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Project W-211, Initial Tank Retrieval Systems, Description of Operations for 241-AP-102 and 241-AP-104

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Abstract: This document provides a basic description of the instrumentation, equipment, general operations, application software, and how the software will control the various retrieval operations for double-shell tanks 241-AP-102 and 241-AP-104.

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PROJECT W-211

INITIAL TANK RETRIEVAL SYSTEMS

DESCRIPTION OF OPERATIONS

FOR

241-AP-102 & 241-AP-104

Prepared for

Numatec Hanford Corporation

June, 1998

Prepared by

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Richland, Washington

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I. INTRODUCTION

A. PURPOSE

The primary purpose of the Initial Tank Retrieval Systems (ITRS) is to provide systems for retrieval of radioactive wastes stored in underground double-shell tanks (DSTs) for transfer to alternate storage, evaporation, pretreatment or treatment, while concurrently reducing risks associated with safety watch list and other DSTs. This Description of Operations (DOO) defines the control philosophy for the waste retrieval system for tanks 241-AP-102 (AP-102) and 241-AP-104 (AP-104). This DOO will provide a basis for the detailed design of the Retrieval Control System (RCS) for AP-102 and AP-104 and establishes test criteria for the RCS. The test criteria will be used during qualification testing and acceptance testing to verify operability.

B. SCOPE

The DOO provides a basic description of the instrumentation, equipment, general operations, applications software, and how the software will control the necessary operations for AP-102 and AP-104. The functional requirements for the operation of the ITRS using the RCS are included. Graphic display screens convey the manner in which the RCS will be used to control the retrieval process (see Appendix D).

C. PROCESS OVERVIEW

The retrieval process at AP-102 and AP-104 will provide feedstock to the privitization contractors by receiving low activity waste (LAW) from source tanks, mixing and pre-treating that waste prior to sampling, and delivering waste to tanks 241-AP-106 and 241-AP-108.

The retrieval control system (RCS) will have the following general capabilities. The retrieval process will be accomplished using a combination of these capabilities dependent on the specific mission profile. An exact listing and description of the 21 specific modes is provided in Section IV.

1. Upon equipment turn-on, the computer will default to the Ready Mode. This will be the default mode with no automatic actions taken and will be the only mode where remote manual control, as well as local manual (handwheel) pre-positioning of all the valves is possible.

2. The RCS will be able to control the Caustic Supply System, including the service water (SW) system, the raw water (RW) system, and the oil-fired water heating boiler.

3. The RCS will be able to establish routing and monitor the transfer of high level waste (HLW) from Valve Pit 241-A-B via line SN-650, through transfer pump pit 241-AP-04D, directly to the HLW Vitrification Plant, thereby bypassing the AP tanks, and flush the lines after transfer is complete.

4. The RCS will be able to establish routing, and control the transfer of LAW from Valve Pit 241-A-B via line SN-650 to either tank AP-102 or AP-104, and flush the lines after transfer is complete.

5. The RCS will be able to establish routing, and control the return of LAW from either AP-102 or AP-104 through Valve Pit 241-A-B via line SN-650 to a receiver tank, and flush the lines after transfer is complete.

6. The RCS will be able to establish routing, and control the addition of diluent from the Caustic Supply System (CSS) to either tank AP-102 or AP-104, either through the tank return lines, or to the suction of each transfer pump to achieve in-line dilution.

7. The RCS will be able to establish routing, and control the recirculation of waste in each tank, from the transfer pump, through an instrumented pipeline back to the tank to measure hydraulic characteristics prior to transfer to another tank, and to flush the lines with diluent after recirculation is complete.

8. The RCS will be able to establish routing, and control the pumping of LAW from either tank AP-102 or AP-104 to either tank AP-106 or AP-108 through valve pit 241-AP-A, and to flush the lines after transfer is complete.

9. The system can be safely shutdown either automatically upon detection of a system or equipment fault, or manually under procedural response to an administrative control.

D. DEFINITIONS

ALARA: As Low As Reasonably Achievable

Application Software: Application software is the general term applied to the software that will be developed based on the operational requirements set forth in this document. The application software performs or supports the performance of the primary functions of the Retrieval Control System (RCS) as described herein.

ATP: Acceptance Test Procedure is used to demonstrate that a system has been properly installed according to the approved design.

Auto: Refers to the automatic operation of equipment and/or control sequences in response to inputs from sensors and outputs to effectors by the process control software of the RCS, without operator intervention. (See Manual for comparison.)

Critical Alarms: Alarms deemed sufficiently important to be communicated to a central operations station (TMACS). These are any alarms signaling immediate safety hazards, critical equipment failures, etc.

CASS: Computer Aided Surveillance System

CCTV: Closed-Circuit Television

CPU: Central Processing Unit (e.g., the 486 or Pentium chip)

CSS: Caustic Supply System

DST: Double-shell tank

HMI Software: A HMI (Human-Machine Interface) software package is used to create the operator interface portion of the RCS.

Control Room: At the AP farm the Control Room is located in an annex to the 241-AP-271 building. The AP-271 building houses all of the electrical power distribution equipment such as panelboards and MCC's necessary to support AP-102 and AP-104 retrieval. The Annex houses two operator control stations, an engineering/control station, and two in-tank CCTV stations, one for each tank. The CCTV monitors and controls are mounted next to the operator control stations. The PLC controller module including local I/O is located in the PLC panel just outside the control room in Room 2 of the annex. Any necessary instrumentation for monitoring/controlling the various pump and winch drives is also located in the annex.

FCV: Flow Control Valve - FCVs are special purpose motor operated ball valves with linearized trim, that include analog position feedback in addition to end-travel limit switches. FCVs may be manually operated by use of a handwheel.

I/O: Inputs and Outputs - The PLC provides the hardware interface for all field inputs and outputs which are typically divided into Discrete (On/Off) and Analog (Process Variable) inputs and outputs. Discrete Inputs and Outputs (DI and DO) are represented by devices such as switches and motor starters, respectively. Analog Inputs and Outputs (AI and AO) are represented by proportional devices such as inputs from flow transmitters, and speed commands to variable speed drives.

ITRS: Initial Tank Retrieval Systems. The ITRS project provides for retrieval of radioactive wastes stored in DST's 241-SY-102; AN-103, -104, -105, -107; AP-102 and 104; AW-101; AY-102; and AZ-102.

Local: Refers to the control capabilities provided at or near the equipment, that do not depend on the RCS/PLC or central control console. Local control generally applies to items such as variable frequency motor drive cabinets, that can operate the motor or pump by manipulating bottons or key pads on the face of the cabinet.

Local/Manual: Refers to physical operation of a device such as a valve handwheel.

Manual: Refers to control of a component or process from the graphic screen by the direct selection and action of the operator, in contrast to "Automatic", which requires no specific operator action. Hardwired interlocks are not bypassed in the remote/manual environment; however, software interlocks active under Auto mode may be bypassed. (See Auto for comparison.)

MCC: Motor Control Center

Menu List: A software list displayed on the graphic display screens that provides the various programmed actions available to the operator. For example, a menu list might contain selections for In-Tank Recirc Mode, Flush Mode, Transfer Mode, and the desired routing for the transfer, etc. Each menu item has prerequisites and condition tables associated with them.

MOV: Motor Operated Valve - These are typically 2-way and 3-way ball valves which are equipped with 120VAC actuators. Limit switches are provided for position indication.

MPS: Master Pump Shutdown - The system that shuts down any pump capable of transferring waste upon the detection of a pipe leak.

OIS: Operator Interface Station (PC with HMI software)

Operating System: Operating System software directly manages the physical computer resources on behalf of the application software. For the RCS, this will be Windows NT® from Microsoft® providing multi-windowing and multi-tasking capability. (See HMI Software).

PC: Personal Computer used with HMI software to provide the OIS.

PLC: The Programmable Logic Controller is the microprocessor-based industrial controller capable of real-time control. The PLC provides all of the discrete and process control logic required for controlling the process. Once the PLC program has been loaded into the PLC controller module, the PLC will execute all control functions even if connection to the Operator Interface computer is severed or interrupted.

PID: Proportional / Integral / Derivative (Relational aspects between process control error and output.)

QTP: Qualification Test Procedure, to validate the software logic.

RAM: Random Access Memory is the location where the computer's CPU temporarily stores data as it executes the programs it is running. Generally, the more RAM a computer has the faster it can run any of its programs, since access to data in RAM is much faster than access to data on a hard disk.

RCS: Retrieval Control System refers to the Industrial IBM compatible PC with its operator interface software, all peripherals such as modems and printers, the PLC system and all field instrumentation. The operator interface will consist of screens with graphics depicting the farm-specific ITRS. The RCS will provide ITRS monitoring and control capabilities to Operations.

Real-time: Indicates that data presented or controls activated are being processed and implemented in an acceptable time frame which is usually after an imperceptible time delay from the process events.

Remote: Refers to the operation of any device and process control from the RCS either in Auto or Manual Mode. (See Local).

Sensor: Refers to any instrument or device that detects and inputs signals to provide indication and/or status to the RCS. It may provide an Analog Input (AI) or a Discrete Input (DI).

TCP/IP: Transport Control Protocol / Internet Protocol (De facto standard for Unix and Microsoft Windows communications)

TMACS: Tank Monitoring and Control System

VFD: Variable Frequency Drive which modulates the speed of the motor it controls by changing the frequency of its power supply.

Window: Term used to describe a part or all of a complete screen display.

II. GENERAL DESCRIPTION

The retrieval system for AP-102 and AP-104 will provide for the retrieval of radioactive wastes stored in the tanks. The following major equipment and subsystems will make up the ITRS in AP-102 and 104.

- Mixer pumps (One in each tank)
- Transfer (decant) pump with flexible suction and electric winch (One in each tank)
- Transfer piping, including new pits, leak detectors, new jumpers and new buried pipe.
- One RCS (includes control building equipment [OIS and PLC] and field instrumentation)
- A Control Room Annex to the AP-271 equipment building
- One caustic supply system (CSS) with mobile oil-fired, water-heating boiler, diluent storage tank, a caustic tank truck unloading station, a service water enclosure, and nitrogen bottle station.
- Two CCTV systems, one in each tank
- One tank thermocouple probe for each tank (existing)
- One ENRAF waste level gauge for each tank (replaces FIC gauges)

Dilution with an NaOH diluent will be used to adjust the fluid properties of the waste. Each tank will have a transfer pump with in-line diluent injection capability at the low pressure side of the first impeller of the multi-stage pump. The 20' flexible suction hose can be raised by a winch so the suction inlet is above the settled solids, thus allowing decanting of the supernate. The CSS will provide diluent to the tank either at the transfer pump suction for in-line dilution (as described above) or through a different inlet pipe for in-tank dilution. In-line dilution may be required during transfer if parameters, such as apparent viscosity, approach the upper limits for fluid pumpability. In-line instruments in each of two pump pits (02D and 04D) will measure flow and pressure during transfer.

The CSS will also be used to flush the system piping and transfer line after the completion of a transfer campaign, or upon system shutdown.

The Retrieval Control System (RCS) will consist of three industrial PC's with video monitors, a single PLC system, printer(s), and the field instrumentation and control devices. The PC's will have identical versions of the operator interface software application loaded and running thus increasing availability. Two of the PCs will be nominally dedicated as Operator Interface Stations (OISs) for either tank AP-102 or AP-104, and one PC will be dedicated as an engineering work station (EWS) that can service either of the other two OISs. Graphic display screens will be designed to allow ease of operation and will provide the monitoring and control functions necessary for proper operation.

All instrument inputs and outputs will be connected to the PLC unless stated otherwise. Instrumentation will provide the following monitoring and control functions for the ITRS (for each tank unless stated otherwise):

- Mixer pumps: Motor speed and amperage, upper and lower motor bearing vibration and temperature, motor winding temperature, turntable rotation and orientation, seal water flow and pressure

- Transfer pump: Motor speed and amperage, seal gas flow and pressure and motor winding temperature

- Transfer Pump Winch: Position of suction nozzle

- Transfer Pump Pit: MOV Positions, pump pressure, rupture disk failure, and waste flow

- Inside tank: Tank level, temperature and dome pressure

- Common: Waste pressure and flow (From and to Valve Pit 241-A-B)

- Leak Detection: Existing and new leak detection from pits and farm waste transfer piping which activates the Master Pump Shutdown (MPS) system.

- CSS: MOV positions, raw water supply pressure, boiler operation, caustic injection operation, flush tank temperature, conductivity (to determine pH) and level, system discharge temperature, pressure, and diluent flow, and dual radiation detectors for each tank feed to detect possible waste backflow to the CSS.

- AP271 Annex: All pump VFD and motor starter monitoring and control signals, including pump speeds and motor loads via the ModBus Plus link between the PLC controller module and the VFDs.

A. RCS DESCRIPTION

The RCS will be based on three industrial IBM-compatible PCs with Pentium CPUs, each with the following, configuration: 32 Megabytes of RAM, a 2.5 Gigabyte Hard Drive, and a 20 inch super VGA, operator interface station (OIS). One computer OIS will nominally be dedicated to tank AP-102, one to tank AP-104, and the remaining computer will be an engineering work station (EWS). Common portions of the piping system will be shown on both monitors, and appropriate messages and interlocks will be provided to prevent one operator from interferring with the other operator's campaign. While each monitor will be nominally dedicated to a tank, either monitor will be able to perform all functions. A single Modicon Quantum® PLC system will provide the control and monitoring functions for both tanks. The PLC and the PCs will communicate over the Modbus Plus PLC network.

Two uninterruptable power supplies (UPSs) are provided to maintain power to the PLC, I/O racks, and operator stations during short (approximately one hour) power outages. One UPS is in the RCS enclosure in the AP-271 annex, and one is in the field I/O enclosure. The UPSs will provide power to position two valves to the "fail closed" position to prevent gravity draindown of the diluent supply tank to a waste tank upon loss of normal power, and will retain the RCS system "memory" for a rapid recovery after normal power is restored.

Custom application software for the ITRS will be developed using the Contol Plus® PLC programming software for the Modicon Quantum® PLC, and the Ci Technology Citect® operator interface software for the PC. The requirements for external system interfaces include communication links with the Tank Monitoring and Control System (TMACS), the VFDs, and HLAN.

The design of the RCS will allow Manual (and local/manual) operation of all MOVs in the Ready mode. When in a Mode other than Ready, the RCS will allow manual operation of only those MOVs not part of the current routing arrangement. All valves may be locally operated with a handwheel; however, handwheel operation cannot conflict with electric operation. To place a valve in a position not allowed by the PLC logic, will require supervisor approval to disable the electrical supply to the valve. This administrative control is necessary to avoid defeating the misrouting prevention features of the RCS without proper authority. All pump starts are Manual. There is no provision for automatic pump starts, although that feature could be added in the future. The RCS is configured to allow the transfer of operational control to a future central location for transfer operations. The RCS operator interface PCs will be located in the control room in the AP-271 annex.

The RCS software will provide a process system report when requested by the operator. This report will contain the current status of all significant process equipment and alarms.

The RCS will provide a display of any caution or warning messages while in the process of startup. All alarms, controls, and indications will be available to the operator when in the mode indicated in Appendix B.

All screens on the OIS will be available for selection by two methods: by using the SCREEN LIST pop-up menu or by clicking on the appropriate screen target.

All screen and equipment controls will be executed in either one of two ways: clicking on screen targets with the mouse or keyboard commands.

B. RCS FUNCTIONS

The RCS will monitor the process via the instrumentation, control the process via the equipment connected as outputs to the PLC, display status information, and accept operator input. The application software will include all of the tools necessary to provide the required functions. The RCS will be designed and programmed to implement the following process functions:

- Provide monitor and display status and performance of each selected ITRS process subsection and/or component group.
- Provide a signal interface to HLAN for remote monitoring.
- Provide for adjustment of control set points by the operator during operation (e.g., adjust the speed of a pump).
- Provide audible and visual annunciation for all alarm conditions.
- Provide indication of all monitored parameters.
- Allow Auto/Manual control of system processes and equipment.
- Include Proportional/Integral/Derivative (PID) loop controls.
- Provide on-line historical and real-time trending of process parameters with report capability for a period of one week. After one week, data will be downloaded to an appropriate archive, either removable storage media or an as-yet-to-be-defined HLAN/SACS/TMACS/network data repository.
- Provide prioritized, grouped, and time/date stamped Alarm Summary screen and event log on the RCS. All alarms may be automatically printed out on the RCS alarm printer. Alarms and operator actions on the RCS will be automatically logged to the hard drive for periodic archival to off-line storage media.

C. USER CHARACTERISTICS

1. OPERATORS & SUPERVISORS

The RCS application software will be designed for use by process operators. All computer displays and windows will be representative of the process flow and components. All persons who operate this equipment will receive training on the RCS OIS.

2. SYSTEM ENGINEERS

System Engineers will be TWRS engineers trained to provide support for the ITRS. The System Engineers will be familiar with the RCS operating system, Windows NT. The System Engineers will also be familiar with the Modicon Quantum® PLCs, the Control Plus® PLC programming software, and the Citect® operator interface software. The System Engineers will have access to all of the process control documentation, software and keys required to build/rebuild/modify PLC logic, communications drivers, graphic screens, databases, and any other software components of the system.

D. NETWORKING CAPABILITIES

The RCS operator interface software will be capable of communicating over any network using TCP/IP protocol, including HLAN and TMACS. This will make it possible to interface with other systems site-wide.

III. GENERAL FUNCTIONAL REQUIREMENTS

A. OPERATOR INTERFACE

The following are the system general functional requirements:

1. All RCS graphical display screens ("screens"), designed to be operator friendly, will be graphically oriented. There will be two modes of selection: with the mouse or with keyboard key combinations. Menu-driven operations will be used to control the system (operator selects from an on-screen "menu" as opposed to having to "spell out" commands from a keyboard). Menu selections will be provided as keyboard key combinations, such as Ctrl-F1, and lists of commands and/or command symbols which can be selected with the mouse. The RCS screens will allow the user the capability of going from one screen to another by clicking the designated area (e.g., a Pump symbol). All screens will be standardized for key assignments, color assignments, etc. (e.g., F1 is the Help key). See Appendix A for list of standard key assignments.

2. The RCS will provide data storage capabilities to an ASCII or common spreadsheet format, e.g., Microsoft Excel®.

3. The RCS will provide historical trending capabilities. All important process parameters will be trended. See Appendix B for the list of parameters which will initially be configured for trending.

4. Loss of PLC communications, as well as other PLC diagnostics, will be annunciated with the screen indicator flashing red and an audible alarm. In addition, all values displayed on the OIS PCs from the PLC will show as "????" upon loss of communications between the PLC and the HMI running on the OIS PCs. The I/O modules monitor their own inputs, and report to the PLC on any loss of signal, the PLC then reports the problem to the HMI screen. The loss of voltage on the incoming 480 volt feeder to the ITRS will also be annunciated.

5. All required software will load automatically any time the RCS is started or reset. This includes restart after a power outage. The operator must, however, log-in again into Windows NT and the RCS (see Appendix D, Figure 1). The RCS will already be in communications with the PLC, gathering data, etc.

6. All remotely operated pumps and valves will have running and position indications displayed on the RCS display monitors.

7. All operator initiated actions will be logged, e.g., if any remotely operated device or equipment is placed in Manual control.

8. The alarms and indications will be displayed on the RCS monitors. Any logic which is used for interlocks or control will be programmed into the PLC, instead of the HMI software. The PLC will set a separate bit for each alarm associated with the triggering of an interlock (e.g., Hi-Hi Tank Level will cause the mixer pumps to stop). The RCS PC operator interface (HMI) software will log, display, and annunciate all alarms, as well as providing alarm logic.

9. Graphic Screen Color Coding

   a. Process lines on the screens will be color-coded as follows:

Line Color Code	Condition
White	General piping arrangement - not selected
Dark Gray	Correctly configured for selected mode
Green with white diamonds	Flow

   b. Valve Operation Indication

   Each open valve port will be green. A closed port will be white. Valve symbols will always indicate current position whether they are in the auto or manual mode. When in transition, the valve symbols will be yellow. There will be a valve transition delay for each valve which if exceeded will cause the failure alarm for that valve to be annunciated, and will cause the entire valve symbol to flash red.

   c. Pump Operation Indication

   Each pump will also have separate border and interior colors. The border and interior colors will follow those of the process line as given above except that the pump interior color will be white until the motor auxiliary switch or the VFD notifies the PLC that the pump has started. The pump interior will then go to a steady green.

   If a pump fails to start, a failure alarm will be sounded and displayed after an adjustable time delay. The pump failure alarm will cause the pump symbol to flash red.

10. Security - User Access to Displays and Functions

    In order to use the operator interface software application to control the retrieval operation, the user must be in the group that will allow him or her to perform the desired functions. In some cases, a user from the Operations Supervisor group must be logged in to enable or execute a certain function. In other cases, a user from the Operator group will be able to enable and execute the function. Supervisor and Operator groups are just for operations, while the Systems Engineer may make changes to the application programming, as well. The following table lists the user group and its access to the different types of functions.

User Group	Accessible Functions
Operator	May perform resets, input operating parameters, start and stop equipment, change auto/manual modes for specific pieces of equipment, sort alarms, and initiate all operational modes.
Operations Supervisor	May override software interlocks, and disable alarms, instruments or equipment and perform all of the operator functions.
Systems Engineer	May override all functions, make software changes to all of the system software, and perform all of the operator and operations supervisor group functions. Works with instrument technicians to upgrade and repair RCS.

B. ALARM HANDLING

The following section defines the alarm handling requirements. See Appendix B for a list of alarms and their setpoints.

1. Alarms shall have the following sequence of operation:

   a. An alarm condition will produce a red flashing alarm indication on the RCS monitors and audible beeps from the PC speakers.

   b. In addition, if the alarming device or parameter is shown on a sub-screen, the sub-screen will display with the appropriate symbol or display box flashing. Please see below for color schemes.

   c. The alarm page may be displayed by clicking on the flashing alarm symbol (upper right of a full page screen), by clicking the alarm icon button on the navigation bar (left side of a full page screen) or by pressing the "F5" key. From the alarm page any active alarm can be acknowledged by clicking on the alarm text. Each alarm displays the following information, tag name, time and date of activation, name, a brief description, value, and the state. Please see below for color schemes.

   d. The alarm summary screen may be displayed by clicking on the alarm summary button on the navigation bar or by pressing the "F6" key. This page will display a history of alarms giving alarm name, brief description of alarm, time alarm became active, time alarm became inactive, and operator comments. Operator comments can be added to any alarm on the alarm summary screen by right clicking on the text of the alarm that is in focus (text outlined by white).

2. The alarm summary screen will display (on multiple pages) up to 1,000 alarms. Alarms will stay on the summary page for 60 minutes after they become active.

3. Color Schemes:

   Symbols and display boxes flashes red/white for critical alarms (e.g. High High level or Low Low level) and yellow/black for non-critical alarms (e.g. High level, Low level, or valve fail). The symbols and display boxes stay flashing until the alarm becomes inactive, not after acknowledgment.

Alarm and summary alarm pages text flashes red, yellow, or blue (critical, non-critical, and misc.) for alarms that are unacknowledged and active. The colors go steady when the alarm is acknowledged but still active. When the alarm is no longer active but not acknowledged the text colors invert (e.g. red on grey goes to grey on red). When the alarm is acknowledged and inactive it disappears from the alarm page and turns light blue on the alarm summary page. Any disabled alarms will be white.

4. The set points of certain analog alarms can be changed by the operator via the alarm set points screen.:

5. All alarms will be individually available to TMACS over a serial data link. In addition, alarms that could occur when no retrieval activities are in progress and the control room is unoccupied (such as low nitrogen bottle pressure) are transmitted via a local annunciator to TMACS as a combined "AP-271 TROUBLE" alarm.

C. CONTROL

1. The RCS will be designed and programmed to operate either in a manual mode or an automatic mode. The manual mode occurs when the RCS is in the "READY" Mode, and the automatic mode is in effect when any other "Mode" is in effect. The RCS includes a "Misrouting Prevention" provision, that prevents the transfer pump from being operated unless the approved waste transfer route is verified by automatically comparing actual valve positions against procedurally required valve positions. This feature requires that the transfer pump be prevented from being started when the system is in the "READY" mode, because no valve position checks are made in the READY Mode. This preventive interlock will be able to be bypassed under administrative control. All MOVs will be able to be controlled manually in the READY mode. For all other modes, all MOVs related to that mode must be in Auto in order to activate the mode. MOVs not related to the active mode may be individually placed in the Manual Mode, and manually operated for maintenance or other reasons. Valves that could interfere with operation of any currently active Mode, will be prevented from being individually placed in the Manual Mode.

   The RCS will maintain the process variables with a PID algorithm (where appropriate) at the set points set by the operator. Process (analog) control and on-off (discrete) control of equipment will be in accordance with those control sequences described herein and the logic diagrams done in Control Plus® format. See Appendix B for list of controls for the retrieval equipment and processes.

2. The retrieval system will automatically revert to a safe shutdown condition upon detection of specified events such as a leak detected. The operator will also be able to manually place the retrieval system in a safe shutdown condition. Both the automatic and manual shutdown commands will take precedence over any other retrieval activities in progress.

3. All I/O control (analog and discrete) will be programmed into the PLC. The operator interface to the PLC will be via color graphic display screens on both of the OIS monitors. The redundant operator interface PCs will be capable of independent action. For example, one PC could be used to monitor alarms the majority of the time while the other PC could be used to show the current area of interest. The graphic displays will be hierarchical with the Overview screen depicting the basic overall arrangement of either tank AP-102 or AP-104, and common elements. If the operator selects any of the major blocks on the screen, the screen will change to a more detailed screen of that process block, e.g., Tank 241-AP-102 (see Appendix D, Figure 9). The detailed process screens will indicate individual components, the status of the component (On/Off, Auto/Manual, etc.) and the control mode for the component or process. See Appendix D for a depiction of the screens.

4. Equipment symbols on the screens which provide further detail or control will be signified with black text.

5. Operator actions that will be subject to interlocking will be programmed into the PLC logic (software interlocks) to protect equipment and personnel and to prevent any undesired process action.

6. Monitoring and control of all analog I/O will be programmed into the PLC, including PID algorithms. The process variable signal from an analog instrument, e.g., the transfer pump discharge pressure, will be displayed on the RCS as a digital readout with the engineering units displayed next to the reading. In some cases, an additional analog indication, such as a bar graph, will also be displayed. The modulating control of appropriate processes, e.g., CSS flow control via CHEMB-FCV-131 (see Appendix D, Figure 15), will be programmed into the PLC logic and displayed on the appropriate RCS screen.

7. Various process setpoints will be entered into the RCS by the operator. Provisions will be made to enter these settings into the program in an operator-friendly manner. All setpoints will have minimum and maximum limits to prevent the operator from entering set points outside these limits. If the operator attempts to enter an out-of-range setpoint, the invalid setpoint will be rejected and the operator will be notified immediately with the appropriate message. Setpoint ranges will be adjustable at an operations supervisor or systems engineer security level. (See Appendix D, Figure 4.)

8. All pump auto/manual, on/off and start/stop selections and indications will be provided at the RCS. The appropriate "buttons" will be located in a pop-up window showing a standard pump control faceplate triggered by selecting the pump symbol. (See Appendix D, Figure 4.)

9. All remote controlled valve auto/manual and position selections and indications will be provided at the RCS. The appropriate "buttons" will be located in a pop-up window showing a standard valve control faceplate triggered by selecting the valve symbol. (See Appendix D, Figure 4.)

10. When waste transfer modes WT2 or WT4 are selected, the RCS will require the operator to select a destination tank, ie., tank AP-106 or 108. Upon destination tank selection, the Overview screen will highlight the appropriate flow routing path from tank AP-102 or 104, via valve pit AP-A, to the selected destination tank, AP-106 or 108. Subsequent selection of post transfer flush modes PTF2 or PTF4, will require similar operator selection of destination tank and will result in similar flow route highlighting. This portion of the flow path highlighting is an administrative aid for the operator to visualize the flow path, but valve positions in the AP-A valve pit are not automatically verified, because there are no operable valve position switches in the AP-A valve pit.

D. MISCELLANEOUS

1. Provisions will be programmed into the RCS to allow the operator to print in color any screen that is displayed. This will capture the alarms (shown in red), as well as the normal states.

2. Winch Operation

   Each transfer pump will include a flexible suction hose, that will allow pump suction to be taken above the bottom of the tank to minimize pickup of settled (or settling) solids. This feature will be implemented by providing a remotely controlled electric winch, with a cable attached to the suction hose inlet. The gear train between the winch motor and cable drum includes an electric clutch that is energized to dis-engage. The clutch will normally be deenergized, and engaged. The dis-engage feature is to allow the flexible hose to be let down (for pump removal) in the event of winch motor failure.

The RCS will monitor and display the position of the suction bell by monitoring winch cable drum position, and will provide the capability to raise the suction bell to its upmost position and hold it there while the mixer pump is operating. The control system will compare the winch (suction) position to the tank level, and sound an alarm if the tank level is less than 24 inches above the winch position. The mixer pump will be prevented from operating if the suction bell is not in its upmost position. The nominal winch (suction) position will be shown on the overview and tank-specific screens.

IV. MODE OF OPERATION - FUNCTIONAL REQUIREMENTS

The purpose of this section is to define the sequence of operations for the ITRS. Initial startup and commissioning of the ITRS after installation will be addressed in the Acceptance Test Procedure (ATP) document. The final objective of the procedures described herein is to obtain safe, automatic operation, by describing key operator interactions required, such as starting pumps and manipulating valves.

The software logic behind the "MODE SELECT" window will not allow an operator to enter (select) a mode that will conflict with any currently selected mode. Some modes do not conflict, and different modes may be run simultaneously on the two different operator consoles. For example, in-tank recirculation in tank AP-102 (ITR2) will be able to run on one console, while in-tank dilution in tank AP-104 (DIL4) is running on the other console. Similarly, ITR2 will not be able to be selected if input to AP-102 (IN2) is already running, because both modes use one or more common elements such as pipes or valves.

A. MIXER PUMP OPERATIONS

A mixer pump will be able to be operated independent of any operational mode, except the transfer pump cannot be running. The pump will be able to be run any time that the tank level is above 66" (approximately 48" above pump discharge), the waste temperature is below 195°F, the transfer pump is off, the suction bell is raised, and tank vapor space vacuum is greater than 0.25 " W.G. The mixer pump will be prevented from starting or operating if the transfer pump suction winch is not in its full UP position. When in AUTO, the mixer speed will be automatically controlled by the PLC, as a function of pump nozzle rotation angle, to minimize jet impingement on other in-tank components. The mixer pump will automatically shutdown on loss of tank vacuum, hi-hi waste temperature, or lo-lo tank level. Only one of the two mixers (one in each tank) will be able to be run at greater than 75% speed at the same time. If one pump is above 75% speed, the other pump will be automatically limited to between 58% and 60% speed. The lower limit is imposed by the dynamic shaft seal requirements, and the upper limit is imposed by the size of the common electrical supply transformer. (This description is for tank AP-102. Tank AP-104 is identical.)

1. Initial Startup

On the initial startup of the mixer pump or after a long period of non-use, when the mixer pump intake may be immersed in a layer of sludge, adding diluent at the intake is desirable in order to dilute the sludge and enable the mixer pump to start and operate. The mixer pump will be able to be flushed and started with either the intake-mounted sparge ring piping, or the casing flush piping, connected to the flexible hose from the Retrieval Service Water Enclosure.

2. Normal Startup and Operations

The operator will prepare to operate a mixer pump by placing it in either Auto or Manual Mode, depending upon operational requirements. This will require a series of steps as given below (tank AP-102 in this example):

a. Select the "241-AP-102" tank location on the Retrieval System Overview Screen. This will display the Tank 241-AP-102 Screen.

b. Select the "Mixer Pump" symbol and the Mixer Pump faceplate for the mixer pump and the turntable drive controls will pop-up.

c. On the mixer pump faceplate, enter the desired speed setpoint in percent (60% minimum allowable and 100% maximum allowable) or adjust it up or down using the speed up or down buttons. Initial value for mixer pump speed upon PLC power-up will be 60%.

d. The faceplate will also allow the operator to put the mixer pump into AUTO or MANUAL mode, as well as START and STOP it. In AUTO mode, the mixer pump speed will be able to be controlled per the speed versus position profile (see Appendix F and Figure 12). It will also be stopped if any of the automatic shutdown conditions occur, or if stopped by the operator.

e. Select the mixer pump START button. If the mixer pump does not start, the mixer pump failure alarm will be annunciated after an adjustable delay.

f. Using the faceplate controller for the turntable drive, enter the desired speed setpoint for the turntable drive in percent or adjust it up or down using the speed up or down buttons. Initial value for turntable drive speed upon PLC power up will be 100%.

g. There will also be a faceplate for the turntable which allows the operator to put the mixer turntable drive into AUTO or MANUAL mode, as well as, START and STOP it. In AUTO mode, the mixer turntable drive will oscillate between two operator-selected limits, from 0° rotation to ± 90° rotation with 0° indicating North. It will automatically stop at the end of each oscillation and reverse direction. In MANUAL, the turntable will move the mixer pump to the position desired by the operator who will use the CW (clockwise) and CCW (counter-clockwise) buttons to position the turntable. The position of the mixer pump nozzles will be displayed by the NOZZLE ORIENTATION symbol.

h. Select the mixer turntable drive START button. If the mixer turntable does not start, the mixer turntable drive failure alarm will be annunciated after an adjustable delay.

B. CAUSTIC SUPPLY SYSTEM (CSS)

From the RCS perspective, the CSS will be able to be started any time that valve CHEMB-FCV-131 is closed, and can continue to operate in the recirculation mode with no outside restrictions. However, some system components such as the caustic supply truck connections, and boiler operation must have been put in service locally by operators. The RCS will be used to remotely control the CSS once it has been locally started. The RCS will control the boiler temperature setpoint, the flush tank level, and the caustic injection ratio. The diluent flow rate will be controlled by the automatic positioning of valve CHEMB-MOV-131, which will result in automatic adjustment of recirculation flow to satisfy the constant speed pump curve.

1. Startup

The caustic supply system (CSS) will supply a caustic solution (diluent) for dilution of the waste, or to flush a line after waste transfer. The oil-fired boiler will heat the incoming water to a pre-set temperature, and the in-tank heater will maintain the tank temperature until the diluent is used. The caustic injection pump will inject NaOH into the heated water to achieve a pre-set conductivity level which is related to solution pH. The flush pump will supply the prepared diluent from the 5,000 gallon flush tank. Startup will be under administrative control, and because the tank may be in a different status prior to each use (e.g., full & hot, cold & empty, etc.), procedures will be developed to address the various startup scenarios. In general, the boiler will be started manually, and once boiler steam is within an acceptable range, inlet water flow to the 5,000 gal. tank will be initiated from the OIS.

The RCS will have been pre-loaded with a look-up table of caustic flow rates vs water flow rates to achieve any one of five pH levels at any one of five flow rates (See Table III-1). If a pH or flow rate not in the table is required, the system can be operated in the manual mode, where all parameters are adjustable, with no restrictions except equipment protection interlocks. The diluent/flush tank contents will be measured for conductivity, and the measurement compared with the conductivity expected for the target pH, to provide a cross-check that the water and caustic injection ratios are within acceptable limits.

The caustic system will be able to be operated in a "batch" mode, where the required volume of diluent is less than one tank full (5,000 gal), or in a "continuous" mode where the required volume is greater than one tank full. In the batch mode, the operator will set the required tank level (volume), and inlet flow will stop when the tank level reaches the pre-set level. The inlet (level control) valve will be automatically disconnected from the tank level controller and will remain closed as the contents of the tank are drained to a nominal "empty" level. In the continuous mode, the inlet and outlet flow rates will be automatically set the same, and the outlet flow rate will be automatically adjusted by flow control valve FCV-130, based on an error signal from a nominal tank level setpoint controller. That is, if the tank level is decreasing, the outlet flow will be decreased slightly to maintain nominal tank level. Operational procedures will be developed with the objective of having the tank at its lowest operational level ("empty") at the completion of a mission profile.

The diluent flow to the waste storage tank will be totalized in two ways, one will be a non-resettable accumulator to indicate total lifetime diluent addition to the AP farm, and the second will be a resettable accumulator that is set for each campaign, and automatically terminates flow when a preset value is reached.

Modes that require diluent useage also require a "CSS Ready" signal from the CSS to allow the selected mode to be "Activated." The criteria for "CSS Ready" are different for the Batch or Continuous modes of the CSS.

In the following conditions, all criteria are to be ANDed unless otherwise noted.

CSS READY:

1. If Batch Mode = ON

   FCV-131 is closed
   Flush Pump is ON
   TI-120 = setpoint ± 5°F
   AI-121 = setpoint ± 1%
   LI-126 = setpoint ± 5"
   LIC-126 is in Manual with *0* gal. setpoint
   FI-123 ≥ 100 gpm
   Not "Diluent Line Leak"

2. If Continuous Mode = ON

   FCV-131 is closed
   Flush Pump is ON
   TI-120 = setpoint ± 5°F
   AI-121 = setpoint solution ± 1%
   LI-126 = setpoint ± 5" and in "AUTO"
   Boiler is ON
   FI-123 ≥ 100 gpm
   CHEMB-P-001 Caustic Pump is ON
   FIC-456 is in Auto (with flow setpoint)
   Boiler Fuel Level ≥ Minimum
   Boiler Temp = Setpoint ± 5°F
   Boiler Pressure = Setpoint ± 5°F
   TIC-457 is in Auto (with Temp. Setpoint)
   Not "Diluent Line Leak"

Setpoints are values entered into the SETUP screen, and are mission-dependent

MODE	Total Diluent Flow (gpm)	Desired Diluent Ph	(f)	(g)	11	11.5	12	12.5	13	13.5	14
		Diluent Molarity, M	0.00E+00	0.00E+00	9.61E-03	3.04E-02	9.61E-02	3.04E-01	9.61E-01	3.04E+00	9.61E+0
		Diluent Conc. %(wt) (wt)	0.00	0.00	0.04	0.12	0.37	1.15	3.65	10.84	29.14
		Hot Water Temp. °F	140.0	AMB	138.90	138.84	138.64	137.99	135.73	126.80	11.65
1	70 (a)	NaOH flow (gpm) H_2O Flow (gpm) Energy Req. (Kw)	0.00 70.00 1037.69	0.00 70.00 0.00	0.04 69.96 1015.42	0.11 69.89 1013.67	0.35 69.65 1008.10	1.12 68.88 990.47	3.53 66.47 933.75	11.18 58.84 749.43	35.35 34.70 364.81
2	95 (b)	NaOH flow (gpm) H_20 Flow (gpm) Energy Req. (Kw)	0.00 95.00 1408.29	0.00 95.00 0.00	0.05 94.95 1378.07	0.15 94.85 1375.69	0.48 94.52 1368.16	1.52 93.48 1344.20	4.79 90.21 1267.24	15.15 79.85 1017.08	47.91 47.09 495.10
3	105 (c)	NaOH flow (GPM) H_2O Flow (gpm) Energy Req. (Kw)	0.00 105.00 1556.54	0.00 105.00 0.00	0.05 104.95 1523.13	0.17 104.83 1520.50	0.53 104.47 1512.17	1.67 103.33 1485.70	5.30 99.70 1400.63	16.75 88.25 1124.15	52.95 52.05 547.21
4	120 (d)	NaOH flow (gpm) H_2O Flow (gpm) Energy Req. (Kw)	0.00 120.00 1778.90	0.00 120.00 0.00	0.06 119.94 1740.72	0.19 119.81 1737.71	0.61 119.39 1728.20	1.91 118.09 1697.94	6.05 113.95 1600.72	19.14 100.86 1284.74	60.52 59.48 625.39
5	140 (e)	NaOH flow (gpm) H_2O Flow (gpm) Energy Req. (Kw)	0.00 140.00 2075.38	0.00 140.00 0.00	0.07 139.93 2030.84	0.22 139.78 2027.33	0.71 139.29 2016.23	2.23 137.77 1980.93	7.06 132.94 1867.51	22.33 117.67 1498.86	70.61 69.39 729.62

Table III-1
50%NAOH vs WATER FLOW RATIOS
for DILUENT PREPARATION

a) Diluent-to-waste ratio of 1:1
b) Diluent-to-waste ratio of 2:1
c) Diluent-to-waste ratio of 3:1
d) Misc. Flush or in-tank diluent addition
e) Misc. Flush or in-tank diluent addition
f) Provision for hot water only
g) Provision for cold water

C. TRANSFER PUMP OPERATION

The transfer pump can be started by the operator in either the AUTO (flow control) mode, or the MANUAL (speed control) mode. In the following operations descriptions, if the transfer pump has not been set up, the following procedure will have to be performed to set up the pump prior to clicking on the "Press Start When Ready" button.

a. Select the "241-AP-102" tank location on the Retrieval System Overview Screen. This will display the Tank 241-AP-102 Screen (Appendix D, Figure 9).

b. Select the "Transfer Pump" box, the next screen to come up will be the Transfer Pump Faceplate (Appendix D, Figure 11).

c. Enter the desired speed setpoint in percent (minimum allowable to maximum allowable) or adjust it up or down using the speed up or down buttons.

d. The faceplate window will allow the operator to put the transfer pump into AUTO or MANUAL mode, as well as, START and STOP it. In AUTO mode, upon MANUAL startup, the transfer pump speed will be controlled in a PID loop to maintain the flow setpoint through FE-258. This setpoint will be available on the Retrieval Setup (LAW Transfer) screen (Appendix D, Figure 4b). In the MANUAL mode, the pump will run at the speed selected. The transfer pump will be stopped if any of the automatic shutdown conditions occur or by a Master Pump Shutdown System trip.

D. OPERATIONAL MODES

Specific control parameters such as pump speed settings, etc., are given in Appendix B.

The operational modes for the Transfer System will be as follows: Refer to Section X, MODE FLOW DIAGRAMS, Figures IV-1a to 1q, pages 33 to 49, and Valve Alignment Matrix, page 50).

1. RDY Ready Mode
2. HVT High Level Waste transfer from VP A-B to the Vitrification Plant
3. IN2 Into AP-102 from VP-A-B
4. RTN2 Return to VP-A-B
5. RTF2 Flush to VP-A-B
6. IN4 Into AP-104 from VP-A-B
7. RTN4 Return to VP-A-B
8. RTF4 Flush to VP-A-B
9. DIL2 In-tank AP-102 Dilute Mode
10. DIL4 In-tank AP-104 Dilute Mode
11. ITR2 In-tank AP-102 Recirculation Mode
12. ITF2 In-tank AP-102 recirculation path flush
13. ITR4 In-tank AP-104 Recirculation Mode
14. ITF4 In-tank AP-104 recirculation path flush
15. WT2 LAW Transfer from AP-102 to AP-106 or AP-108 Mode
16. PTF2 Post Transfer from AP-102 Flush Mode
17. WT4 LAW Transfer from AP-104 to AP-106 or AP-108 Mode
18. PFF4 Post Transfer from AP-104 Flush Mode
19. ILD2 In-Line Dilution in AP-102 Mode
20. ILD4 In Line Dilution in AP-104 Mode
21. SSD Safe Shutdown Mode(s)

Operation of the CSS will be independent of any mode.

When a mode is selected (except the RDY mode), the RCS will check the status of all prerequisites (valve status, pump status, other mode status, etc.). The RCS will provide an on-screen display of prerequisites not met, and what operator action is required. Examples of required operator actions might be to place a local control in the remote mode (e.g., VFD), or change a valve control from MANUAL to AUTOMATIC. When all prerequisites have been met, the system will display a message that the selected mode is confirmed ready for "activation." The operator can then mouse click on an "ACTIVATE" button causing the actions described below. Note that more than one mode may be in operation at the same time if the modes do not conflict with each other (See Appendix C). The RCS will automatically perform the steps below, unless noted otherwise, e.g., "operator selects." Refer to Appendix D, Figure 2, for valve location information. Note that only the numeric portion of the valve/equipment number is displayed on the overview screen, and the entire valve/equipment number is displayed on any pop-up screens.

When the phrase, "all valves in Auto mode" or similar is used, it means that all valves required for the selected MODE have been put in the AUTO mode by selecting AUTO on each specific valve pop-up face-plate.

1. RDY - Ready Mode

When the RCS system is in the Ready mode, all pump status and valve positions will be monitored and displayed, but no commands will be given automatically to change valve positions or start and stop pumps

except for safety related interlocks. Mixer pumps may be run in AUTO or MANUAL. The transfer pump cannot be run in AUTO or MANUAL in the READY Mode. The CSS may be run in this mode in AUTO or MANUAL.

2. HVT - High Level Waste transfer from valve pit 241-A-B to the Vitrification Plant

This mode will allow transfer of waste from a source tank through valve pit A-B, thence through transfer pump pit 241-AP-04D (added by project W-211), to the high-level vitrification (VIT) plant. Transfer of waste from valve pit 241-A-B to the VIT plant can be manually set up by positioning valves MOV-251 and 252 correctly, and ensuring that the related pressure and flow meters are operational. Pumping of the waste will be from the source tank, not in the AP farm. The source tank operator must be notified when the valves have been configured and the system is ready to pass waste to the VIT plant.

3. IN2 - Input Low Activity Waste (LAW) to AP-102 from valve pit 241-A-B

This mode will bring in waste from Valve Pit A-B to tank AP-102. The source tank will provide the pumping power. The IN2 mode can be activated if the valves listed below are in Auto mode (determined by PLC logic and true for all modes except Ready) and the source tank is ready (administratively controlled). Upon activation, the following events will occur:

a. "Align Valves". When IN2 is activated, the RCS will position (or will confirm position of) WTMOV-243, MOV-244, MOV-250, MOV-251, and MOV-253.

b. Operator advises the source tank operator that tank AP-102 is ready to receive waste.

4. RTN2 - Return waste from tank AP-102 to a receiver tank via Valve Pit A-B.

The RTN2 mode can be activated if the valves listed below are in the Auto mode and no conflicting modes are in progress. Upon activation, the following events will occur:

a. "Align Valves". When RTN2 is activated, the RCS will position (or will confirm position of) WT-MOV-242, MOV-243, MOV-244, MOV-250, and MOV-251.

b. Operator advises the receiving tank operator that tank AP-102 is ready to send waste.

c. Operator starts the transfer pump.

d. Operator stops the transfer pump when the transfer is complete.

e. The transfer lines should be flushed (RTF2) immediately after waste transfer.

5. RTF2 - Flush lines to receiver tank via VP-A-B after RTN2 waste transfer.

The RTF2 mode should be activated by the operator immediately after transferring waste back to a receiver tank via VP-A-B. The mode can be activated if the valves listed below are in the Auto mode and no conflicting modes are in progress. Upon activation, the following events will occur:

a. The RCS will verify that the transfer pump is off and that CSS is "ready."

b. "Align Valves". When RTF2 is activated, the RCS will position (or will confirm position of) CHEMB-MOV-132, WT-MOV-242, 243, 244, 245, 250, 251, and 261. **Note:** The flush fluid will initially flow backward from MOV-242 to backflush the transfer pump for 5 minutes, at which time MOV-242 will be repositioned to automatically route the flush fluid to MOV-243 and thence to VP-A-B.

c. "Start Flush". The RCS will open CHEMB-FCV-131 to flush diluent through established route for (operator-set) minutes.

d. "Drain". When the flush is complete, the RCS will close FCV-131, and reposition MOV-244 to allow the flush fluid to drain into tank AP-102.

6. IN4 - Input Low Activity Waste (LAW) to AP-104 from valve pit 241-A-B

This mode will bring in waste from Valve Pit A-B to tank AP-104. The source tank will provide the pumping power. The IN4 mode can be activated if the valves listed below are in Auto mode (determined by PLC logic and true for all modes except Ready) and the source tank is ready (administratively controlled). Upon activation, the following events will occur:

a. "Align Valves". When IN4 is activated, the RCS will position (or will confirm position of) WT-MOV-247 , MOV-248, MOV-250, MOV-251, and MOV-254.

b. Operator advises the source tank operator that tank AP-104 is ready to receive waste.

7. RTN4 - Return waste from tank AP-104 to a receiver tank via Valve Pit A-B.

The RTN4 mode can be activated if the valves listed below are in the Auto mode and no conflicting modes are in progress. Upon activation, the following events will occur:

a. "Align Valves". When RTN4 is activated, the RCS will position (or will confirm position of) WT-MOV-246, MOV-247, MOV-248, MOV-250, and MOV-251.

b. Operator advises the receiving tank operator that tank AP-104 is ready to send waste.

c. Operator starts the transfer pump.

d. Operator stops the transfer pump when the transfer is complete.

e. The trnsfer lines should be flushed (RTF4) immediately after waste transfer.

8. RTF4 - Flush lines to receiver tank via VP-A-B after RTN4 waste transfer.

The RTF4 mode should be activated by the operator mmediately after transferring waste back to a receiver tank via VP-A-B. The mode can be activated if the valves listed below are in the Auto mode and no conflicting modes are in progress. Upon activation, the following events will occur:

a. The RCS will verify that the transfer pump is off and that CSS is "ready."

b. "Align Valves". When RTF4 is activated, the RCS will position (or will confirm position of) CHEMB-MOV-132, WT-MOV-246, 247, 248, 249, 250, 251, and 263. **Note:** The flush fluid will initially flow backward from MOV-246 to backflush the transfer pump for 5 minutes, at which time MOV-246 will be automatically repositioned to route the flush fluid to MOV-247 and thence to VP-A-B.

c. "Start Flush". The RCS will open CHEMB-FCV-131 to flush diluent through established route for TBD minutes.

d. "Drain". When the flush is complete, the RCS will close FCV-131, and automatically reposition MOV-248 to allow the flush fluid to drain into tank AP-104.

9. DIL2 - In-tank 102 Dilute Mode

The DIL2 mode can be activated if the valves listed below are in the Auto mode, no conflicting modes are in progress, and the CSS is ready (administratively controlled). Upon activation, the following events will occur:

a. "Align Valves". When DIL2 is activated, the RCS will position (or will confirm position of) CHEMB-MOV-132, and WT-MOV-242, 243, 245, 253, and 261.

b. "Open Caustic Suppy System". Once the above valves are in correct alignment, the RCS will open valve CHEMB-FCV-131 and add diluent to AP-102 until the desired total has been reached and equals the setpoint as indicated on status screen ("Diluent Addition to Tank: ###, ### gal."). Diluent flow control valve CHEMB-FCV-131 will modulate around a flow setpoint to control flow of diluent into AP-102.

c. "Recirculate Caustic Supply System". When the "Preset Amount" has been reached (entered on Retrieval Setup screen), the RCS program will automatically close FCV-131, resulting in automatic CSS recirculation through FE-123. (The diluent supply to the flush tank will be automatically terminated at this point.)

10. DIL4 - In-tank 104 Dilute Mode

The DIL4 mode can be activated if the valves listed below are in the Auto mode, no conflicting modes are in progress, and the CSS is ready (administratively controlled). Upon activation, the following events will occur:

a. "Align Valves". When DIL4 is activated, the RCS will position (or will confirm position of) CHEMB-MOV-132, and WT-MOV-246, 247, 249, 254, and 263.

b. "Open Caustic Suppy System". Once the above valves are in correct alignment, the RCS will open valve CHEMB-FCV-131 and add diluent to AP-104 until the desired total has been reached and equals the setpoint as indicated on status screen ("Diluent Addition to Tank: ###, ### gal."). Diluent flow control valve CHEMB-FCV-131 will modulate around a flow setpoint to control flow of diluent into AP-104.

c. "Recirculate Caustic Supply System". When the "Preset Amount" has been reached (entered on Retrieval Setup screen), the RCS program will automatically close FCV-131, resulting in automatic CSS recirculation through FE-123. (The diluent supply to the flush tank will be automatically terminated at this point.)

11. ITR2 - In-Tank 102 Recirculation Mode

The ITR2 Mode can be activated if all related valves are in Auto mode. If all of the prerequisite conditions have been met for this operation, the operator can then activate this mode via the controls on the RCS monitor, by clicking on the Activate Mode ITR2 button or by pressing the correct key combination on the keyboard. This mode can be used to establish waste-specific pump curves for the transfer pump. Upon Activation, the following events will occur:

a. "Align Valves". When ITR2 is activated, the RCS positions (or confirms position of) WT-MOV-242, 243, 245, and 253.

b. "Press Start when ready". Operator activates the transfer pump START button. If the transfer pump does not start, the transfer pump failure alarm will annunciate after an adjustable delay. The RCS will stay in the ITR mode until the objectives of that mode have been met. The operator may then shut down the pump and go to another mode.

c. The transfer lines should be flushed (ITF2) immediately after waste transfer.

12. ITF2 - Backflush after In-Tank Recirculation Mode ITR2.

The optimum time to flush the pump pit jumper is immediately after in-tank recirc. Upon activation, the following events will occur:

a. The RCS will check the ready status of CSS (in recirc and at the correct temperature, pressure and pH for flushing - see Retrieval Setup [CSS] screen, Appendix D, Figure 4).

b. The RCS will stop (or confirm stopped) the Transfer Pump.

c. "Align Valves". When ITF2 is activated, the RCS will position (or will confirm the position of) CHEMB-MOV-132, WT-MOV- 242, 243, 245, 253, and 261. **Note:** The flush fluid will initially flow backward through the pipe section between MOV-242 and the transfer pump for 5 minutes, and then MOV-242 will automatically rotate to direct the flush flow through MOV-243 to the tank via MOV-253 for an additional 5 minutes.

d. "Open Caustic Supply System". The RCS will open CHEMB-131 and backflush the piping for the preset times (entered on Retrieval Setup screen).

e. "Recirculate Caustic Supply System". The RCS will put the CSS in recirc by closing CHEMB-FCV-131.

13. ITR4 - In-Tank 104 Recirculation Mode

The operator selects the ITR4 Mode from the Mode List pop-up window activated by selecting function key F7. If all of the prerequisite conditions have been met for this operation, the operator can then activate this mode via the controls on the RCS monitor, by clicking on the Activate Mode ITR4 button or by pressing the correct key combination on the keyboard. This mode can be used to establish waste specific pump curves for the transfer pump. Upon "Activation", the following events will occur:

a. "Align Valves". When ITR4 is activated, the RCS will position (or will confirm position of) WT-MOV-246, 247, and 254.

b. "Press Start when ready". Operator activates the transfer pump START button. If the transfer pump does not start, the transfer pump failure alarm will annunciate after an adjustable delay. The RCS will stay in the ITR mode until the objectives of that mode have been met. The operator may then shut down the pump and go to another mode.

c. The transfer lines should be flushed (ITF4) immediately after waste transfer.

14. ITF4 - Backflush after In-Tank Recirculation Mode ITR4.

The optimum time to flush the pump pit jumper is immediately after in-tank recirc. Upon activation, the following events will occur:

a. The RCS will check the ready status of CSS (in recirc and at the correct temperature, pressure and pH for flushing - see Retrieval Setup [CSS] screen, Appendix D, Figure 4).

b. The RCS will stop (or confirm stopped) the Transfer Pump.

c. "Align Valves". When ITF4 is activated, the RCS will position (or will confirm the position of) CHEMB-MOV-132, WT-MOV- 246, 247, 249, 254, and 263. **Note:** The flush fluid will initially flow backward through the pipe section between MOV-246 and the transfer pump for 5 minutes, and then MOV-246 will automatically rotate to direct the flush flow through MOV-247 to the tank via MOV-254 for an additional 5 minutes.

d. "Open Caustic Supply System". The RCS will open CHEMB-131 and backflush the piping for the preset times (entered on Retrieval Setup screen).

e. "Recirculate Caustic Supply System". The RCS will put the CSS in recirc by closing CHEMB-FCV-131.

15. WT2 - Transfer waste from tank AP-102 to tank AP-106 or 108 via Valve Pit 241-AP

When the tank waste is considered to be pumpable, the valves in valve pit AP must be manually aligned to route the waste from tank AP-102 to tank AP-106 or 108. See Appendix D, Figure 14. As each manual valve is reported aligned, the console operator will click on that valve symbol on a graphic display to show it in its reported condition. When the manual valves are aligned in accordance with the current operational requirements, and the automatically aligned valves are in their required positions, the RCS will automatically activate the appropriate graphic routing display so the operator has a visual confirmation of the entire (end-to-end) flow route. The manual alignment will normally be performed under administrative control before the automatic alignment. After manual alignment and upon activation of the WT2 mode, the following events will occur:

a. "Align Valves". When mode WT2 is activated, the RCS will position (or will confirm the position of) WT-MOV-242, 243, and 253.

b. "Press Start When Ready". Operator turns on transfer pump at preset speed.

c. When transfer is complete, operator turns off transfer pump. **Note:** Post Transfer Flush (PTF2) should be performed immediately after WT2.

16. PTF2 - Post Transfer Flush from tank AP-102 to tank AP-106 or 108.

The optimum time to flush the waste transfer lines is immediately after waste transfer (WT2). Upon activation, the following events will occur:

a. The RCS will check the ready status of CSS (in recirc and at the correct temperature, pressure and pH for flushing - see Retrieval Setup [CSS] screen, Appendix D, Figure 4).

b. The RCS will stop (or confirm stopped) the Transfer Pump.

c. "Align Valves". When ITF2 is activated, the RCS positions (or confirms the position of) CHEMB-MOV-132, WT-MOV- 242, 243, 245, 253, and 261. **Note:** The flush fluid will initially flow backward through the pipe section between MOV-242 and the transfer pump for 5 minutes, and then MOV-242 will automatically rotate to direct the flush flow through MOV-243 to the receiving tank (AP-106 or 108) for an additional (operator-set) minutes (or gallons).

d. "Open Caustic Supply System". The RCS will open CHEMB-FCV-131 and backflush the piping for the preset times (entered on Retrieval Setup screen).

e. "Recirculate Caustic Supply System". The RCS will put the CSS in recirc by closing CHEMB-FCV-131.

17. WT4 - Transfer waste from tank AP-104 to tank AP-106 or 108 via Valve Pit 241-AP

When the tank waste is considered to be pumpable, the valves in valve pit AP must be manually aligned to route the waste from tank AP-104 to tank AP-106 or 108. See Appendix D, Figure 14. As each manual valve is reported aligned, the console operator will click on that valve symbol on a graphic display to show it in its reported condition. When the manual valves are aligned in accordance with the current campaign requirements, and the automatically aligned valves are in their required positions, the RCS will automatically activate the appropriate graphic routing display so the operator has a visual confirmation of the entire (end-to-end) flow route. The manual alignment will normally be performed before the automatic alignment. After manual alignment, and upon activation of the WT4 mode, the following events will occur:

a. "Align Valves". When mode WT2 is activated, the RCS will position (or will confirm the posion of) WT-MOV-246, 247, and 254.

b. "Press Start When Ready". Operator turns on transfer pump at preset speed.

c. When transfer is complete, operator turns off transfer pump. **Note:** Post Transfer Flush (PTF4) should be performed immediatly after WT4.

18. PTF4 - Post Transfer Flush from tank AP-104 to tank AP-106 or 108.

The optimum time to flush the waste transfer lines is immediately after waste transfer (WT4). Upon activation, the following events will occur:

a. The RCS will check the ready status of CSS (in recirc and at the correct temperature, pressure and pH for flushing - see Retrieval Setup [CSS] screen, Appendix D, Figure 4).

b. The RCS will stop (or confirm stopped) the Transfer Pump.

c. "Align Valves". When PTF4 is activated, the RCS positions (or confirms the position of) CHEMB-MOV-132, WT-MOV- 246, 247, 249, 254, and 263. **Note:** The flush fluid will initially flow backward through the pipe section between MOV-246 and the transfer pump for 5 minutes, and then MOV-246 will automatically rotate to direct the flush flow through MOV-246 to the receiving tank (AP-106 or 108) for an additional (operator-set) minutes (or gallons).

d. "Open Caustic Supply System". The RCS will open CHEMB-FCV-131 and backflush the piping for the preset times (entered on Retrieval Setup screen).

e. "Recirculate Caustic Supply System". The RCS will put the CSS in recirc by closing CHEMB-FCV-131.

19. ILD2 - In-Line Dilution of tank AP-102 Waste

Provisions will be made to allow in-line dilution of waste being pumped by the transfer pump by introducing diluent into the suction bowl of the operating pump. This feature can be performed whenever the pump is running, and the flush system is not being used in some other mode. The mode will be "greyed out" on the mode list if it is not available; otherwise, this mode can be activated while another mode is in progress in the same tank. Upon activation, the following events will occur:

a. "Verify availability of CSS". The RCS will verify the proper temperature, pH, and inventory of prepared diluent.

b. "Align Valves". When ILD2 is activated, the RCS will position (or will confirm the position of) CHEMB-MOV-132 and WT-MOV-261.

c. "Open Caustic Supply System". The RCS will open CHEMB-MOV-131 to a pre-set flowrate.

d. Continue until the need for in-line dilution is satisfied, then operator closes FCV-131 which places the CSS in the recirc mode.

20. ILD4 - In-Line Dilution of tank AP-104 Waste

Provisions will be made to allow in-line dilution of waste being pumped by the transfer pump by introducing diluent into the suction bowl of the operating pump. This feature can be performed whenever the pump is running, and the flush system is not being used in some other mode. The mode will be "greyed out" on the mode list if it is not available; otherwise, this mode can be activated while another mode is in progress in the same tank. Upon activation, the following events will occur:

a. "Verify availability of CSS". The RCS will verify the proper temperature, pH, and inventory of prepared diluent.

b. "Align Valves". When ILD4 is activated, the RCS will position (or will confirm the position of) CHEMB-MOV-132 and WT-MOV-263.

c. "Open Caustic Supply System". The RCS will open CHEMB-MOV-131 to a pre-set flowrate.

d. Continue until the need for in-line dilution is satisfied, then operator closes FCV-131 which places the CSS in the recirc mode.

21. SSD - System Shutdown Mode(s)

A SSD mode will be able to be actuated by the operator, or automatically upon loss of power or certain alarm events such as loss of tank vacuum (See Appendix B). The exact sequence of events following activation of the SSD mode will be different depending upon which mode of operation is being shutdown. In general, the SSD mode will be used only when there is a problem and the current mode must be suspended or stopped. Usually when a mode is complete, the operator selects the next mode to be implemented or returns to the Ready mode.

Unplanned shutdowns due to power failures will cause all valves except CHEMB-FCV-131and LCV-430 (fail closed) to fail in place and all pumps to stop pumping. There will be no danger to the environment or to personnel resulting from such an unplanned shutdown. When power is restored the RCS will come up in the Ready mode with valve positions maintained, and it will be an operator decision to reposition failed closed valves if necessary, reselect the mode, and restart the pumps to resume the mode.

Other types of shutdowns may be caused by a leak being detected and causing a Master Pump Shutdown (MPS) to stop all transfer pumps, a diluent line leak to stop the diluent flush pump, or an abnormal event that procedurally requires the operator to perform an administrative shutdown. Automatic shutdowns will sound an alarm to alert the operator. An MPS actuation will stop the transfer pumps and diluent/flush pumps if they are running. The electric actuators for valves CHEMB-FCV-131 and LCV-430 are powered from the same UPS that supports the RCS, so they will drive to the closed position upon system failure. FCV-131 must close to prevent gravity drain of the flush tank if control is lost, and closure of LCV-430 is necessary to prevent flush tank overflow from the raw water system if control is lost.

Relatively few shutdowns will be programmed for automatic action because there are too many variables involved to "program" all possible scenarios. The following list describes automatic actions. Other shutdown sequences will be covered by written procedures based on a decision matrix.

a. Loss of power - All motors stop, all valves fail in place except CHEMB-FCV-131 and LCV-430 which fail closed, and the RCS goes into the Ready mode.

b. MPS Shutdown - RCS goes into Ready mode, ready for flush if appropriate.

c. RCS Failure - Administratively stop all pumps at the VFDs, physically verify CHEMB-FCV-131 and LCV-430 have automatically closed.

d. Diluent line leak - Stop diluent pump and close valves CHEMB-FCV-131 and LCV-430. RCS goes into the ready mode, but does not get a "Ready" signal from the CSS.

e. Emergency Stop - Stops all pumps and closes valves CHEMB-FCV-131 and LCV-430.

E. INTERLOCKS

Interlocks in the RCS will be provided to prevent equipment damage or harm to the environment or personnel. Any of the interlocks listed below will take the appropriate action (stop the appropriate pump or place the valves in the correct positions) in all modes and the appropriate alarm will be annunciated, whether the interlock is bypassed or not. When any interlock is activated a warning message will be displayed to the operator. There will be two types of interlocks: one via the PLC and one hard-wired. Interlocks for safety class items such as MPS will be hard-wired interlocks, and not dependent on the RCS or PLC to take action (See Table IV-2, page 29). Non-safety class alarms and/or interlocks may be either hard-wired or PLC implemented. There will be two types of interlocks provided via the PLC: those that can be bypassed and those that cannot. Bypassable PLC interlocks will only be bypassed at a Supervisor or higher level access. All PLC interlocks are listed in table IV-2b, page 30. See Appendix D, Figure 8 for the PLC Interlocks screen.

All interlocks are processed in the PLC and remain in effect even if the operator station is turned off or malfunctions. If the last operator station is turned off, any bypasses in effect will be reset (cancelled) so that no bypasses can be in effect unless at least one operator station is active.

The two hard-wired interlocks are MPS, which shuts down the transfer pump and diluent/flush pump, and loss of electric power, which shuts down all equipment except the RCS computers and PLC. Inputs that cause an MPS actuation include leaks detected in AP farm pits, leaks detected in the transfer or diluent pipe encasements, or gamma radiation detected at the diluent supply piping, indicating the extremely unlikely backflow of waste into the diluent/flush system.

Upon loss of primary ac power, all pumps stop and valves FCV-131 and LCV-430 are driven closed by the RCS using UPS power. The system can remain in this mode indefinately.

ACTION \ INITIATOR	RAH RXA	RAH RXA	RAH RXA	RAH RXA	LDE LDK	RAH RXA	LDE LDK	LE LEK
Shutdown Mixer Pumps (via PLC)						Y		
Shutdown Transfer Pump (hardwired)	Y	Y	Y	Y	Y			
Shutdown Diluent/Flush Pump (via PLC)							Y	
Alarm Window in 241-AP-271 (hardwired)	Y	Y	Y	Y	Y	Y	Y	Y
Individual alarm to CASS/TMACS	Y	Y	Y	Y	Y			
Combined alarm to CASS/TMACS						Y	Y	Y
Automatic PLC Action						Y	Y	
Master Pump Interlock (MPS)	Y	Y	Y	Y	Y			
Description of Initiator Event	Rad Monitor 125A, Caustic Sys Backflow, Hi Rad or Channel Fail	Rad Monitor 125B, Caustic Sys Backflow, Hi Rad or Channel Fail	Rad Monitor 127A, Caustic Sys Backflow, Hi Rad or Channel Fail	Rad Monitor 127B, Caustic Sys Backflow, Hi Rad or Channel Fail	Any Transfer Line Encasement Leak Detected or Channel Fail	Rad Monitor 126, Raw Water Sys Backflow, Hi Rad or Channel Fail	Diluent Line(s) Encasement Leak Detected or Channel Fail	Caustic System Sump Liquid Detected or Channel Fail

Table IV-2a

Table IV-2b
Interlocks

Intl'k No.°	Equip't	Interlock	Bypass Avail.?	Description
10	Transfer Pump	Disch Press Hi-Hi	Yes	Protects transfer pump from damage due to over-pressure.
10	Transfer Pump	Tank Waste Level Lo-Lo	Yes	Prevents pump cavitation.
10	Transfer Pump	Minimum NPSH	Yes	Waste level within 24" of winch (pump suction) position.
10	Transfer Pump	Motor Current Hi-Hi	Yes	Prevents pump motor from exceeding a safe current limit.
10	Transfer Pump	Discharge Blocked	No	Prevents transfer pump from running if MOV-242 or 246 are in the C position.
10	Transfer Pump	Loss of tank vacuum	No	Reduces gas release when ventilation is not available.
10	Transfer Pump	Tank Waste Temperature Hi Hi	No	Reduces additional heat input to waste.
10	Transfer Pump	Rupture Disk Failure	Yes	Prevents pipe overpressure.
10	Transfer Pump	Motor Winding Temperature Hi-Hi	Yes	Prevents pump motor winding from exceeding a safe temperature limit.
3*	Transfer Pump	Master Pump Shutdown (MPS)	No	Prevents/stops pumping when a leak or radiation is detected.
1	Transfer Pump	No Mode besides Ready selected	Yes	Prevents transfer pump from running unless misrouting prevention is in effect.
2	Mixer Pump	Tank Waste Level Lo-Lo	Yes	Prevents pump cavitation.
7	Mixer Pump	Motor Current Hi-Hi	Yes	Prevents pump motor from exceeding a safe current limit.
7	Mixer Pump	Motor Upper Bearing Vibration Hi-Hi	No	Prevents pump motor bearing from exceeding a safe vibration limit.
7	Mixer Pump	Motor Lower Bearing Vibration Hi-Hi	No	Prevents pump motor bearing from exceeding a safe vibration limit.

Intl'k No.°	Equip't	Interlock	Bypass Avail.?	Description
7	Mixer Pump	Motor Upper Bearing Temperature Hi-Hi	No	Prevents pump motor bearing from exceeding a safe temperature limit.
7	Mixer Pump	Motor Lower Bearing Temperature Hi-Hi	No	Prevents pump motor bearing from exceeding a safe temperature limit.
7	Mixer Pump	Motor Winding Temperature Hi-Hi	No	Prevents pump motor winding from exceeding a safe temperature limit.
2	Mixer Pump	Loss of Tank Vacuum	No	Reduces release of gas from waste when ventilation is not available.
2	Mixer Pump	Tank Waste Temperature Hi-Hi	No	Reduces additional heat input to waste
8	Mixer Pump	Suction Bell Not Full Up	Yes	Prevents suction line whip.
4*	Flush Pump	MPS actuation	Yes	Prevents pumping diluent to encasement annulus.
5	Flush tank outlet valve	Closes FCV-131 when diluent pump is off.	Yes	Prevents gravity drain of diluent to waste tank.
6	Flush tank inlet valve	Flush tank level Hi-Hi closes LCV-430	No	Overrides level control and forces LCV-430 closed at maximum tank capacity.
NA	Loss of AC Power	All motor operated equipment	No	Computer and PLC remain in service

° See drawing H-14-102086, sheet 1 for interlock schedule
* Hard-wired interlocks

V. HARDWARE INTERFACES

Communications between the computers and the PLC will be via Modbus Plus links so that the PLC communicates with both PC's directly. See drawing H-14-020150 for PLC System Cabling diagram.

VI. SOFTWARE INTERFACES

The OIS software will be capable of communicating directly with data handling programs running on the OI PC, such as Microsoft Excel.®

VII. COMMUNICATION INTERFACES

The RCS inter-system communication equipment will use TCP/IP protocol. Between the RCS and TMACS, for example, the HLAN physical layer will be used as the TMACS workstations gather data directly from the PLC via an Ethernet to Modbus Plus communications link.

VIII. MAINTAINABILITY

The RCS PLC software will be capable of being changed on-line should the need arise. The PLC code is modularized by function and a function module may be altered and down-loaded while the system is on-line and operational. The flexibility of the system hardware and software thereby allows on-line fixes of operational functions if necessary.

IX. QUALITY ASSURANCE TESTING

The software shall undergo testing to ensure that all functional requirements have been met. The RCS is considered a class GS design. An acceptance test document, and a functional test document, will be prepared and approved prior to final operation to verify system operations. All software documentation will be prepared in accordance with appropriate procedures.

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

X. MODE FLOW DIAGRAMS

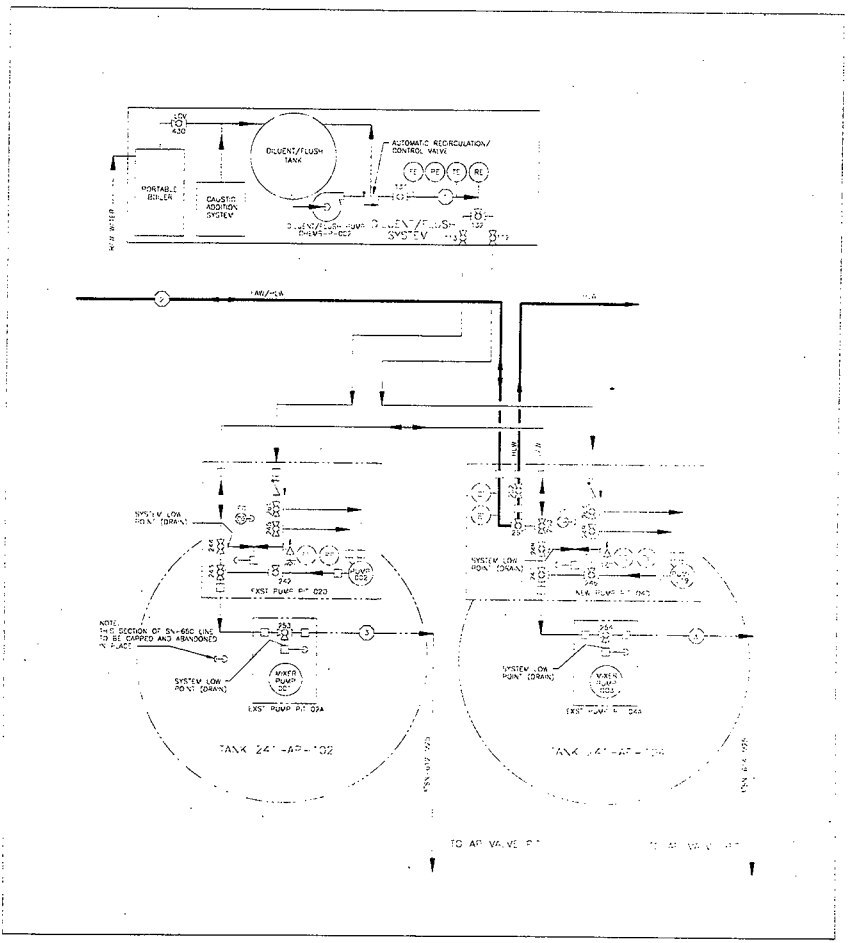

Figure IV-1a: HVT

BEST AVAILABLE COPY

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

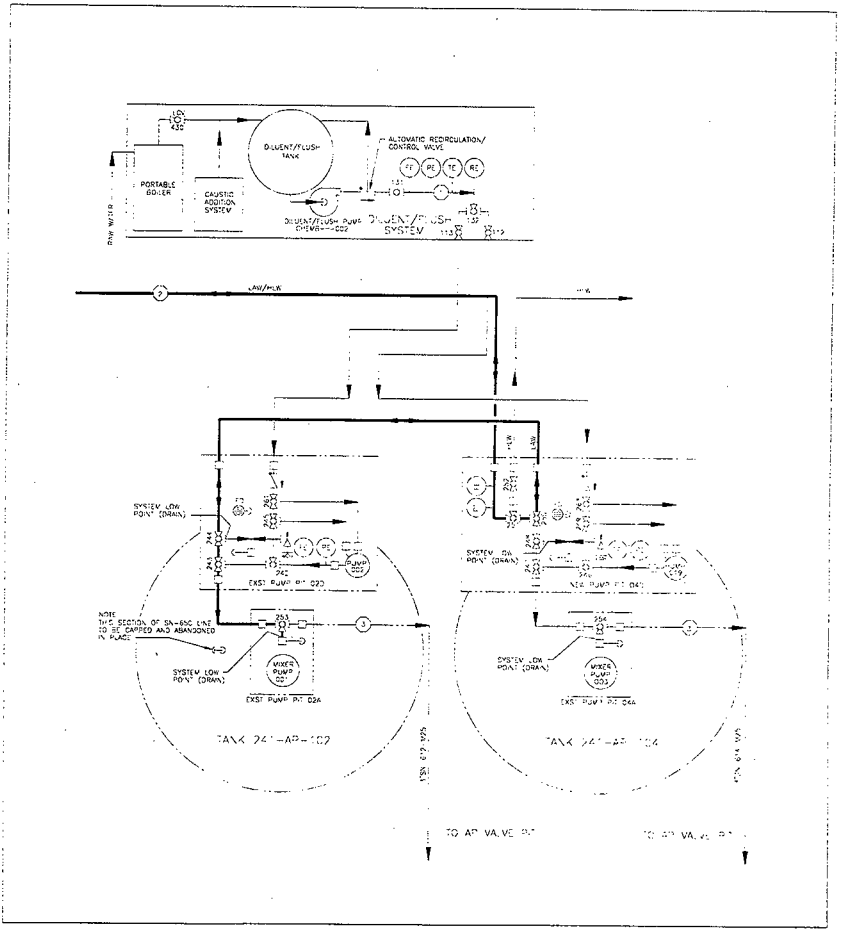

Figure IV-1b: IN2

BEST AVAILABLE COPY

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

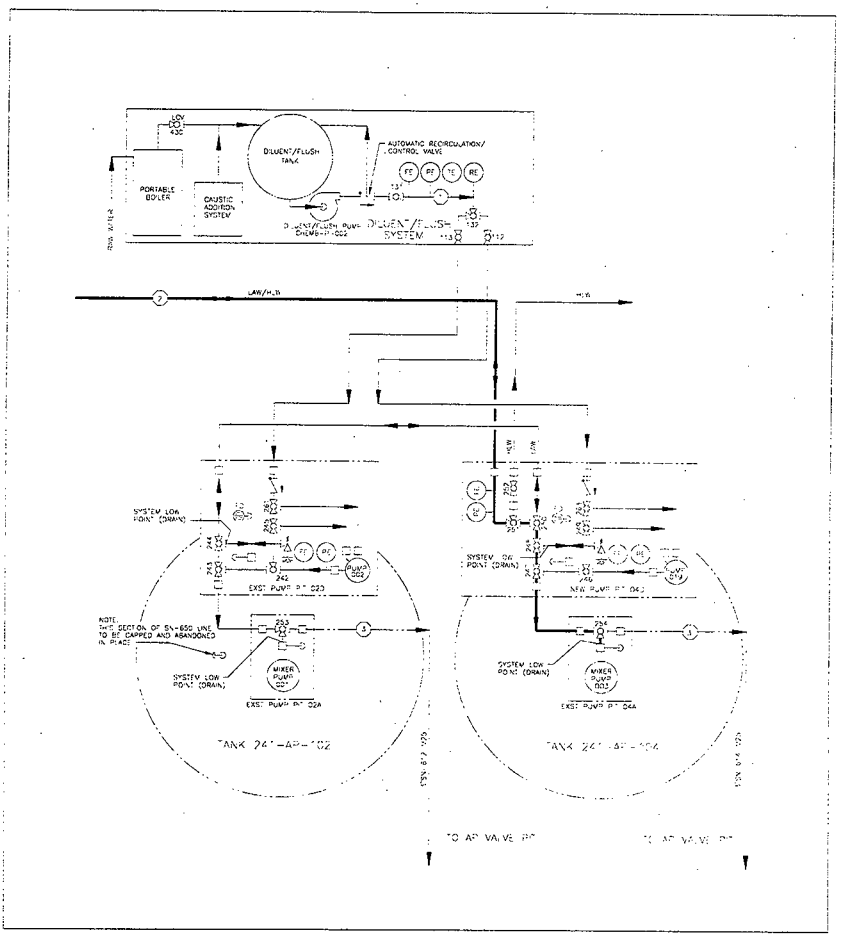

Figure IV-1c: IN4

BEST AVAILABLE COPY

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

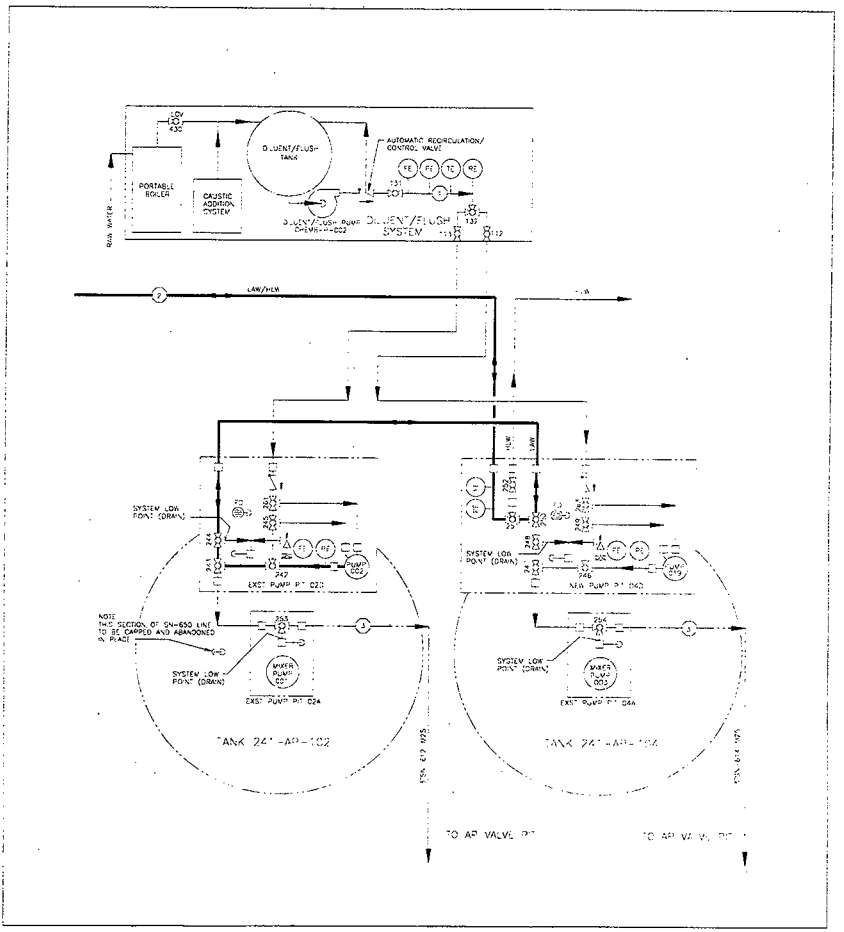

Figure IV-1d: RTN2

BEST AVAILABLE COPY

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

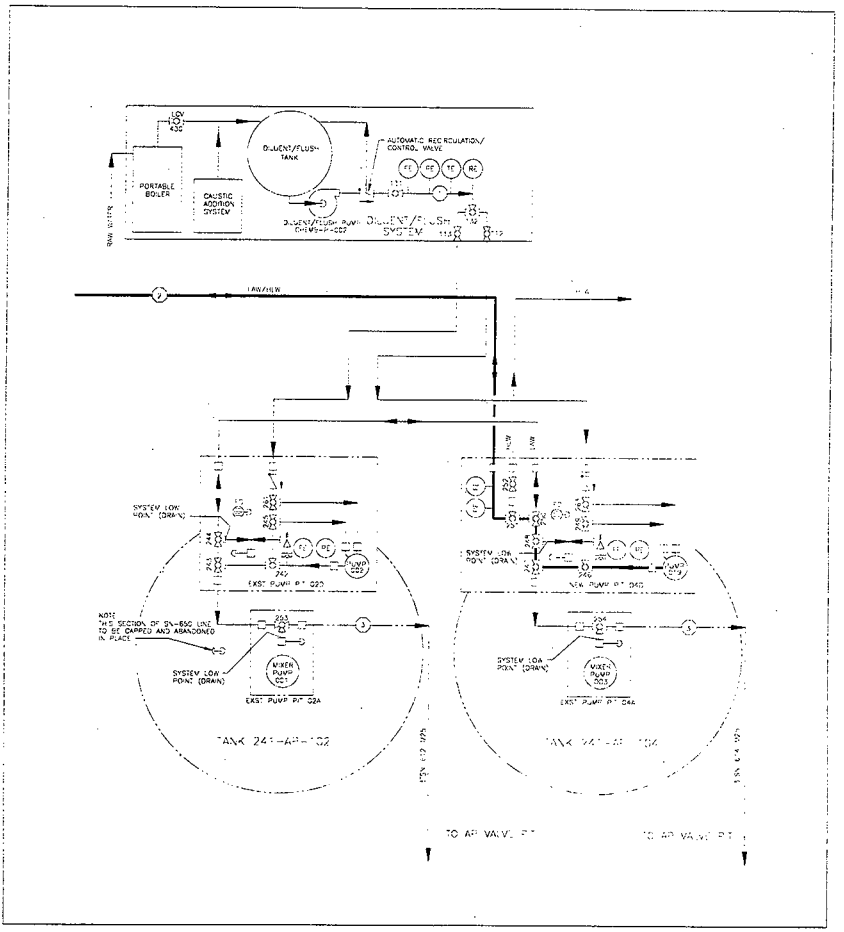

Figure IV-1e: RTN4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

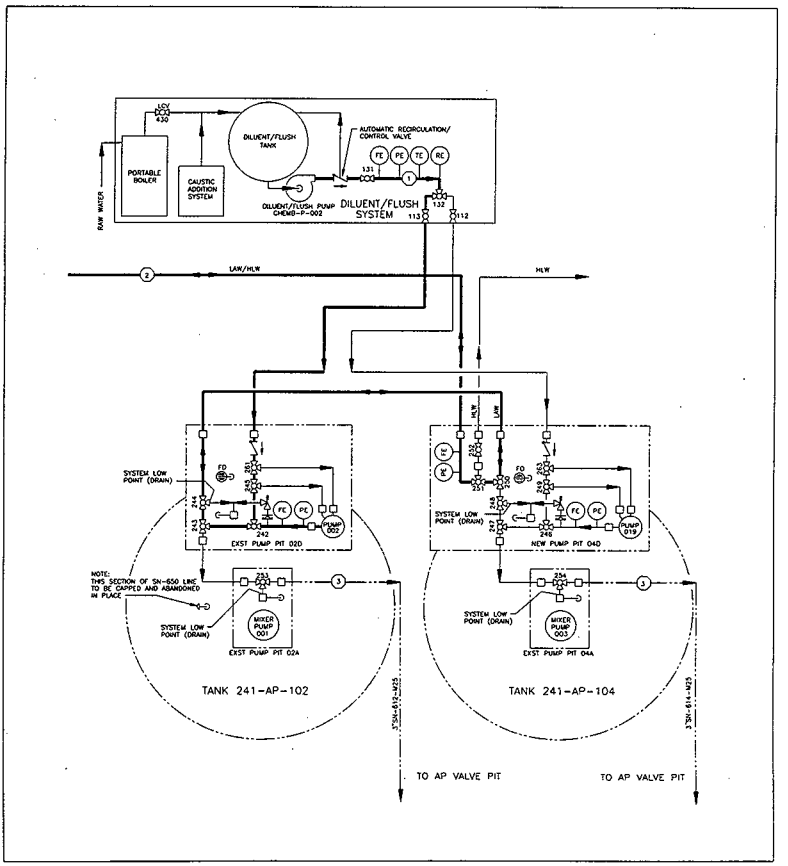

Figure IV-1f: RTF2

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

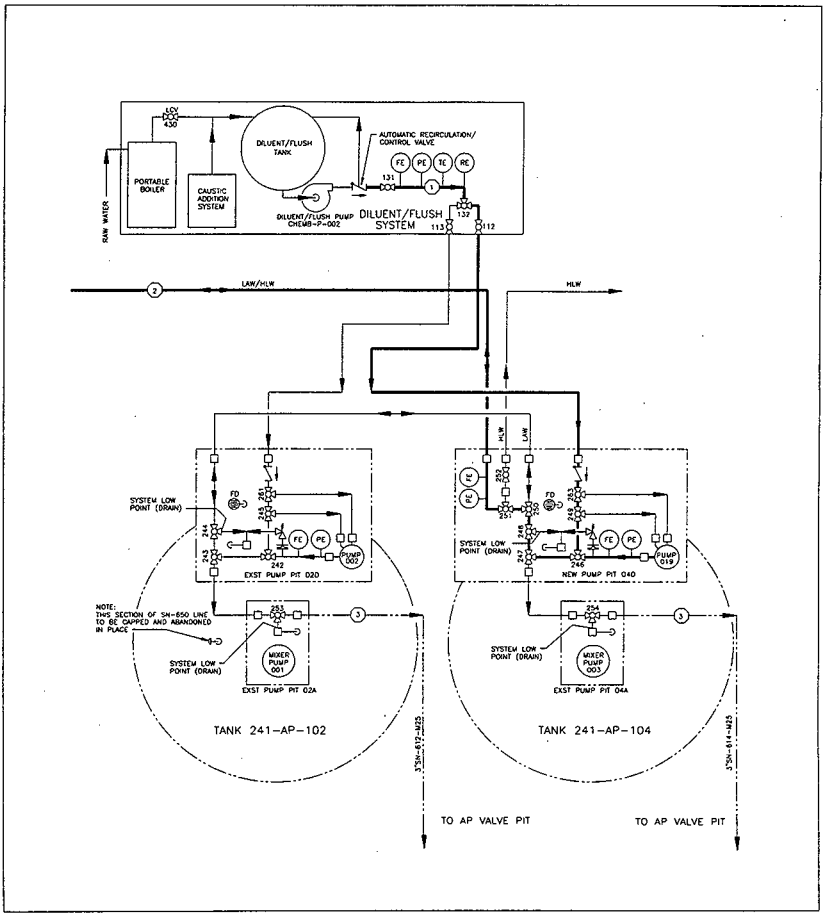

Figure IV-1g: RTF4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

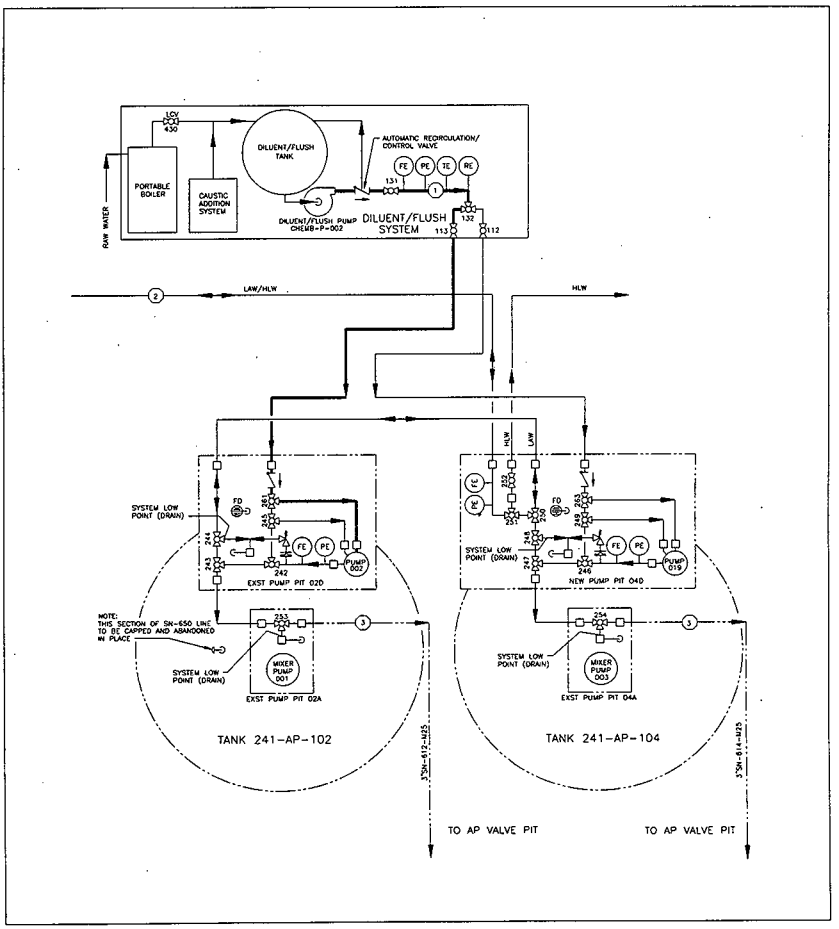

Figure IV-1h: DIL2

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

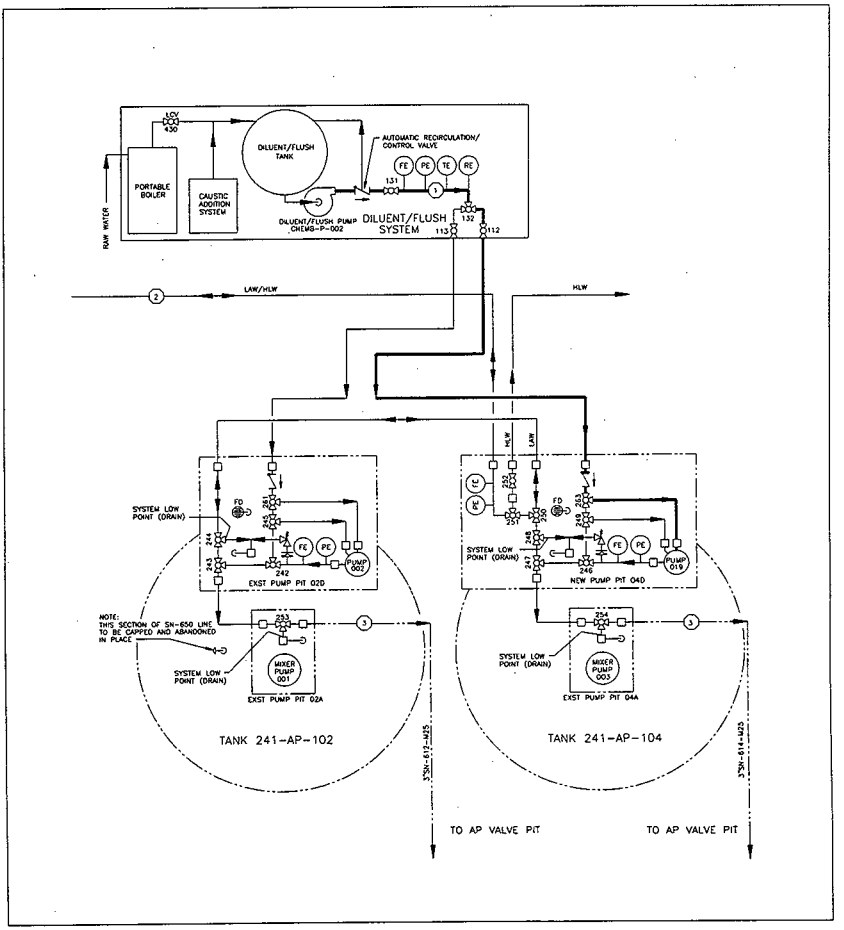

Figure IV-1i: DIL4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

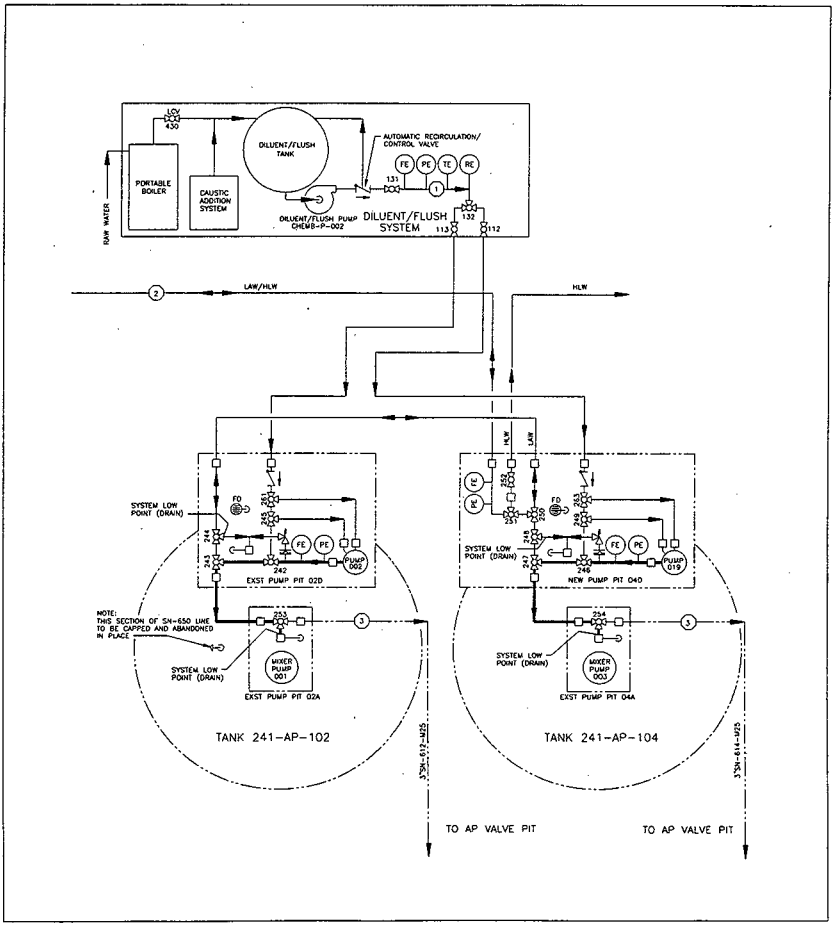

Figure IV-1j: ITR2 and ITR4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

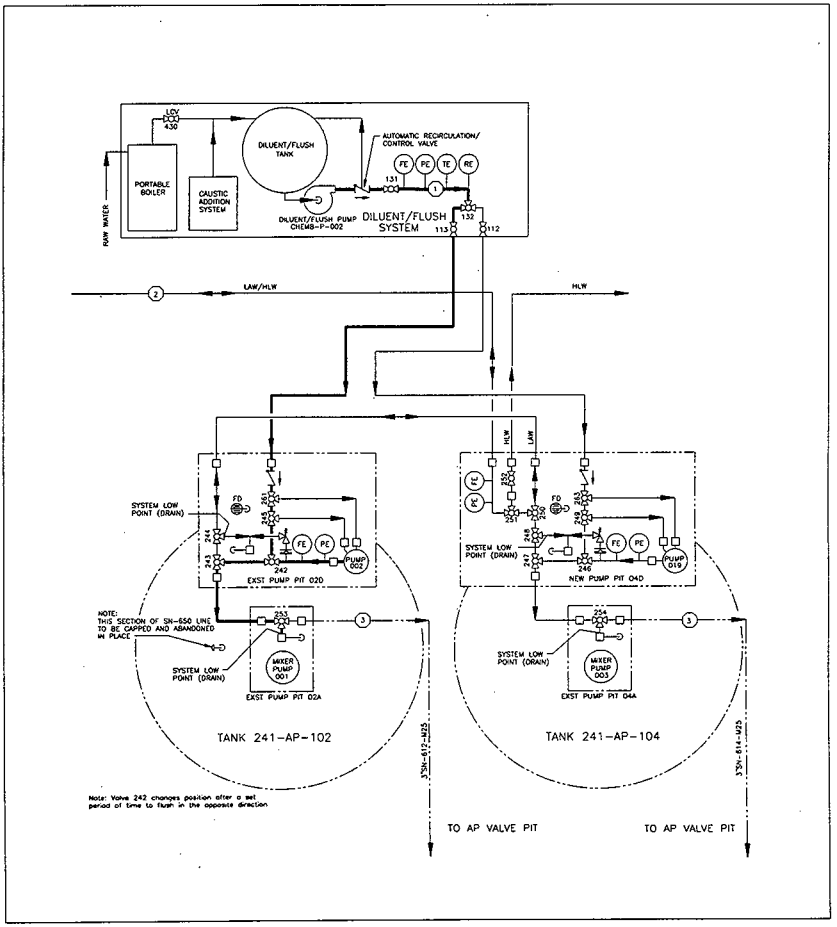

Figure IV-1k: ITF2

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

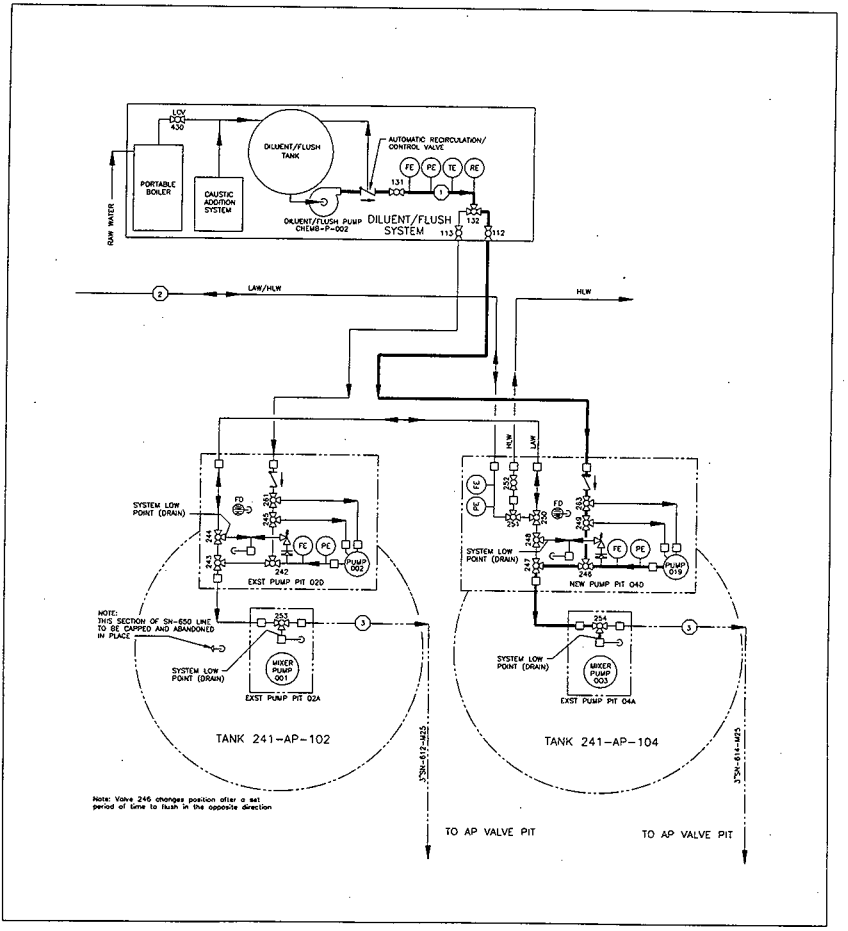

Figure IV-1I: ITF4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

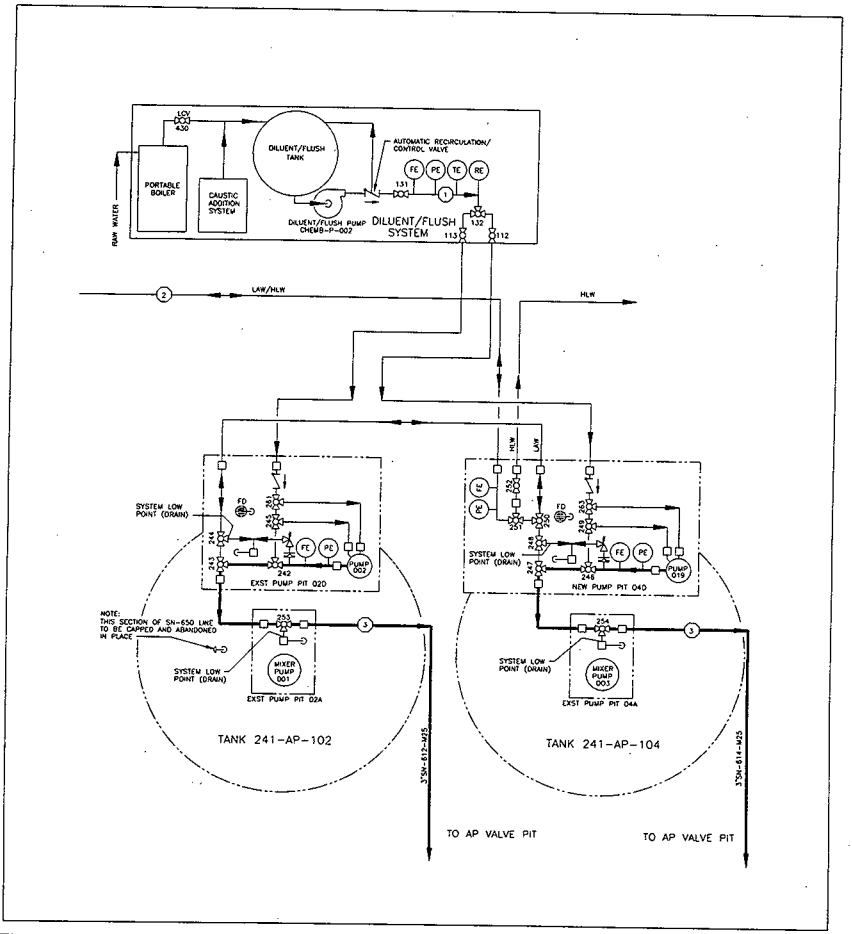

Figure IV-1m: WT2 and WT4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

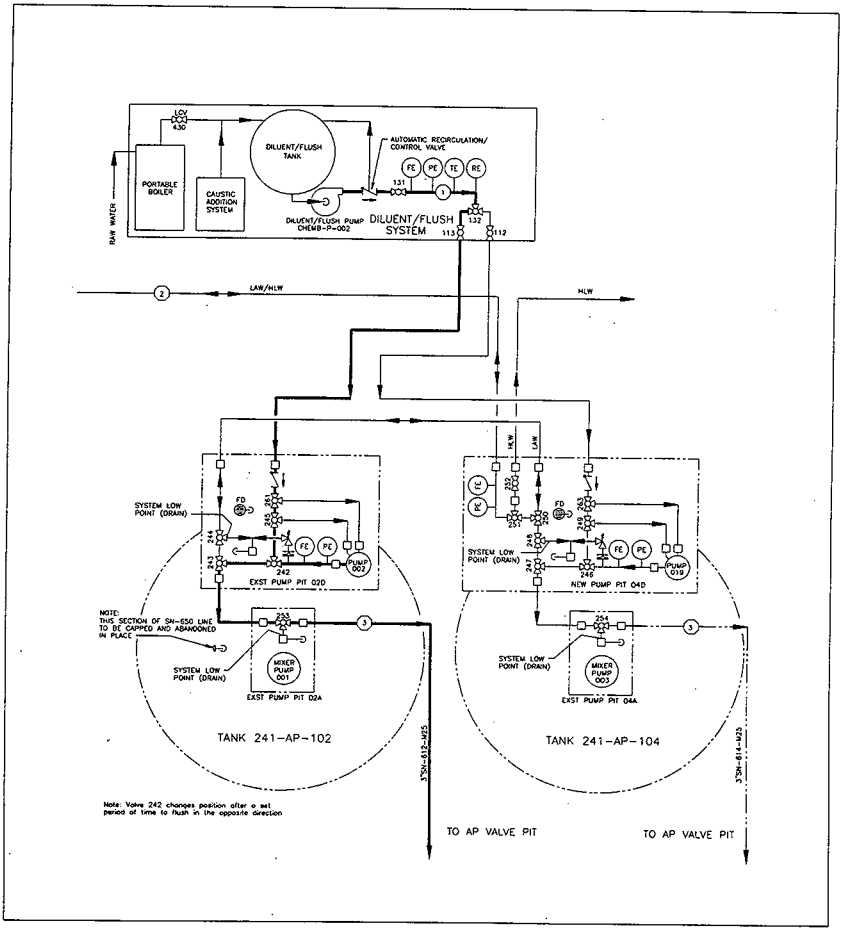

Figure IV-1n: PTF2

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

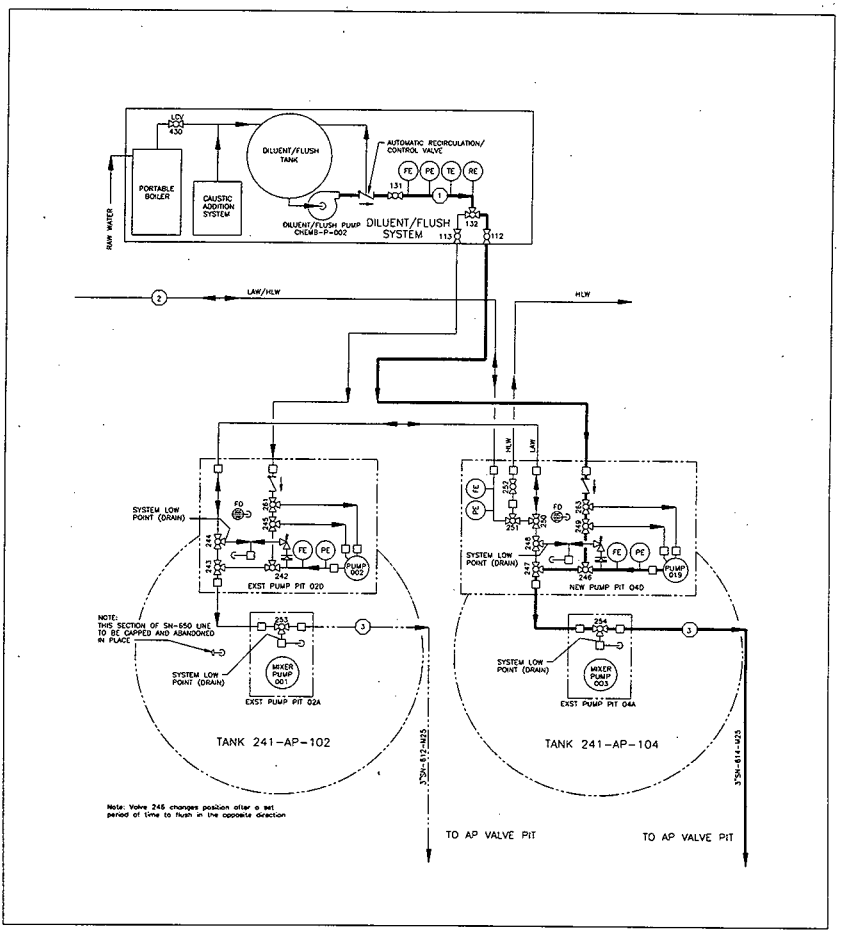

Figure IV-1o: PTF4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

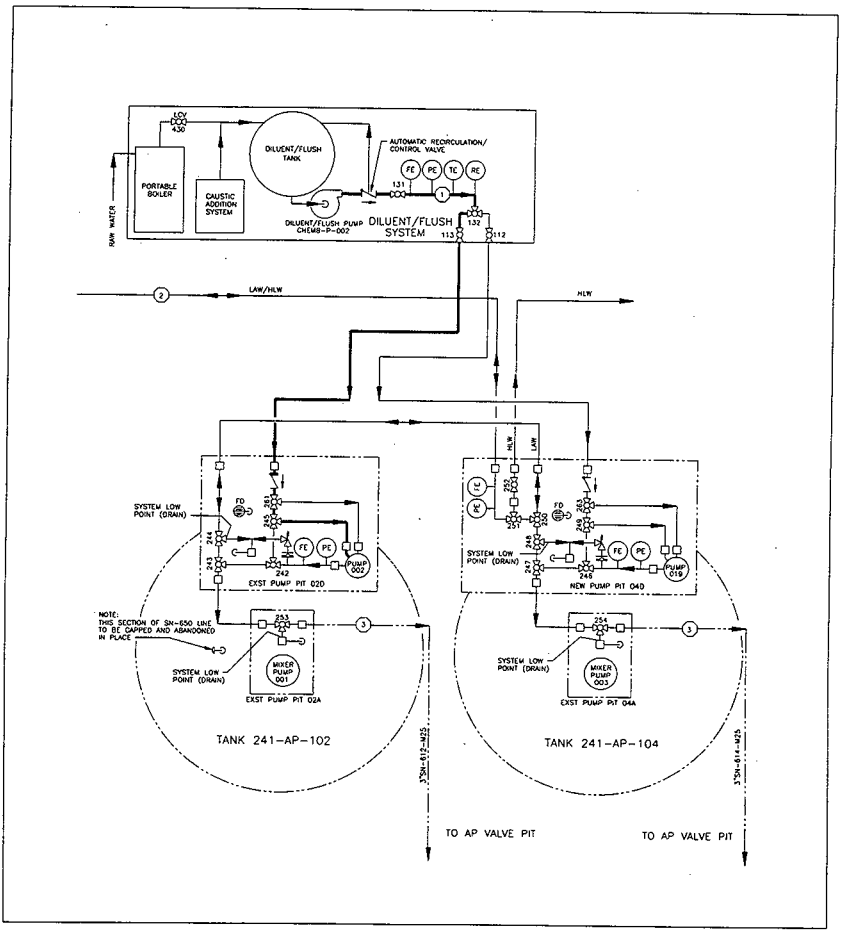

Figure IV-1p: ILD2

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

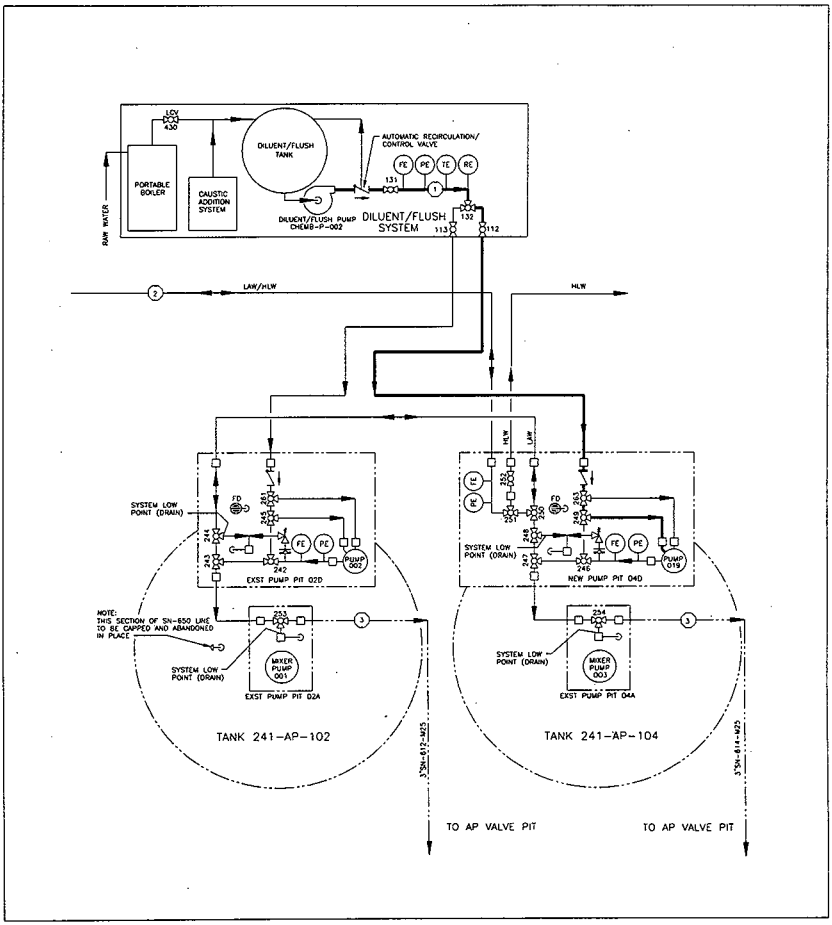

Figure IV-1q: ILD4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

The ■ symbol indicates required valve position for the related operating mode or step within that mode.

Mode		Steps	1 (LSB) FCV_131_AUTO_OPEN	2 FCV_131_AUTO_CLOSE	3 MOV_242_AUTO_POSA	4 MOV_242_AUTO_POSB	5 MOV_242_AUTO_POSC	6 MOV_243_AUTO_POSA	7 MOV_243_AUTO_POSB	8 MOV_243_AUTO_POSC	9 MOV_244_AUTO_POSA	10 MOV_244_AUTO_POSB	11 MOV_244_AUTO_POSC	12 MOV_245_AUTO_POSA	13 MOV_245_AUTO_POSB	14 (MSB) MOV_245_AUTO_POSC	15 MOV_246_AUTO_POSA	16 MOV_246_AUTO_POSB	17 MOV_246_AUTO_POSC	18 MOV_247_AUTO_POSA	19 MOV_247_AUTO_POSB
RDY																					
HVT		Align Valves																			
IN2		Align Valves								■	■										
RTN2		Align Valves				■		■			■										
RTF2	1	Stop Xfer Pump																			
	2	Align Valves		■	■			■			■				■						
	3	Start Flush	■		■			■			■				■						
	4	Reroute Flush	■				■	■			■				■						
	5	Close Valves		■			■	■			■				■						
DIL2	1	Align Valves		■																	
	2	Open Caustic	■																		
	3	Recirc Caustic		■																	
ITR2		Align Valves				■			■												
ITF2	1	Stop Xfer Pump																			
	2	Align Valves		■	■				■						■						
	3	Start Flush	■		■				■						■						
	4	Reroute Flush	■				■		■						■						
	5	Recir Caustic		■			■		■						■						
WT2		Align Valves				■			■												
PTF2	1	Stop Xfer Pump																			
	2	Align Valves		■	■				■						■						
	3	Start Flush	■		■				■						■						
	4	Reroute Flush	■				■		■						■						
	5	Recirc Caustic		■			■		■						■						
ILD2	1	Align Valves		■												■					
	2	Open Caustic	■													■					
	3	Recirc Caustic		■												■					
IN4		Align Valves																			
RTN4		Align Valves																■		■	
RTF4	1	Stop Xfer Pump																			
	2	Align Valves		■													■			■	
	3	Start Flush	■														■			■	
	4	Reroute Flush	■																■	■	
	5	Close Valves		■															■	■	
DIL4	1	Align Valves		■																	
	2	Open Caustic	■																		
	3	Recirc Caustic		■																	
ITR4		Align Valves																■			■
ITF4	1	Stop Xfer Pump																			
	2	Align Valves		■													■				■
	3	Start Flush	■														■				■
	4	Reroute Flush	■																■		■
	5	Recir Caustic		■															■		■
WT4		Align Valves																■			■
PTF4	1	Stop Xfer Pump																			
	2	Align Valves		■													■				■
	3	Start Flush	■														■				■
	4	Reroute Flush	■																■		■
	5	Recirc Caustic		■															■		■
ILD4	1	Align Valves		■																	
	2	Open Caustic	■																		
	3	Recirc Caustic		■																	
MP8		Stop Xfer Pump		■																	
LAHH-222		Align Valves		■																	

Mode		Steps	20 MOV_247_AUTO_POSC	21 MOV_248_AUTO_POSA	22 MOV_248_AUTO_POSB	23 MOV_248_AUTO_POSC	24 MOV_249_AUTO_POSA	25 MOV_249_AUTO_POSB	26 MOV_249_AUTO_POSC	27 MOV_250_AUTO_POSA	28 MOV_250_AUTO_POSB	29 MOV_250_AUTO_POSC	30 MOV_251_AUTO_POSA	31 MOV_251_AUTO_POSB	32 MOV_251_AUTO_POSC	33 MOV_252_AUTO_OPEN	34 MOV_252_AUTO_CLOSE	35 MOV_253_AUTO_POSA	36 MOV_253_AUTO_POSB	37 MOV_253_AUTO_POSC	38 MOV_254_AUTO_POSA
RDY																					
HVT		Align Valves												■		■					
IN2		Align Valves								■			■					■			
RTN2		Align Valves								■			■								
RTF2	1	Stop Xfer Pump																			
	2	Align Valves								■			■								
	3	Start Flush								■			■								
	4	Reroute Flush								■			■								
	5	Close Valves								■			■								
DIL2	1	Align Valves																			
	2	Open Caustic																			
	3	Recirc Caustic																			
ITR2		Align Valves																■			
ITF2	1	Stop Xfer Pump																			
	2	Align Valves																■			
	3	Start Flush																■			
	4	Reroute Flush																■			
	5	Recir Caustic																			
WT2		Align Valves																	■		
PTF2	1	Stop Xfer Pump																			
	2	Align Valves																	■		
	3	Start Flush																	■		
	4	Reroute Flush																	■		
	5	Recirc Caustic																	■		
ILD2	1	Align Valves																			
	2	Open Caustic																			
	3	Recirc Caustic																			
IN4		Align Valves	■		■							■	■								■
RTN4		Align Valves			■							■	■								
RTF4	1	Stop Xfer Pump																			
	2	Align Valves			■							■	■								
	3	Start Flush			■							■	■								
	4	Reroute Flush			■							■	■								
	5	Close Valves			■							■	■								
DIL4	1	Align Valves																			
	2	Open Caustic																			
	3	Recirc Caustic																			
ITR4		Align Valves																			■
ITF4	1	Stop Xfer Pump																			
	2	Align Valves						■													■
	3	Start Flush						■													■
	4	Reroute Flush						■													■
	5	Recir Caustic						■													■
WT4		Align Valves																			
PTF4	1	Stop Xfer Pump																			
	2	Align Valves						■													
	3	Start Flush						■													
	4	Reroute Flush						■													
	5	Recirc Caustic						■													
ILD4	1	Align Valves							■												
	2	Open Caustic							■												
	3	Recirc Caustic							■												
MP8		Stop Xfer Pump																			
LAHH-222		Align Valves																			

Mode		Steps	39 MOV_254_AUTO_POSB	40 MOV_254_AUTO_POSC	41 MOV_261_AUTO_POSA	42 MOV_261_AUTO_POSB	43 MOV_261_AUTO_POSC	44 MOV_263_AUTO_POSA	45 MOV_263_AUTO_POSB	46 MOV_263_AUTO_POSC	47 CHEMB_LCV_430_AUTO_OPEN	48 CHEMB_LCV_430_AUTO_CLOSE	49 CHEMB_MOV_132_AUTO_POSA	50 CHEMB_MOV_132_AUTO_POSB	51 CHEMB_MOV_132_AUTO_POSC	52 WT_P_002_AUTO_ENABLE	53 WT_P_002_AUTO_STOP	54 WT_P_019_AUTO_ENABLE	55 WT_P_019_AUTO_STOP
RDY																			
HVT		Align Valves																	
IN2		Align Valves																	
RTN2		Align Valves																	
RTF2	1	Stop Xfer Pump															■		
	2	Align Valves				■											■		
	3	Start Flush				■											■		
	4	Reroute Flush				■											■		
	5	Close Valves				■											■		
DIL2	1	Align Valves					■						■						
	2	Open Caustic					■						■						
	3	Recirc Caustic					■						■						
ITR2		Align Valves																	
ITF2	1	Stop Xfer Pump															■		
	2	Align Valves				■							■				■		
	3	Start Flush				■							■				■		
	4	Reroute Flush				■							■				■		
	5	Recir Caustic				■							■				■		
WT2		Align Valves																	
PTF2	1	Stop Xfer Pump															■		
	2	Align Valves				■							■				■		
	3	Start Flush				■							■				■		
	4	Reroute Flush				■							■				■		
	5	Recirc Caustic				■							■				■		
ILD2	1	Align Valves				■							■						
	2	Open Caustic				■							■						
	3	Recirc Caustic				■							■						
IN4		Align Valves																	
RTN4		Align Valves																	
RTF4	1	Stop Xfer Pump																	■
	2	Align Valves												■					■
	3	Start Flush												■					■
	4	Reroute Flush												■					■
	5	Close Valves												■					■
DIL4	1	Align Valves								■				■					
	2	Open Caustic								■				■					
	3	Recirc Caustic								■				■					
ITR4		Align Valves																	
ITF4	1	Stop Xfer Pump																	■
	2	Align Valves							■					■					■
	3	Start Flush							■					■					■
	4	Reroute Flush							■					■					■
	5	Recir Caustic							■					■					■
WT4		Align Valves	■																
PTF4	1	Stop Xfer Pump																	■
	2	Align Valves	■						■					■					■
	3	Start Flush	■						■					■					■
	4	Reroute Flush	■						■					■					■
	5	Recirc Caustic	■						■					■					■
ILD4	1	Align Valves							■					■					
	2	Open Caustic							■					■					
	3	Recirc Caustic							■					■					
MP8		Stop Xfer Pump										■					■		■
LAHH-222		Align Valves										■					■		■

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

XI. APPENDICES

APPENDIX A - KEYBOARD ASSIGNMENTS
APPENDIX B - PARAMETERS FOR TRENDING, ALARMS, CONTROLS AND INDICATIONS.
APPENDIX C - MODE INTERLOCK MATRIX
APPENDIX D - HMI SCREENS

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

APPENDIX A - KEYBOARD ASSIGNMENTS

Function Key	Label	Description
F1	HELP	Displays the HELP Screen.
F2	MENU	Displays the screen selection Pop-Up Window menu.
F3	LOG ON	Displays the Title Screen and Log-On Prompt.
F4	(Not Used)	
F5	ALARMS	Displays the Current Alarms page.
F6	SUMMARY	Displays the Alarm Summary page.
F7	HARDWARE	Displays the Hardware Alarms page.
F8	(Not Used)	
F9	LAST PAGE	Displays the previous page.
F10	(Not Used)	
F11	(Not Used)	
F12	LOG OFF	Displays the Title Screen and Logs off current user.
END	CLOSE	Closes active Pop-Up Window
ESC	Shutdown	Shuts down the Control System (With proper access level.)
Print Screen	Print Screen	Prints the current screen to the default printer.

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

APPENDIX B - PARAMETERS FOR TRENDING, ALARMS, CONTROLS AND INDICATIONS

This appendix lists the tag names which will be used in the control of the retrieval process for tanks 241-AP-102 and 241-AP-104.

General Tag Naming Convention:
In general, the tag name consists of the following elements:

[System]_[Equipment Type]_[Equipment Id]

Where [System] is the abbreviated letter of a recognized system, such as WST (Waste Storage Tank) Prefix is used for Piping/Instrumentation in Pump Pit 02A (H-14-102086, sheet 2). The [Equipment Type] can be either a control or an indication signal (e.g., FI : Flow Indication, SC: Speed Control, etc.). The [Equipment Id] will be the equipment identification number used in the P&ID drawings. Note that the underscore "_" is used in the tag name instead of the standard "-" sign used in P&ID drawing because the HMI software does not accept "-" as a valid character to use in a tag name. (The complete tag number includes a location designation such as AP271; however, this field is not used in the RCS, eg,. AP271-WST-LI-222.)

Alarm Naming Convention:
Alarm tag names for analog values are different from the designated alarm names used in the P&ID set. For instance, tank level alarms in the P&ID are noted as LAHH-222, LAH-222, LAL-222, and LALL-222, which stand for Hi-Hi, Hi, Low, and Low-Low level alarms. In Citect®, the alarm tag name will have the same name as the analog tag with the alarm level appended at the ends. For example, with the same tank level analog tag name: WST-LI-222, the following alarm tags and tank level value are used:

WST_LI_222.Value	: Current analog value
WST_LI_222.HighHigh	: Hi-Hi analog alarm
WST_LI_222.High	: Hi analog alarm
WST_LI_222.Low	: Lo analog alarm
WST_LI_222.LowLow	: Lo-Lo analog alarm

These tag names are not modifiable and therefore will be used in the program to substitute for the P&ID alarm designations, with the exception of wired limit switches, such as TAH_273 (Temperature High Alarm), *where the actual alarm tag name will be used.*

Table Fields Description:

P&ID H-14-	P&ID drawing and sheet number
Tagname	Name for an item
Trend	"Y" to indicate that trending is pre-programmed for this item (all analog values can be trended)
Description	Literal description of the tagname
Range	The possible range in engineering units of the item
Alarm Setpoints	Empty fields indicate alarm setpoint is not needed
Unit	Engineering units of the item
Fail States	Refers to equipment control

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

Note to reviewers:

The following tag names for analog and discrete I/O were derived from the P&ID set issued 7/17/98. If there is any modification to this set, it may affect this list.

This is a list of actual I/O points needed for the control system. Note that all 3-way valves are assumed to have all three positions even though some 3-way valves will have only two positions. This will be determined and modified later. Furthermore, I/O points to and from the mixer and transfer pumps, the mixer turntable VFDs, the caustic system boiler, and the NAOH injection pump PLCs, are to be obtained directly from the devices' PLCs through a Modbus Plus connection.

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

Analog Input/Output Instrumentation

P&ID H-14-	Tagname	Trend	Description	Range	Alarm Setpoints HiHi	Hi	Lo	LoLo	Units
102086/2	WST_SC_201		Mixer Pump WST-P-001 Speed Demand	58-100					%
	WST_SI_201	Y	Mixer Pump WST-P-001 Speed Indication	58-100					%
	WST_II_201	Y	Mixer Pump WST-P-001 Motor Current Indication		364	300			Amps
	WST_VI_206		Mixer Pump WST-P-001 Motor Upper Vibration Ind.	0-10	3.0	2.5			mils
	WST_VI_207		Mixer Pump WST-P-001 Motor Lower Vibration Ind.	0-10	3.0	2.5			mils
	WST_TI_203		Mixer Pump WST-P-001 Motor Upper Bearing Temp Ind	0-400	203	185			°F
	WST_TI_204		Mixer Pump WST-P-001 Motor Winding Temp Indication	0-400	293	275			°F
	WST_TI_205		Mixer Pump WST-P-001 Motor Lower Bearing Temp Ind	0-400	203	185			°F
	WST_ZI_208		Mixer Pump WST-P-001 Nozzle Position Indication	0-180					deg.
	WST_SC_202		Mixer Pump WST-P-001 Turntable Speed Demand	0.05-0.2					RPM
	WST_SI_202		Mixer Pump WST-P-001 Turntable Speed Indication	0.05-0.2					RPM
	WST_II_202		Mixer Pump WST-P-001 Turntable Motor Current Ind.	0-10					Amps
	WST_LI_222	Y	Tank 241-AP-102 Level Indication (Alarms for xfer pump)	0-450	419	400	36	24	in.
	WST_LI_222	Y	(Same as above, alarms for Mixer Pump)	"	"	"	70	66	in.
	WST_102_TE_36 to WST_102_TE_53	Y	Tank 241-AP-102 Temp Probe Element Indications	50-250	190	175			°F
	WST_PI_112	Y	Tank 241-P-102 Pressure (Vacuum) Indication	-10 to +5			-1.0	-0.25	in. WC

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-	Tagname	Trend	Description	Range	Alarm Setpoints HiHi	Hi	Lo	LoLo	Units
102086/2	WST-LI-106		Tank 241-AP-106 Level Indication (From Privitization)	TBD					
	WST-LI-108		Tank 241-AP-108 Level Indication (From Privitization)	TBD					
102086/3	WT_SC_258		Transfer Pump WT-P-002 Speed Demand	0-100					%
	WT_SI_258	Y	Transfer Pump WT-P-002 Speed Indication	0-100					%
	WT_II_258	Y	Transfer Pump WT-P-002 Motor Current Indication	TBD	TBD	TBD			Amps
	WT_ZI_262		Transfer Pump WT-P-002 Winch Position Indication	0-250	240				In.
	WT_FI_258	Y	Transfer Pump WT-P-002 Output Flow Indication	0-200					gpm
	WT_FQIC_258		Transfer Pump WT-P-002 Output Flow Totalizer Indication	0-65000					kilogal
	WT_PI_259	Y	Transfer Pump WT-P-002 Ouput Flow Pressure Indication	0-300	265	255			psig
	WT-TI-277		Transfer Pump WT-P-002 Motor Winding Temperature	0-400	293	275			°F
102086/4	WST_SC_213		Mixer Pump WST_P_003 Speed Demand	58-100					%
	WST_SI_213	Y	Mixer Pump WST-P-003 Speed Indication	58-100					%
Y	WST_II_213		Mixer Pump WST-P-003 Current Indication	0-300	364	300			Amps
	WST_VI_218		Mixer Pump WST-P-003 Motor Upper Vibration Ind.	0-10	3.0	2.5			mils
	WST_VI_219		Mixer Pump WST-P-003 Motor Lower Vibration Ind.	0-10	3.0	2.5			mils
	WST_TI_215		Mixer Pump WST-P-003 Motor Upper Bearing Temp Ind	0-400	203	185			°F

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-	Tagname	Trend	Description	Range	Alarm Setpoints HiHi	Hi	Lo	LoLo	Units
102086/4	WST_TI_216		Mixer Pump WST-P-003 Motor Winding Temp Indication	0-400	293	275			°F
	WST_TI_217		Mixer Pump WST-P-003 Motor Lower Bearing Temp Ind	0-400	203	185			°F
	WST_ZI_220		Mixer Pump WST-P-003 Nozzle Position Indication	0-180					deg.
	WST_SC_214		Mixer Pump WST-P-003 Turntable Speed Demand	0.05-0.2					RPM
	WST_SI_214		Mixer Pump WST-P-003 Turntable Speed Indication	0.05-0.2					RPM
	WST_II_214		Mixer Pump WST-P-003 Turntable Motor Current Ind.	0-10					Amps
	WST_LI_224	Y	Tank 241-AP-104 Level Indication (For transfer Pump)	0-450	419	400	36	24	in.
	WST_LI_224		Tank 241-AP-104 Level Indication (For Mixer Pump)	"	"	"	70	66	in.
	WST_104_TE_36 to WST_104_TE_53	Y	Tank 241-AP-104 Temp Probe Element Indications	50-250	190	175			°F
	WST_PI_304A	Y	Tank 241-AP-104 Dome Pressure (Vacuum) Indication	-10 to +5			-1.0	-0.25	in. WC
102086/5	WT_SC_264		Transfer Pump WT-P-019 Speed Demand	0 - 100					%
	WT_SI_264	Y	Transfer Pump WT-P-019 Speed Indication	0 - 100					%
	WT_II_264		Transfer Pump WT-P-019 Motor Current Indication						
	WT_TI_274		Transfer Pump Motor Winding Temperature Indication						
	WT_ZI_268		Transfer Pump WT-P-019 Pump Winch Position Indication	0-250	240				In.
	WT_FI_264	Y	Transfer Pump WT-P-019 Output Flow Indication	0 - 200					gpm

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-	Tagname	Trend	Description	Range	Alarm Setpoints HiHi	Hi	Lo	LoLo	Units
102086/5	WT_FIC_264		Transfer Pump WT-P-019 Output Flow Totalizer Indication	0-65000					kilogal
	WT_PI_266	Y	Transfer Pump WT-P-019 Output Pressure Indication	0 - 300	265	255			psi
102086/6	WT_FI_270		SN-650 line Flow Indication	0 - 200					gpm
	WT_PI_271		SN-650 line Pressure Indication	0 - 300					psig
			CAUSTIC SYSTEM						
102304/1	RW_FI_455		Service Water Flow Indication	0 - 200					gpm
	RW_FQI_455		Totalizer from Service Water Flow Indication	0-65000					kilogal
	RW_PI_452		Service Water Pressure Indication	0 - 200			60		psig
102304/2	CHEMB_TI_124		Diluent/Flush Temp Indication	50 - 250					°F
	CHEMB_PI_123		Diluent/Flush Pressure Indication	0 - 200					psig
	CHEMB_FI_122		Diluent/Flush Flow Indication	0 - 200					gpm
	CHEMB_FQI_122		Diluent/Flush Flow Totalizer	0-65000					kilogal
102304/2	CHEMB_FI_123		Diluent/Flush Flow to CHEMB-TK-001	0 - 200					gpm
	CHEMB_LI_126		Diluent/Flush CHEMB-TK-001 Level Indication	0 - 150		120	24	16	in.

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-	Tagname	Trend	Description	Range	Alarm Setpoints HiHi	Hi	Lo	LoLo	Units
	CHEMB_AI_121		Diluent/Flush CHEMB-TK-001 Cond Indication	2×10^6	10^5	10^4	10^2	10^1	micro Seiverts
	CHEMB_TI_120		Diluent/Flush CHEMB-TK-001 Temperature Indication	0 - 200	160	150	130	120	°F
	CHEMB_FI_456X		Diluent/Flush Boiler Water Flow Indication	0 - 200					gpm
	CHEMB_TI_457		Diluent/Flush Boiler Water Temperature Indication	0 - 200	160	150	130	120	°F
	CHEMB_PI_546		Diluent/Flush Boiler Steam Pressure Indication	0 - 50					psia
	CHEMB_TIC_457		Diluent/Flush Boiler Water Temperature Control Command	50 - 250					°F
	CHEMB_LI_548		Diluent/Flush Boiler Water Level Indication						in.
	CHEMB_FCV_ 131_ZT		FCV-131 Valve Percent Open	0 - 100					%
	CHEMB_LCV_ 430 _ZT		LCV-430 Valve Percent Open	0 -100					%

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

Table B-2, Discrete Input/Output Instrumentation

P&ID H-14-#/Sht	Tagname	Description	Setpoint
102086/2	WST_YL_201A_LOCAL	Mixer Pump WST-P-001 Local Indication	
	WST_YL_201A_REMOTE	Mixer Pump WST-P-001 Remote Indication	
	WST_SS_201_AUTO	Mixer Pump WST-P-001 Auto Command	
	WST_SS_201_MAN	Mixer Pump WST-P-001 Manual Command	
	WST_YL_201B_AUTO	Mixer Pump WST-P-001 Auto Indication	
	WST_YL_201B_MAN	Mixer Pump WST-P-001 Manual Indication	
	WST_HS_201A_START	Mixer Pump WST-P-001 Start Command	
	WST_HS_201A_STOP	Mixer Pump WST-P-001 Stop Command	
	WST_YL_201C_ON	Mixer Pump WST-P-001 On Indication	
	WST_YL_201C_OFF	Mixer Pump WST-P-001 Off Indication	
	WST_YL_202A_LOCAL	Mixer Pump WST-P-001 Turntable Local Indication	
	WST_YL_202A_REMOTE	Mixer Pump WST-P-001 Turntable Remote Indication	
	WST_SS_202_AUTO	Mixer Pump WST-P-001 Turntable Auto Command	
	WST_SS_202_MAN	Mixer Pump WST-P-001 Turntable Manual Command	
	WST_YL_202B_AUTO	Mixer Pump WST-P-001 Turntable Auto Indication	
	WST_YL_202B_MAN	Mixer Pump WST-P-001 Turntable Manual Indication	
	WST_HS_202A_START	Mixer Pump WST-P-001 Turntable Start Command	
	WST_HS_202A_STOP	Mixer Pump WST-P-001 Turntable Stop Command	
	WST_YL_202C_ON	Mixer Pump WST-P-001 Turntable On Indication	
	WST_YL_202C_OFF	Mixer Pump WST-P-001 Turntable Off Indication	
	WST_HS_202B_CW	Mixer Pump WST-P-001 Turntable CW Command	
	WST_HS_202B_CCW	Mixer Pump WST-P-001 Turntable CCW Command	
	WST_YL_202D_CW	Mixer Pump WST-P-001 Turntable CW Indication	
	WST_YL_202D_CCW	Mixer Pump WST-P-001 Turntable CCW Indication	
	WST_TAH_273	I/O Enclosure ENCL-101 Temperature Hi Alarm	95 °F

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	WST_TAL_273	I/O Enclosure ENCL-101 Temperature Low Alarm	35 °F
102086/3	WT_YL_258A_LOCAL	Transfer Pump WT-P-002 Local Indication	
	WT_YL_258A_REMOTE	Transfer Pump WT-P-002 Remote Indication	
	WT_SS_258_AUTO	Transfer Pump WT-P-002 Auto Command	
	WT_SS_258_MAN	Transfer Pump WT-P-002 Manual Command	
	WT_YL_258B_AUTO	Transfer Pump WT-P-002 Auto Indication	
	WT_YL_258B_MAN	Transfer Pump WT-P-002 Manual Indication	
	WT_HS_258A_START	Transfer Pump WT-P-002 Start Command	
	WT_HS_258A_STOP	Transfer Pump WT-P-002 Stop Command	
	WT_YL_258C_ON	Transfer Pump WT-P-002 On Indication	
	WT_YL_258C_OFF	Transfer Pump WT-P-002 Off Indication	
	WT_HS_262_RAISE	Transfer Pump WT-P-002 Winch Raise Command	
	WT_HS_262_LOWER	Transfer Pump WT-P-002 Winch Lower Command	
	WT_YL_262_RAISE*	Transfer Pump WT-P-002 WinchRaise Indication	
	WT_YL_262_LOWER*	Transfer Pump WT-P-002 Winch Lower Indication	
	WT_ZAHH_262	Transfer Pump Winch at UP Position	
	WT_ZALL_262	Transfer Pump Winch at DOWN Position	
	WT_MOV_242_ZCA	MOV-242 Position A Command	
	WT_MOV_242_ZCB	MOV-242 Position B Command	
	WT_MOV_242_ZCC	MOV-242 Position C Command	
	WT_MOV_242_ZSA	MOV-242 Position A Indication	
	WT_MOV_242_ZSB	MOV-242 Position B Indication	
	WT_MOV_242_ZSC	MOV-242 Position C Indication	
	WT_MOV_245_ZCA	MOV-245 Position A Command	
	WT_MOV_245_ZCB	MOV-245 Position B Command	
	WT_MOV_245_ZCC	MOV-245 Position C Command	
	WT_MOV_245_ZSA	MOV-245 Position A Indication	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	WT_MOV_245_ZSB	MOV-245 Position B Indication	
	WT_MOV_245_ZSC	MOV-245 Position C Indication	
	WT_MOV_261_ZCA	MOV-261 Position A Command	
	WT_MOV_261_ZCB	MOV-261 Position B Command	
	WT_MOV_261_ZCC	MOV-261 Position C Command	
	WT_MOV_261_ZSA	MOV-261 Position A Indication	
	WT_MOV_261_ZSB	MOV-261 Position B Indication	
	WT_MOV_261_ZSC	MOV-261 Position C Indication	
	WT_MOV_243_ZCA	MOV-243 Position A Command	
	WT_MOV_243_ZCB	MOV-243 Position B Command	
	WT_MOV_243_ZCC	MOV-243 Position C Command	
	WT_MOV_243_ZSA	MOV-243 Position A Indication	
	WT_MOV_243_ZSB	MOV-243 Position B Indication	
	WT_MOV_243_ZSC	MOV-243 Position C Indication	
	WT_MOV_244_ZCA	MOV-244 Position A Command	
	WT_MOV_244_ZCB	MOV-244 Position B Command	
	WT_MOV_244_ZCC	MOV-244 Position C Command	
	WT_MOV_244_ZSA	MOV-244 Position A Indication	
	WT_MOV_244_ZSB	MOV-243 Position B Indication	
	WT_MOV_244_ZSC	MOV-244 Position C Indication	
	WT_MOV_253_ZCA	MOV-253 Position A Command	
	WT_MOV_253_ZCB	MOV-253 Position B Command	
	WT_MOV_253_ZCC	MOV-253 Position C Command	
	WT_MOV_253_ZSA	MOV-253 Position A Indication	
	WT_MOV_243_ZSB	MOV-253 Position B Indication	
	WT_MOV_253_ZSC	MOV-253 Position C Indication	
	WT_FAH_260	Seal Gas Flow High	
102086/3	WT_PAL_280	Seal Gas Pressure Low	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
102086/4	WST_YL_213A_LOCAL	Mixer Pump WST-P-003 Local Indication	
	WST_YL_213A_REMOTE	Mixer Pump WST-P-003 Remote Indication	
	WST_SS_213_AUTO	Mixer Pump WST-P-003 Auto Command	
	WST_SS_213_MAN	Mixer Pump WST-P-003 Manual Command	
	WST_YL_213B_AUTO	Mixer Pump WST-P-003 Auto Indication	
	WST_YL_213B_MAN	Mixer Pump WST-P-003 Manual Indication	
	WST_HS_213A_START	Mixer Pump WST-P-003 Start Command	
	WST_HS_213A_STOP	Mixer Pump WST-P-003 Stop Command	
	WST_YL_213C_ON	Mixer Pump WST-P-003 On Indication	
	WST_YL_213C_OFF	Mixer Pump WST-P-003 Off Indication	
	WST_YL_214A_LOCAL	Mixer Pump WST-P-003 Turntable Local Indication	
	WST_YL_214A_REMOTE	Mixer Pump WST-P-003 Turntable Remote Indication	
	WST_SS_214_AUTO	Mixer Pump WST-P-003 Turntable Auto Command	
	WST_SS_214_MAN	Mixer Pump WST-P-003 Turntable Manual Command	
	WST_YL_214B_AUTO	Mixer Pump WST-P-003 Turntable Auto Indication	
	WST_YL_214B_MAN	Mixer Pump WST-P-003 Turntable Manual Indication	
	WST_HS_214A_START	Mixer Pump WST-P-003 Turntable Start Command	
	WST_HS_214A_STOP	Mixer Pump WST-P-003 Turntable Stop Command	
	WST_YL_214C_ON	Mixer Pump WST-P-003 Turntable On Indication	
	WST_YL_214C_OFF	Mixer Pump WST-P-003 Turntable Off Indication	
	WST_HS_214B_CW	Mixer Pump WST-P-003 Turntable CW Command	
	WST_HS_214B_CCW	Mixer Pump WST-P-003 Turntable CCW Command	
	WST_YL_214D_CW	Mixer Pump WST-P-003 Turntable CW Indication	
	WST_YL_214D_CCW	Mixer Pump WST-P-003 Turntable CCW Indication	
102086/5	WT_YL_264A_LOCAL	Transfer Pump WT-P-019 Local Indication	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	WT_YL_264A_REMOTE	Transfer Pump WT-P-019 Remote Indication	
	WT_SS_264_AUTO	Transfer Pump WT-P-019 Auto Command	
	WT_SS_264_MAN	Transfer Pump WT-P-019 Manual Command	
	WT_YL_264B_AUTO	Transfer Pump WT-P-019 Auto Indication	
	WT_YL_264B_MAN	Transfer Pump WT-P-019 Manual Indication	
	WT_HS_264A_START	Transfer Pump WT-P-019 Start Command	
	WT_HS_264A_STOP	Transfer Pump WT-P-019 Stop Command	
	WT_YL_264C_ON	Transfer Pump WT-P-019 On Indication	
	WT_YL_264C_OFF	Transfer Pump WT-P-019 Off Indication	
	WT_HS_268_RAISE	Transfer Pump WT-P-019 Winch Raise Command	
	WT_HS_268_LOWER	Transfer Pump WT-P-019 Winch Lower Command	
	WT_YL_268_RAISE*	Transfer Pump WT-P-019 Winch Raise Indication	
	WT_YL_268_LOWER*	Transfer Pump WT-P-019 Winch Lower Indication	
	WT_ZAHH_268	Transfer Pump WT-P-019 Winch at UP Limit	
	WT_ZALL_268	Transfer Pump WT-P-019 Winch at DOWN Limit	
	WT_MOV_246_ZCA	MOV-246 Position A Command	
	WT_MOV_246_ZCB	MOV-246 Position B Command	
	WT_MOV_246_ZCC	MOV-246 Position C Command	
	WT_MOV_246_ZSA	MOV-246 Position A Indication	
	WT_MOV_246_ZSB	MOV-246 Position B Indication	
	WT_MOV_246_ZSC	MOV-246 Position C Indication	
	WT_MOV_249_ZCA	MOV-249 Position A Command	
	WT_MOV_249_ZCB	MOV-249 Position B Command	
	WT_MOV_249_ZCC	MOV-249 Position C Command	
	WT_MOV_249_ZSA	MOV-249 Position A Indication	
	WT_MOV_249_ZSB	MOV-249 Position B Indication	
	WT_MOV_249_ZSC	MOV-249 Position C Indication	
	WT_MOV_263_ZCA	MOV-263 Position A Command	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	WT_MOV_263_ZCB	MOV-263 Position B Command	
	WT_MOV_263_ZCC	MOV-263 Position C Command	
	WT_MOV_263_ZSA	MOV-263 Position A Indication	
	WT_MOV_263_ZSB	MOV-263 Position B Indication	
	WT_MOV_263_ZSC	MOV-263 Position C Indication	
	WT_MOV_247_ZCA	MOV-247 Position A Command	
	WT_MOV_247_ZCB	MOV-247 Position B Command	
	WT_MOV_247_ZCC	MOV-247 Position C Command	
	WT_MOV_247_ZSA	MOV-247 Position A Indication	
	WT_MOV_247_ZSB	MOV-247 Position B Indication	
	WT_MOV_247_ZSC	MOV-247 Position C Indication	
	WT_MOV_248_ZCA	MOV-248 Position A Command	
	WT_MOV_248_ZCB	MOV-248 Position B Command	
	WT_MOV_248_ZCC	MOV-248 Position C Command	
	WT_MOV_248_ZSA	MOV-248 Position A Indication	
	WT_MOV_248_ZSB	MOV-248 Position B Indication	
	WT_MOV_248_ZSC	MOV-248 Position C Indication	
	WT_MOV_254_ZCA	MOV-254 Position A Command	
	WT_MOV_254_ZCB	MOV-254 Position B Command	
	WT_MOV_254_ZCC	MOV-254 Position C Command	
	WT_MOV_254_ZSA	MOV-254 Position A Indication	
	WT_MOV_254_ZSB	MOV-254 Position B Indication	
	WT_MOV_254_ZSC	MOV-254 Position C Indication	
102086/6	WT_MOV_250_ZCA	MOV-250 Position A Command	
	WT_MOV_250_ZCB	MOV-250 Position B Command	
	WT_MOV_250_ZCC	MOV-250 Position C Command	
	WT_MOV_250_ZSA	MOV-250 Position A Indication	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	WT_MOV_250_ZSB	MOV-250 Position B Indication	
	WT_MOV_250_ZSC	MOV-250 Position C Indication	
	WT_MOV_251_ZCA	MOV-251 Position A Command	
	WT_MOV_251_ZCB	MOV-251 Position B Command	
	WT_MOV_251_ZCC	MOV-251 Position C Command	
	WT_MOV_251_ZSA	MOV-251 Position A Indication	
	WT_MOV_251_ZSB	MOV-251 Position B Indication	
	WT_MOV_251_ZSC	MOV-251 Position C Indication	
	WT_MOV_252_ZCO	MOV-252 Open Command	
	WT_MOV_252_ZCC	MOV-252 Close Command	
	WT_MOV_252_ZSO	MOV-252 Open Indication	
	WT_MOV_252_ZSC	MOV-252 Closed Indication	
	WT_FAH_261	Seal Gas Flow High	
	WT_PAL_281	Seal Gas Pressure Low	
102304/1	RW_PAL_125	Pump Column Pressure AP-102 Low Alarm	? psig
	RW_PAL_126	Pump Column Pressure AP-104 Low Alarm	? psig
	RW_PDAH_456	Service Water 5 Micron Filter Hi Alarm	5 psid
	RW_PDAH_454	Service Water 75 Micron Filter Hi Alarm	5 psid
	RW_TAL_453	Service Water Enclosure Temperature Low Alarm	45 °F
	RW_TAL_459	Service Water Weather Cover Low Temperature Alarm	? °F
	RW_HS_451_ON	Service Water Strainer Motor On Command	
	RW_HS_451_OFF	Service Water Strainer Motor OFF Command	
	RW_YL_451_ON	Service Water Strainer Motor On Indication	
102304/1	RW_YL_451_OFF	Service Water Strainer Motor Off Indication	
	RW_MOV_451_ZCO	Service Water Strainer Drain Valve Open Command	
	RW_MOV_451_ZCC	Service Water Strainer Drain Valve Close Command	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	RW_MOV_451_ZSO	Service Water Strainer Drain Valve Open Indication	
	RW_MOV_451_ZSC	Service Water Strainer Drain Valve Closed Indication	
102304/2	CHEMB_HS_130_START	Diluent/Flush Pump Start Command	
	CHEMB_HS_130_STOP	Diluent/Flush Pump Stop Command	
	CHEMB_YL_130_ON	Diluent/Flush Pump On Indication	
	CHEMB_YL_130_OFF	Diluent/Flush Pump Off Indication	
	CHEMB_HS_128_START	Diluent/Flush Metering Pump Start Command	
	CHEMB_HS_128_STOP	Diluent/Flush Metering Pump Stop Command	
	CHEMB_YL_128_ON	Diluent/Flush Metering Pump On Indication	
	CHEMB_YL_128_OFF	Diluent/Flush Metering Pump Off Indication	
	CHEMB_LAHH_126	Diluent/Flush Tank Overfill	
	CHEMB_SS_550_STOP	Diluent/Flush Boiler Stop Command	
	CHEMB_YL_550_ON	Diluent/Flush Boiler On Indication	
	CHEMB_YL_550_OFF	Diluent/Flush Boiler Off Indication	
	CHEMB_YA_549	Diluent/Flush Boiler Trouble Indication	
	CHEMB_LA_127	Diluent/Flush Leak Detected Alarm	On/Off
	CHEMB_MOV_132_ZCA	MOV-132 Position A Command	
	CHEMB_MOV_132_ZCB	MOV-132 Position B Command	
	CHEMB_MOV_132_ZCC	MOV-132 Position C Command	
	CHEMB_MOV_132_ZSA	MOV-132 Position A Indication	
	CHEMB_MOV_132_ZSB	MOV-132 Position B Indication	
	CHEMB_MOV_132_ZSC	MOV-132 Position C Indication	
	CHEMB_FCV_131_ZCO	FCV-131 Open Command	
	CHEMB_FCV_131_ZCC	FCV-131 Close Command	
	CHEMB_FCV_131_ZSO	FCV-131 Open Indication	
	CHEMB_FCV_131_ZSC	FCV-131 Close Indication	
	RW_LCV_430_ZCO	LCV-430 Open Command	

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

P&ID H-14-#/Sht	Tagname	Description	Setpoint
	RW_LCV_430_ZCC	LCV-430 Close Command	
	RW_LCV_430_ZSO	LCV-430 Open Indication	
	RW_LCV_430_ZSC	LCV-430 Close Indication	
	EDS_LOP_001	Loss of Power	

APPENDIX C - MODE INTERLOCK MATRIX

MODE	RDY	HVT	IN2	RTN2	RTF2	DIL2	ITR2	ITF2	WT2	PTF2	ILD2	IN4	RTN4	RTF4	DIL4	ITR4	ITF4	WT4	PTF4	ILD4	SSD
RDY	X																				
HVT		X				o	o	o	o	o	o				o	o	o	o	o	o	
IN2			X								o				o	o	o	o	o	o	
RTN2				X							o				o	o	o	o	o	o	
RTF2					X											o		o			
DIL2		o				X						o	o			o		o			
ITR2		o					X				o	o	o	o	o	o	o	o	o	o	
ITF2		o						X				o	o			o		o			
WT2		o							X		o	o	o	o	o	o	o			o	
PTF2		o								X		o	o			o					
ILD2		o	o	o			o		o		X	o	o			o		o			
IN4						o	o	o	o	o	o	X								o	
RTN4						o	o	o	o	o	o		X							o	
RTF4							o		o					X							
DIL4		o	o	o			o		o						X						
ITR4		o	o	o	o	o	o	o	o	o	o					X				o	
ITF4		o	o	o			o		o								X				
WT4		o	o	o	o	o	o	o			o							X		o	
PTF4		o	o	o			o												X		
ILD4		o	o	o			o		o			o	o			o		o		X	
SSD																					X

Blank: Not allow simultaneous Mode Activation
o : Allow Simultaneous Mode Activation.

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

APPENDIX D - HMI SCREENS (Only screens developed to date are included)

FIGURE 1 - TWRS OVERVIEW SCREEN
FIGURE 2 - ITRS OVERVIEW SCREEN
FIGURE 3 - INITIAL TANK RETRIEVAL SYSTEMS RCS FOR DST 241-AP-102 & 241-AP-104
FIGURE 4 - RETRIEVAL SYSTEM OVERVIEW
FIGURE 5 - SCREEN LIST
FIGURE 6 - TYPICAL RETRIEVAL SETUP
FIGURE 7 - MODE LIST
FIGURE 8 - BYPASSABLE PLC INTERLOCKS
FIGURE 9 - TYPICAL TANK OVERVIEW
FIGURE 10 - TYPICAL MIXER PUMP FACEPLATE
FIGURE 11 - TYPICAL TRANSFER PUMP FACEPLATE
FIGURE 12 - MIXER PUMP SPEED VS. POSITION PROFILE
FIGURE 13 - TEMPERATURE PROFILE FACEPLATE
FIGURE 14 - DILUENT/FLUSH SYSTEM
FIGURE 15 - SERVICE WATER SYSTEM
FIGURE 16 - TYPICAL ALARM SETPOINT FACEPLATE
FIGURE 17 - FLOW CONTROL VALVE FACEPLATE
FIGURE 18 - 2-WAY MOV FACEPLATE
FIGURE 19 - 3-WAY MOV FACEPLATE
FIGURE 20 - CONTROL SYSTEM HARDWARE SETUP
FIGURE 21 - TREND SELECTION
FIGURE 22 - TREND DISPLAY

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

FIGURE 1

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

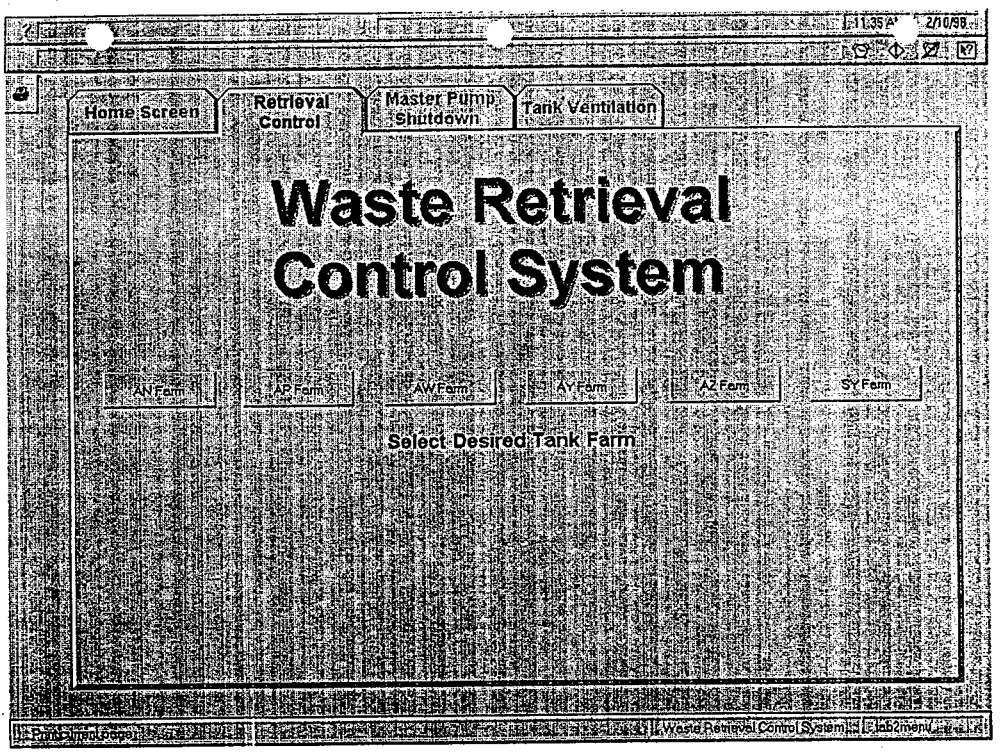

FIGURE 2

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

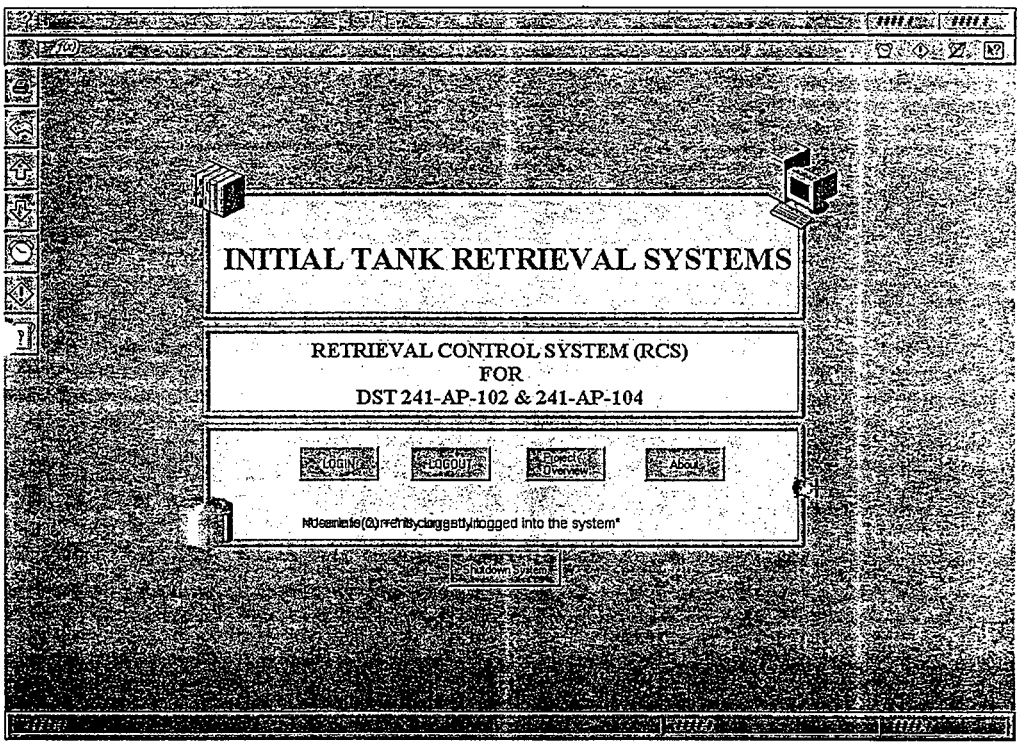

FIGURE 3

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

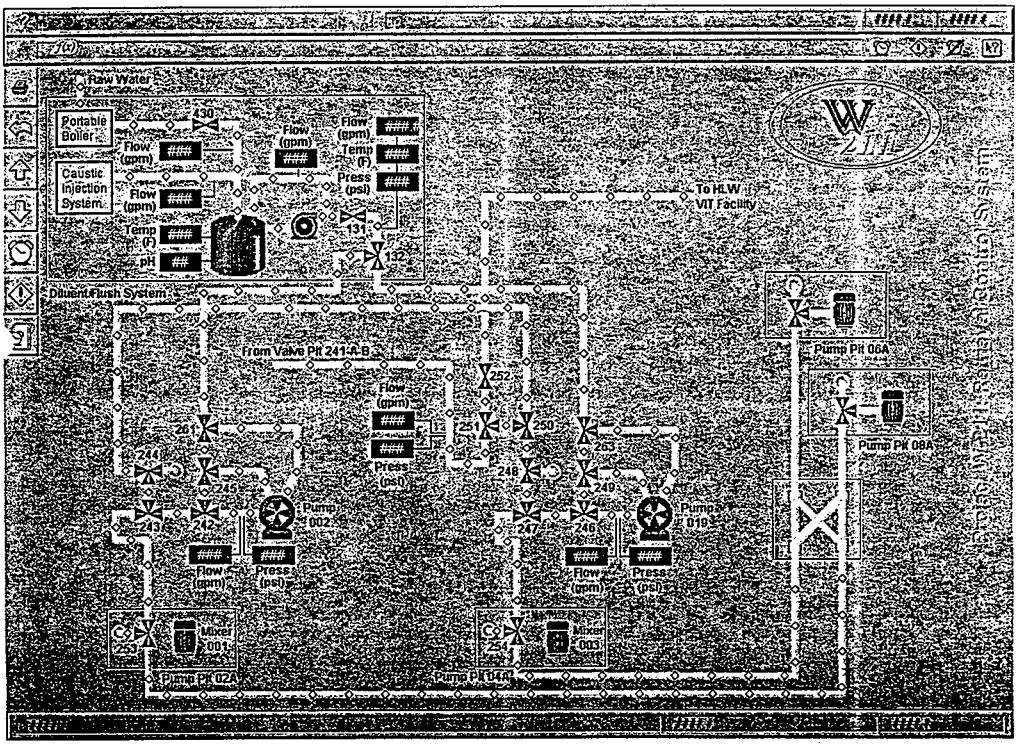

FIGURE 4

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

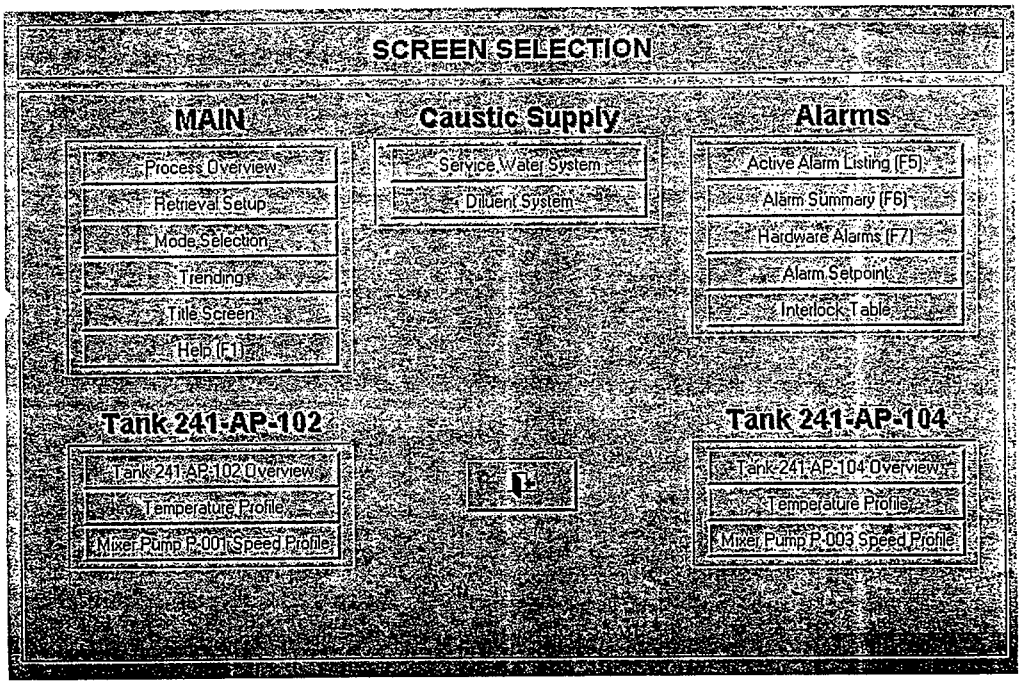

FIGURE 5

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

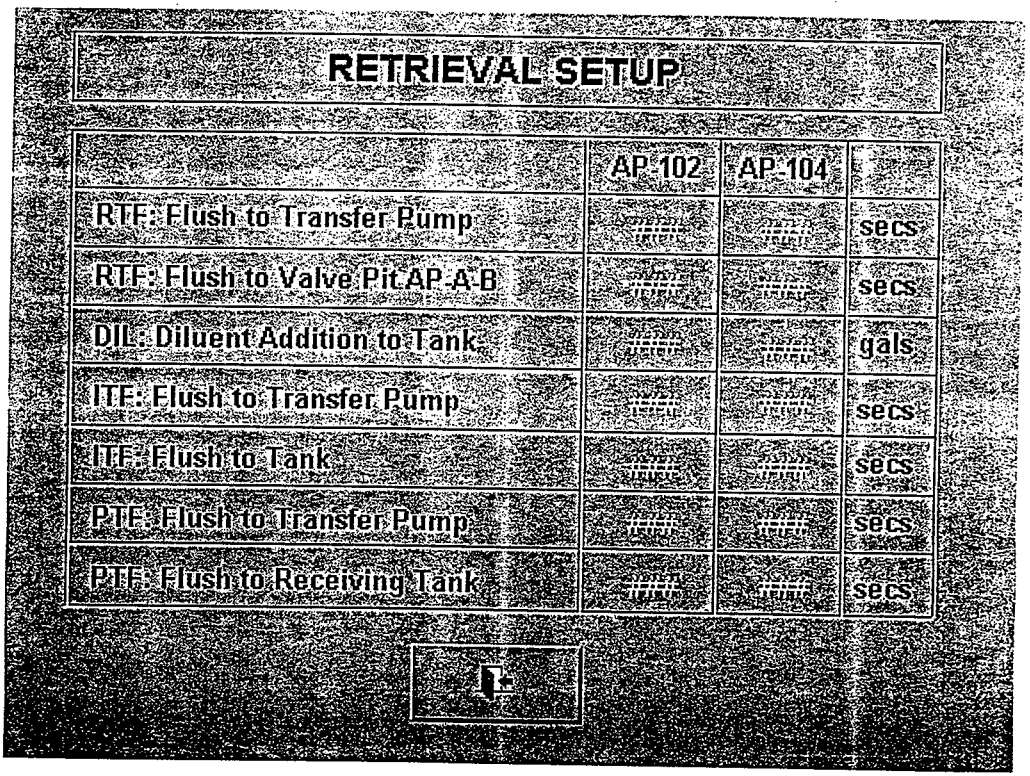

FIGURE 6

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

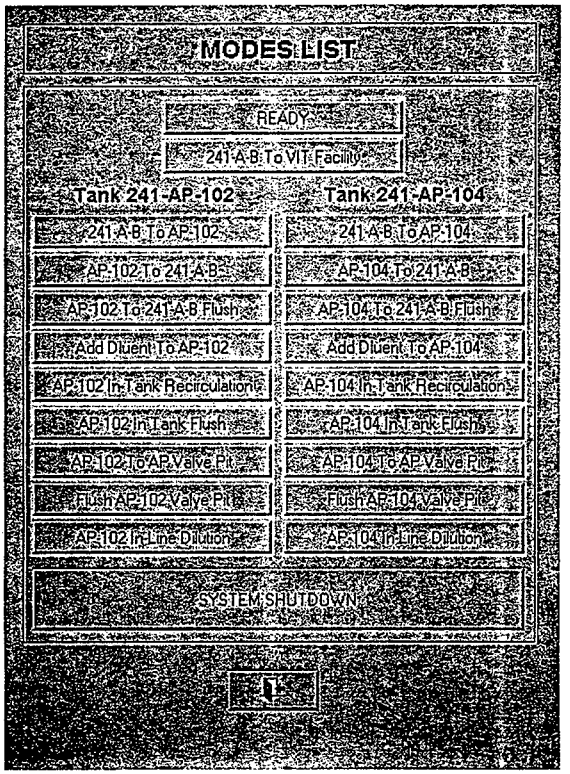

FIGURE 7

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

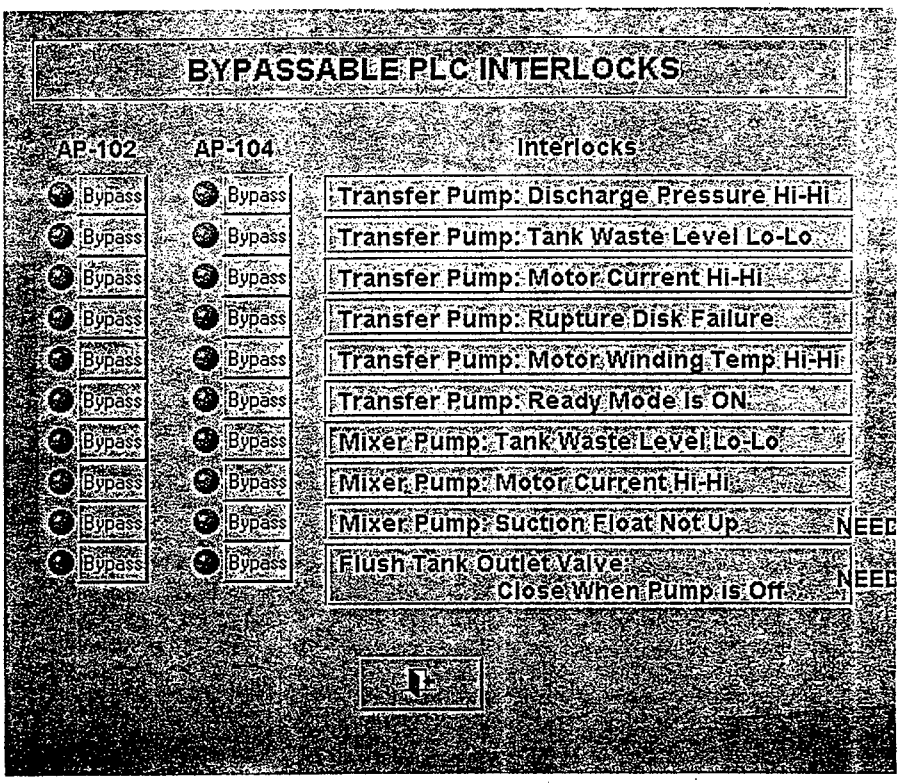

FIGURE 8

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

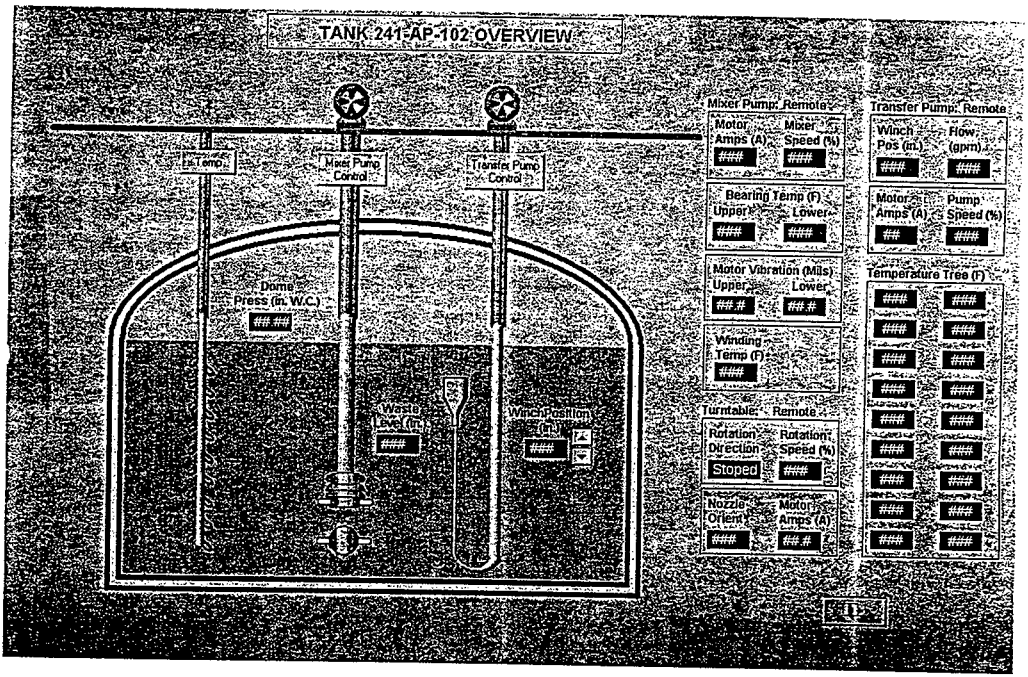

FIGURE 9

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

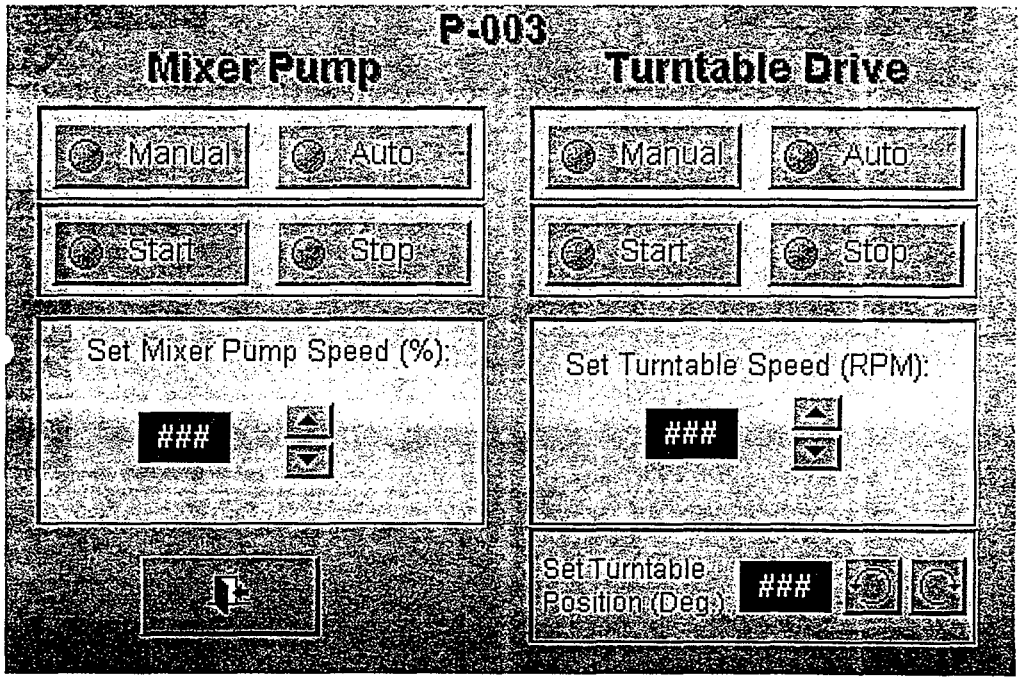

FIGURE 10

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

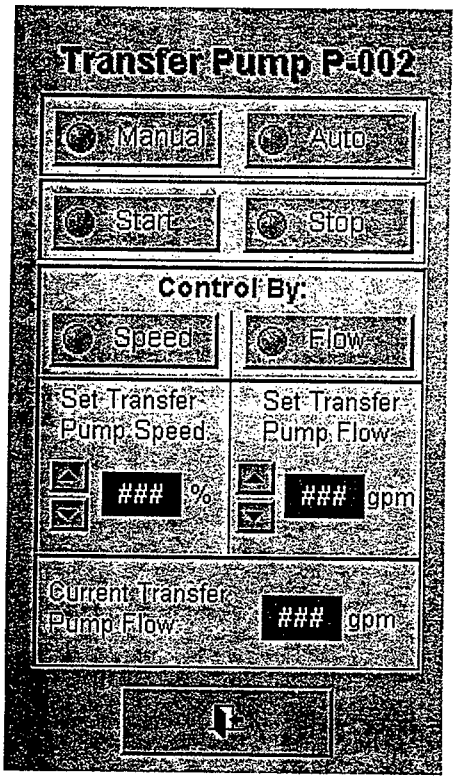

FIGURE 11

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

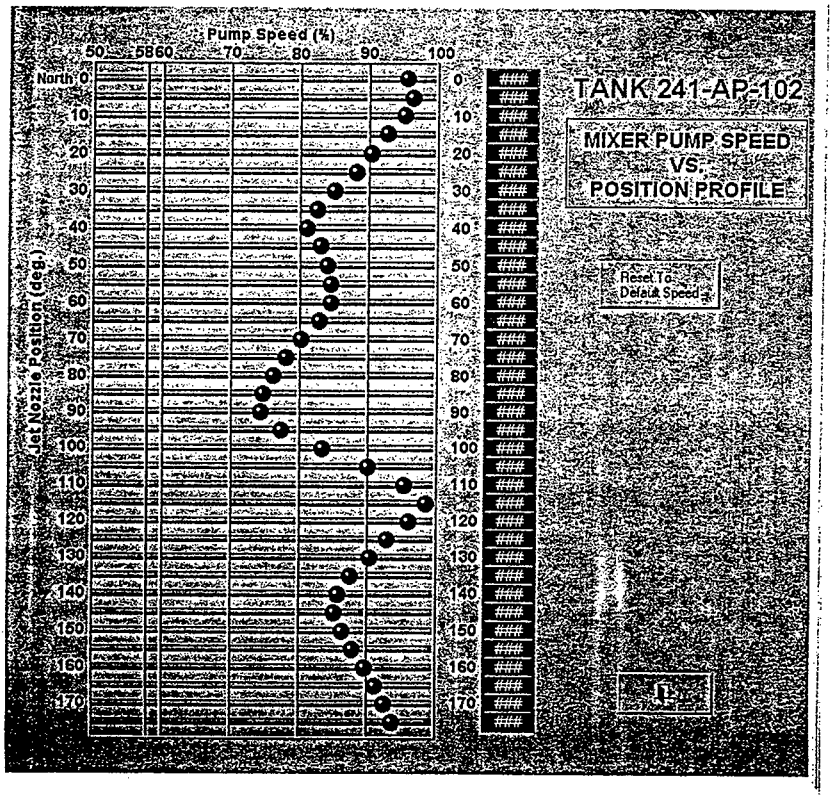

FIGURE 12

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

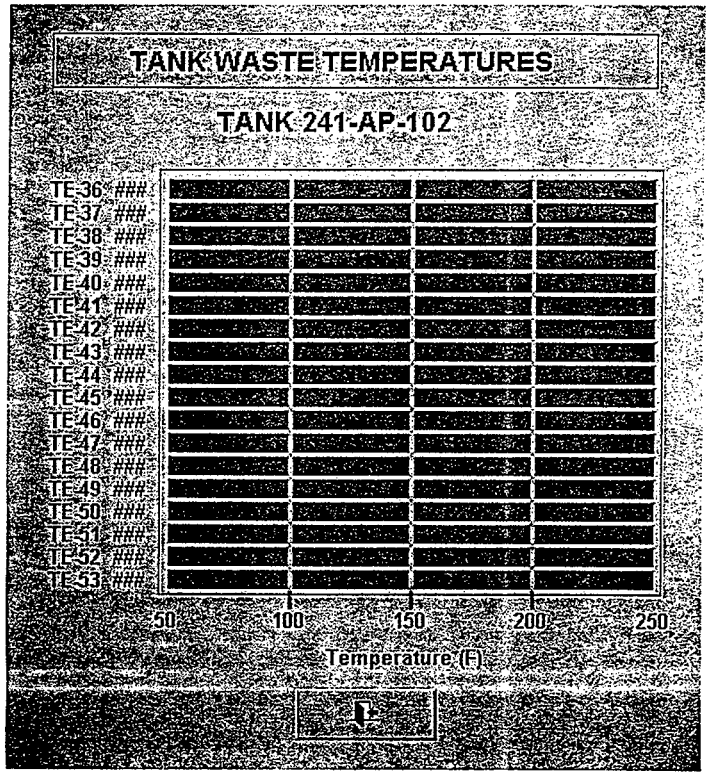

FIGURE 13

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

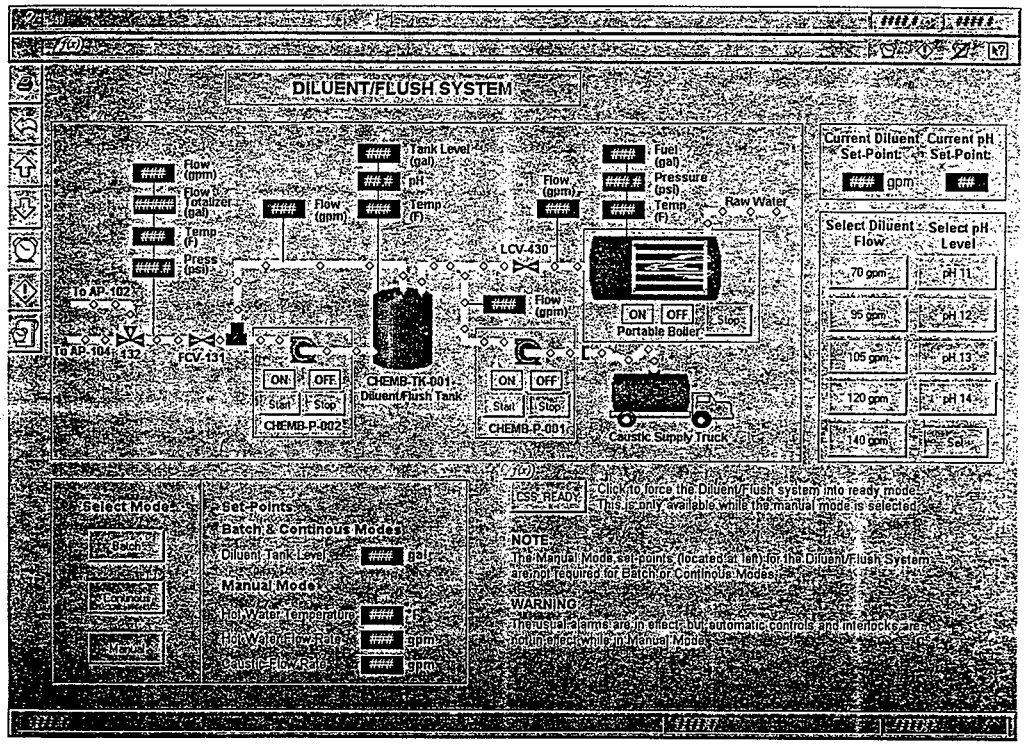

FIGURE 14

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

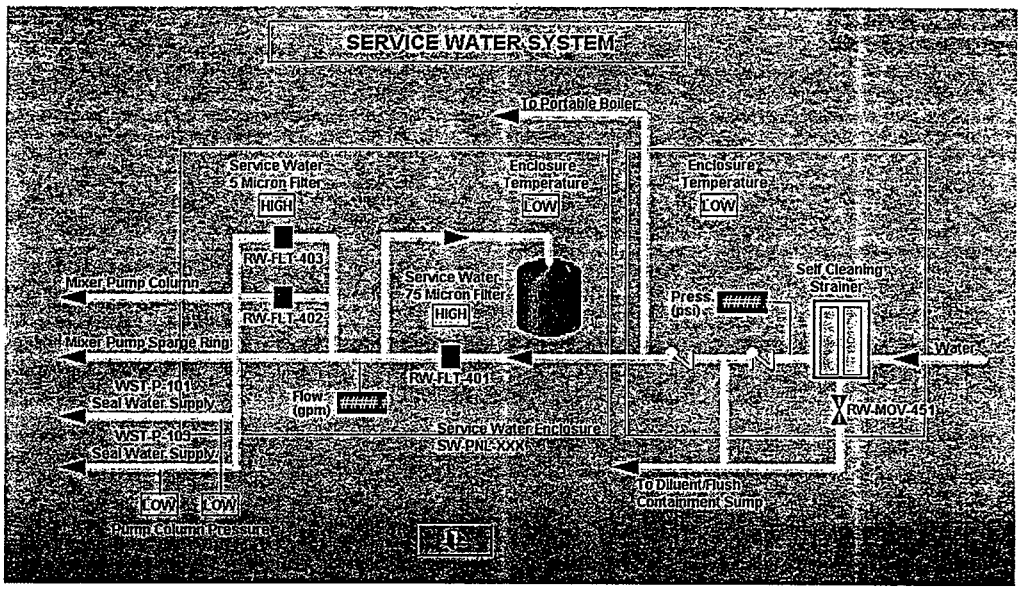

FIGURE 15

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

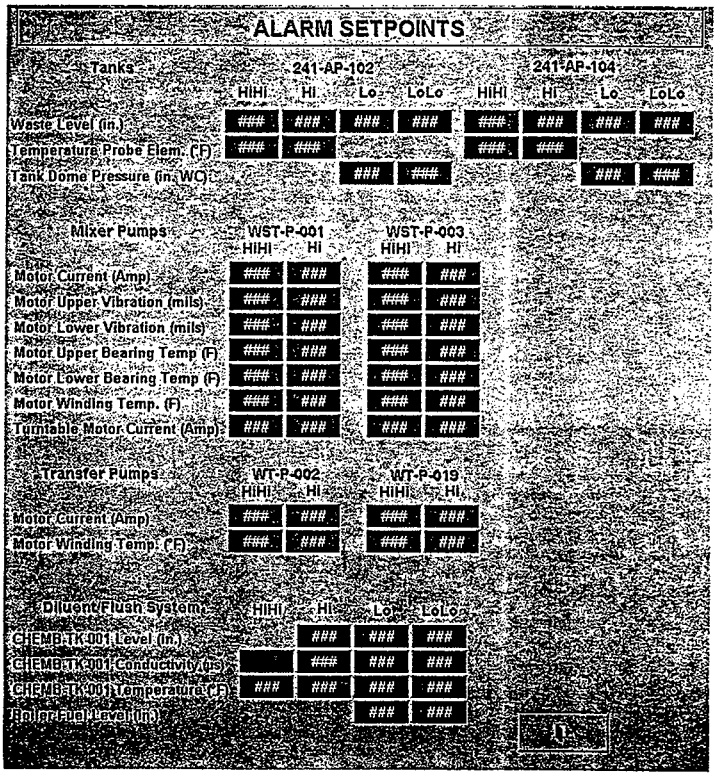

FIGURE 16

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

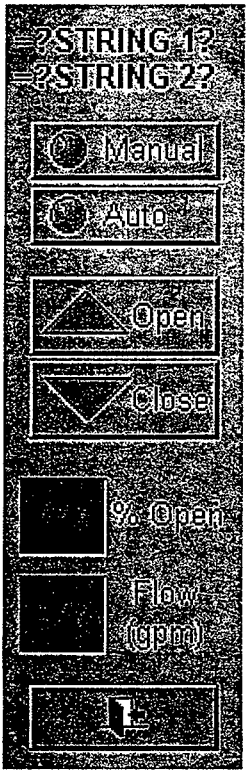

FIGURE 17

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

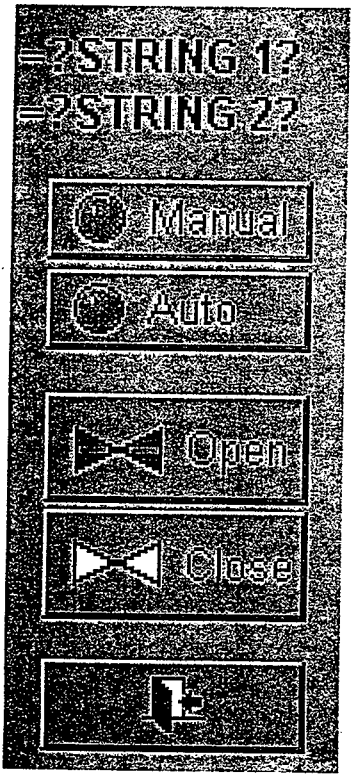

FIGURE 18

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

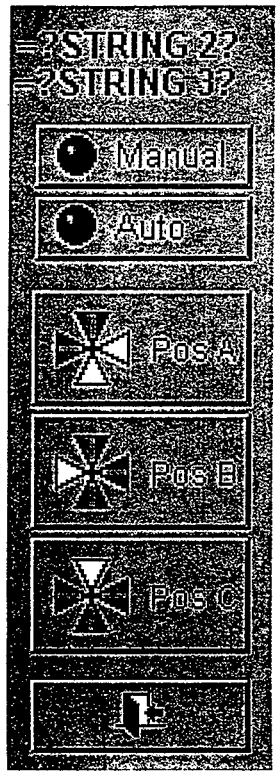

FIGURE 19

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

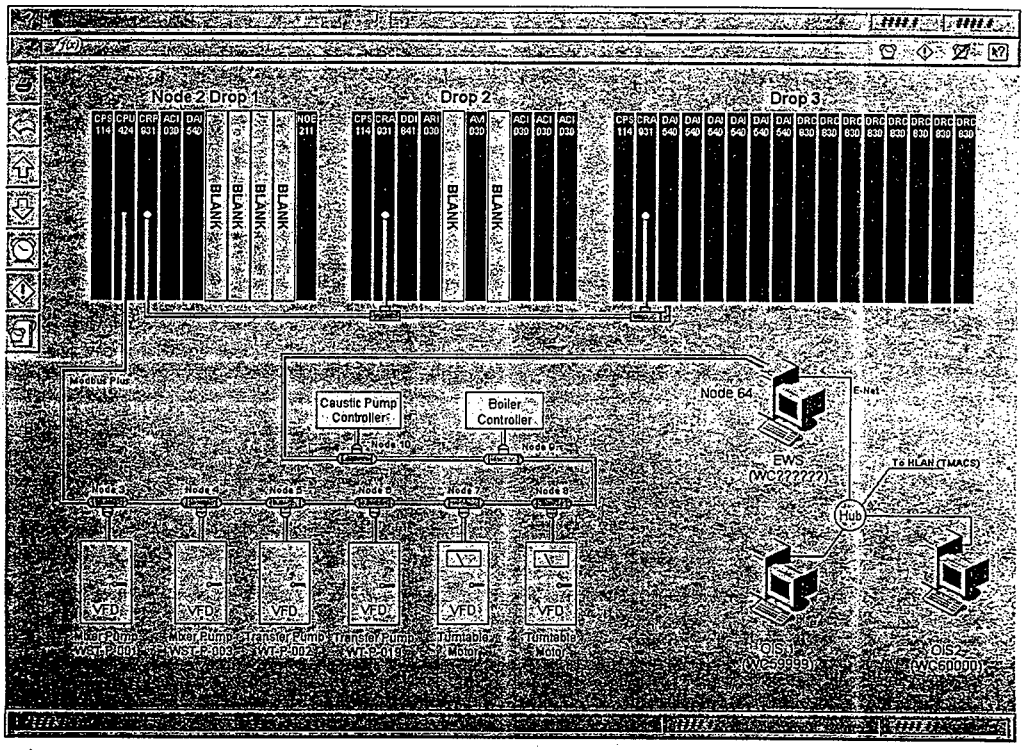

FIGURE 20

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

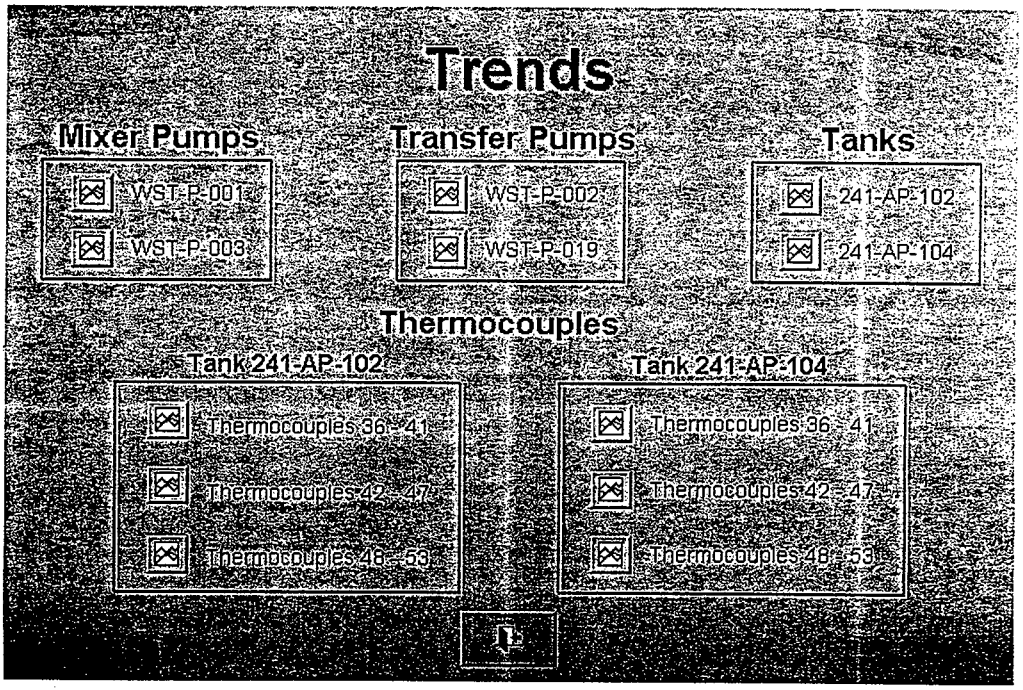

FIGURE 21

Description of Operations for DSTs 241-AP-102 & AP-104 Retrieval

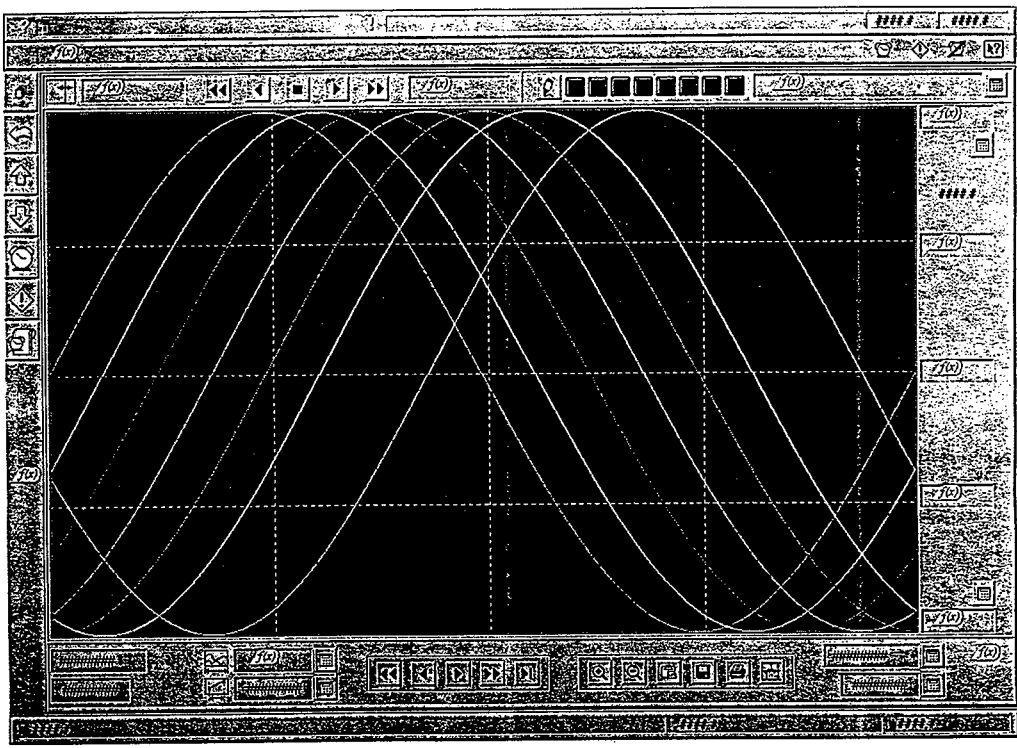

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FIGURE 22