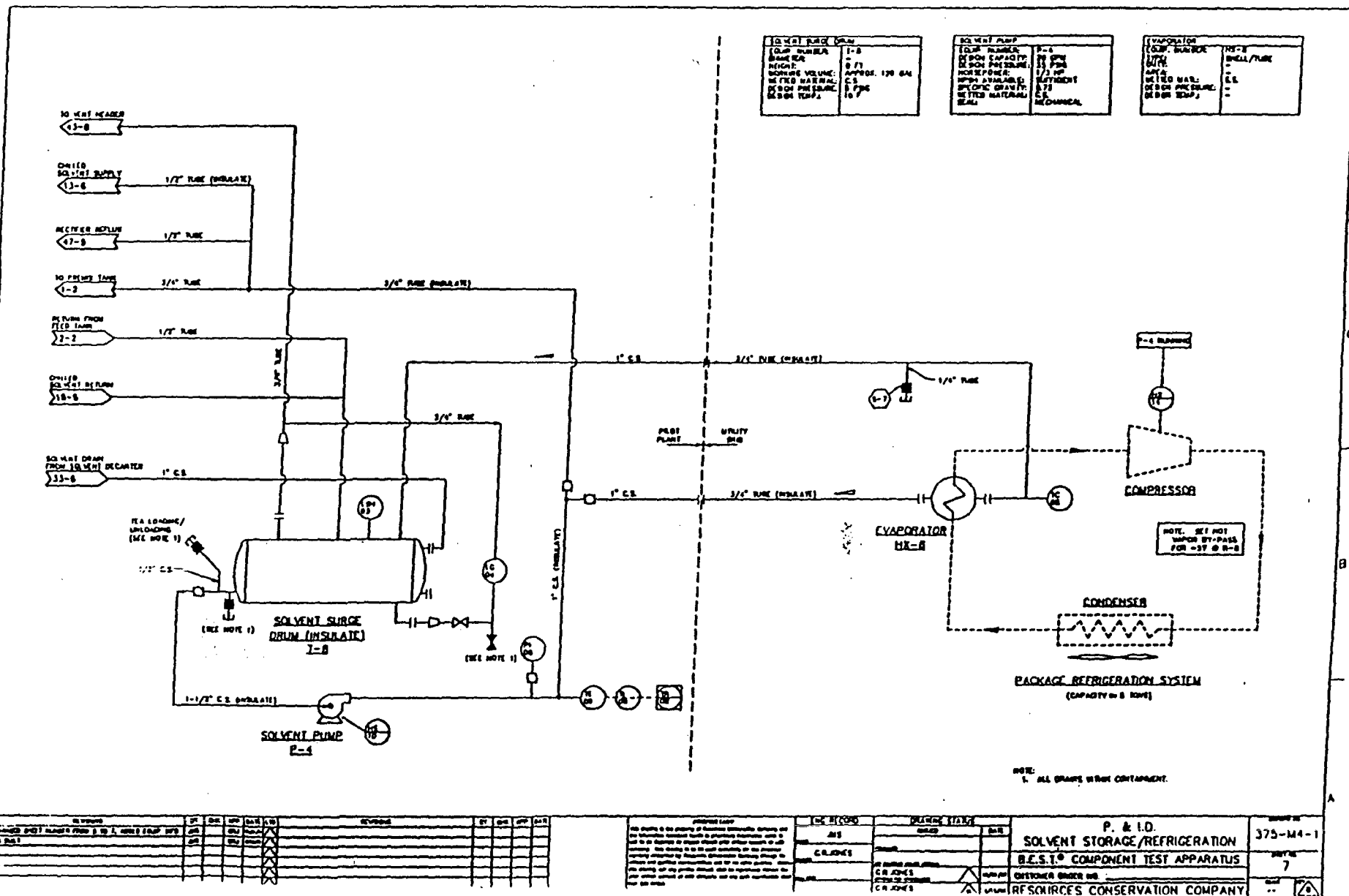
OIL DECANTER (OIL NUMBER: 1-3) DESIGN VOLUME: APPROX 30 GAL DESIGN PRESSURE: 15 PSIG DESIGN TEMP: 150°F	OIL DECANTER PUMP (OIL NUMBER: 1-3) DESIGN CAPACITY: 11 GPM DESIGN PRESSURE: 11 PSIG DESIGN TEMP: 150°F MOTOR POWER: 1/2 HP MOTOR VOLTAGE: 115V MOTOR PHASE: 3 PH MOTOR FREQUENCY: 60 HZ MOTOR SPEED: 1725 RPM MOTOR TYPE: 1/2 HP MOTOR EFFICIENCY: 85%	WATER PUMP (OIL NUMBER: 1-3) DESIGN CAPACITY: 11 GPM DESIGN PRESSURE: 11 PSIG DESIGN TEMP: 150°F MOTOR POWER: 1/2 HP MOTOR VOLTAGE: 115V MOTOR PHASE: 3 PH MOTOR FREQUENCY: 60 HZ MOTOR SPEED: 1725 RPM MOTOR TYPE: 1/2 HP MOTOR EFFICIENCY: 85%	OVERHEAD RECTIFIER (OIL NUMBER: 1-3) DESIGN VOLUME: APPROX 30 GAL DESIGN PRESSURE: 15 PSIG DESIGN TEMP: 150°F	OIL POLISH HEATER (OIL NUMBER: 1-3) DESIGN VOLUME: APPROX 30 GAL DESIGN PRESSURE: 15 PSIG DESIGN TEMP: 150°F	WATER VAPORATOR (OIL NUMBER: 1-3) DESIGN VOLUME: APPROX 30 GAL DESIGN PRESSURE: 15 PSIG DESIGN TEMP: 150°F
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- NOTES:
1. ALL DRAWS WITHIN CONTAINMENT.
2. ALL STEAM CONDENSATE TO CLEAN CONDENSATE RECOVERY.

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10 VENT SURGE DRUM	
DRUM NUMBER	1-8
DESIGN	10 VENT
DESIGN PRESSURE	10 PSIG
DESIGN TEMPERATURE	100°F
DESIGN VOLUME	100 GALS
DESIGN MATERIAL	CS
DESIGN PRESSURE	10 PSIG
DESIGN TEMPERATURE	100°F

SOLVENT PUMP	
DRUM NUMBER	P-4
DESIGN PRESSURE	10 PSIG
DESIGN TEMPERATURE	100°F
DESIGN VOLUME	100 GALS
DESIGN MATERIAL	CS
DESIGN PRESSURE	10 PSIG
DESIGN TEMPERATURE	100°F

EVAPORATOR	
DRUM NUMBER	HX-8
DESIGN PRESSURE	10 PSIG
DESIGN TEMPERATURE	100°F
DESIGN VOLUME	100 GALS
DESIGN MATERIAL	CS
DESIGN PRESSURE	10 PSIG
DESIGN TEMPERATURE	100°F

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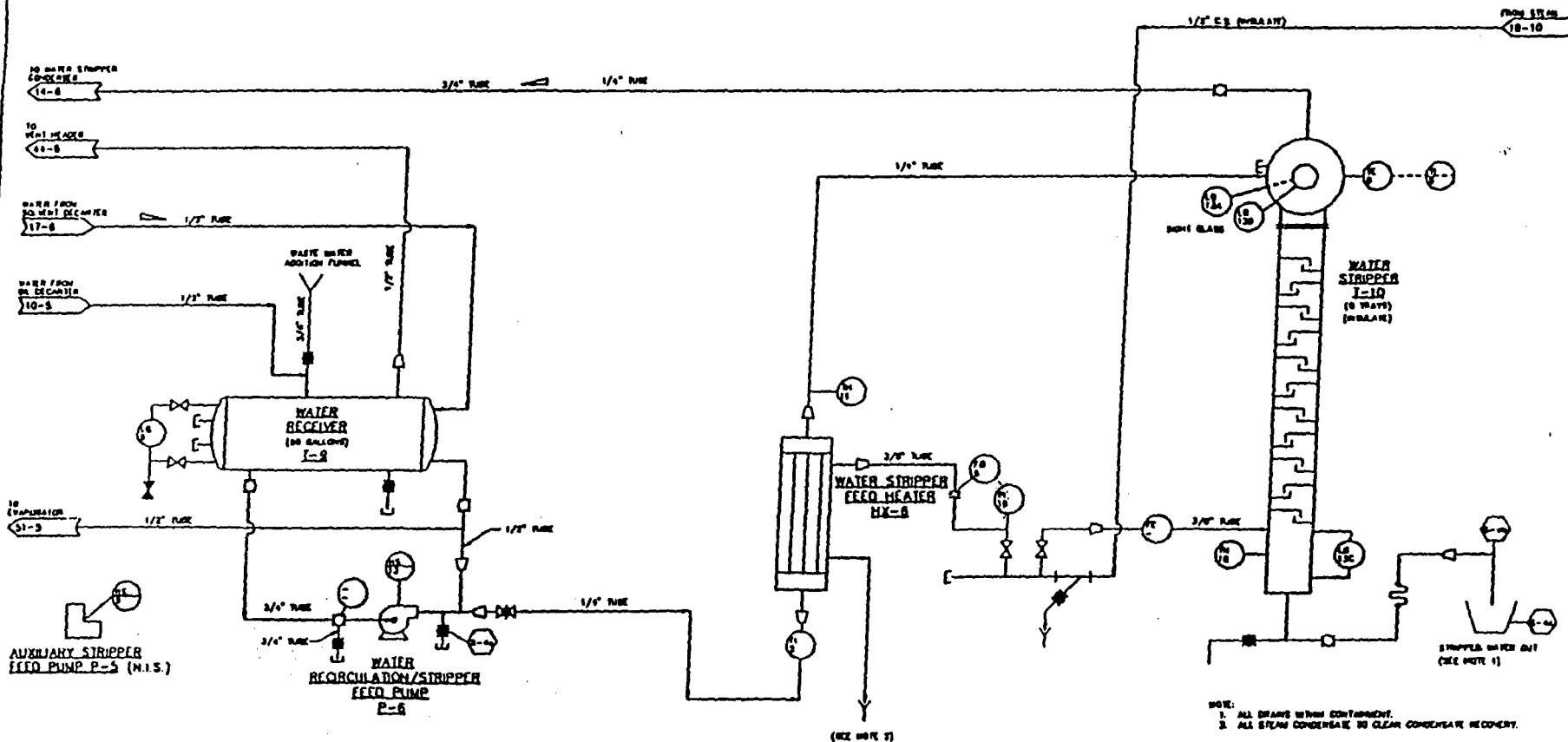
WATER REQUIRED	
CROP NUMBER:	1-8
INCHES:	0
HEIGHT:	0 FT
GROWING VOLUME:	APPROX 80 GAL
NET MATERIAL:	2.5
OF DRY WEIGHT:	2 PPM
IN DRY TEND:	2007

AUG. STOPPER FEED P.V.	
1 QRP, NUMBER:	P-5
IN 500 CAPACITY:	250 ML/WH
IN 500 PRE-DRUM:	5 PMS
WORTH PMS:	-
IN 504 AVAILABLE:	SUFFICIENT
SPECIFIC QUANTITY:	10
RETTED MATERIAL:	ALL BY
RE AL:	PACKED

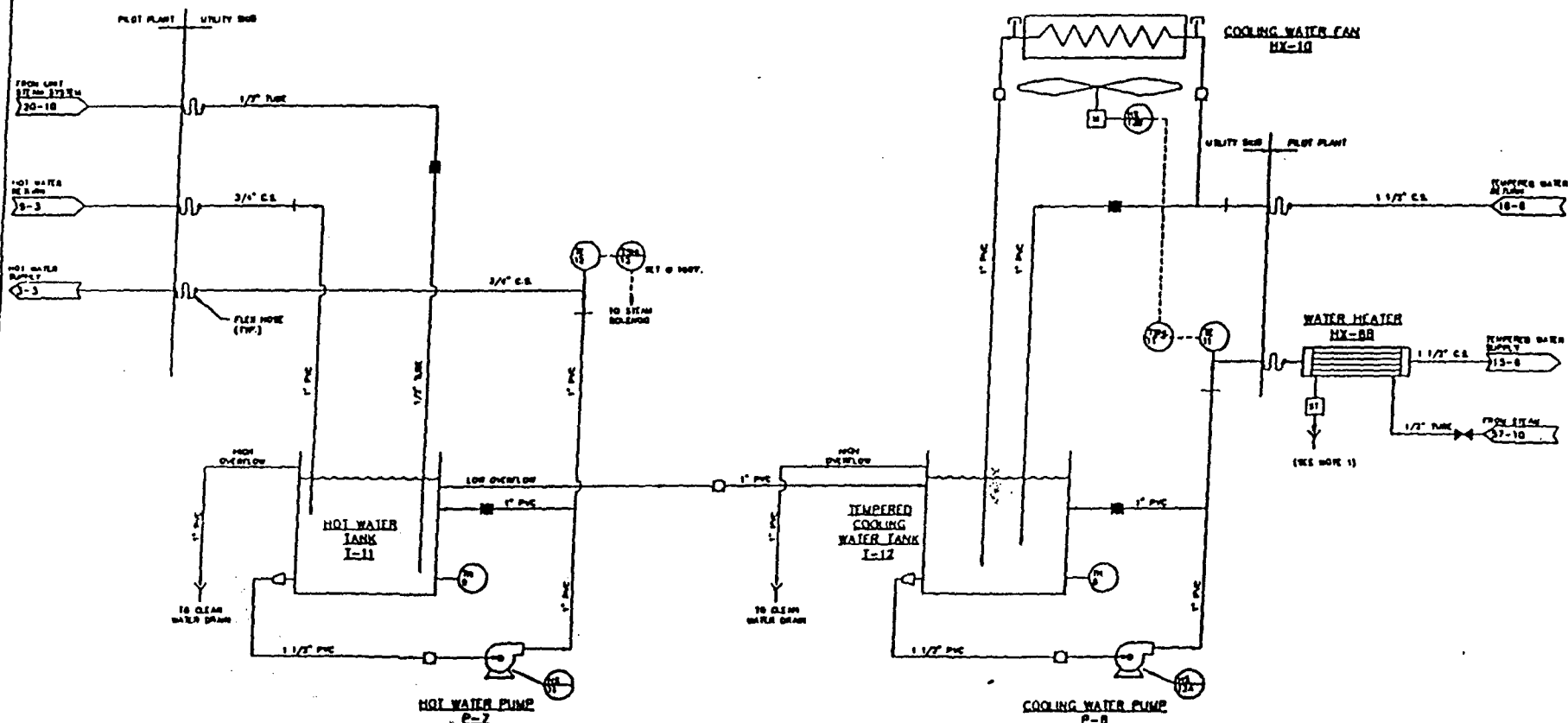
WATER RESISTANT TYPING	
GROUP NUMBER:	P-6
DESIGN CAPACITY:	8 PGS
DE SIGN PRO SIZE:	8 PGS
NON DEFORM:	-
WATER RESISTANT:	SUFFICIENT
SPOTTY GRAVITY:	1.0
WETTING MATERIAL:	NO / YES
REMARKS:	MECHANICAL

WATER SIPPERS FISH M.	
TEMP. AIR/WATER	MB-6A
TYPE:	WHEEL/TANK
OUT:	"
AREA:	"
WETTED WATER:	5.5
DEION PRESSURE:	75 PSI
DEION TEMP:	100 F

WATER TIGHT	
PLUMP, PLUMBER	1-10
GAMETER	0
HEICHT	-
WORMING VOLUME	-
WETTED MATERIAL	25
EXTRA PAPER	3 PDC
EXTRA TEMP.	320 F

[illegible]

WATER HEATER	
COMP. NUMBER:	NR-88
TYPE:	WELL/PUMP
BATH:	-
AREA:	-
WETTED MATERIAL:	SS
DESIGN PRESSURE:	75 PSIG
DESIGN TEMP:	200F



1. ALL STEAM CONDENSATE IS CLEAN CONDENSATE AS PER

10 copies DIVISION ONE, JANUARY 1 TO 6, 1965 (1000 1000)		11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 5
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