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System Description for Tank 241-AZ-101 Waste Retrieval Data Acquisition System

SG Romero

Fluor Federal Services

Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: Describes the hardware and software for the AZ-101 Mixer Pump Data Acquisition System.

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SYSTEM DESCRIPTION

For

TANK 241-AZ-101 WASTE RETRIEVAL

DATA ACQUISITION SYSTEM (DAS)

FLUOR FEDERAL SERVICES

January 3, 2000

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM OPERATION

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TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

1 INTRODUCTION

1.1 PURPOSE

The purpose of the tank 241-AZ-101 retrieval system Data Acquisition System (DAS) is to provide monitoring and data acquisition of key parameters in order to confirm the effectiveness of the mixer pumps utilized for suspending solids in the tank. The suspension of solids in Tank 241-AZ-101 is necessary for pretreatment of the neutralized current acid waste (NCAW), and eventual disposal as glass via the Hanford Waste Vitrification Plant.

1.2 SCOPE

This Supporting Document (SD) provides a basic description of the tank 241-AZ-101 retrieval system DAS, including the field instrumentation and application software. The DAS is provided to fulfill requirements for data collection and monitoring as requested in Lockheed Martin Hanford Corporation Contract #4978, Release #29 (Ref 4.1.3). This SD is not an operations procedure nor is it intended to describe the mixing operation.

1.3 PROCESS OVERVIEW

Instrumentation signals from tank 241-AZ-101 are routed from field sensors to specific junction boxes that are close in proximity. The collected signals in each junction box are multiplexed to enable their transmission via Ethernet. An Ethernet network is provided to link the junction boxes to an Ethernet hub located in the Utility Vault. The hub is connected via a Thinnet cable to a human machine interface (HMI) personal computer (PC) which is installed in an operator control console located in the Mixer Pump Control Facility 241-AZ-156.

Instrumentation signals from the two-mixer pump variable frequency drives, located in 241-AZ-156, are connected directly to the HMI PC via Ethernet.

Selected data from the AZ-702 Ventilation System Distributed Control System (DCS), located in 241-AZ-271, and the AY-801A Programmable Logic Controller (PLC) are transmitted to the HMI PC via Hanford Local Area Network (HLAN).

1.4 DEFINITIONS

CSV: Comma Separated Values, a generic data output format

DAS: Data Acquisition System based on a PLC/PC architecture to collect field data and provide a full user interface/HMI to display, manipulate, save and print data.

DCS: Distributed Control system, a control system package combining PLC and HMI functionality, with multiple autonomous controllers and interfaces.

Ethernet Hub: Device used as a connection point between two or more Ethernet devices.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

HMI Software: A Human-Machine Interface software package developed by Ci Technologies, Citect®¹, is used to create the human-machine interface portion of the DAS. The PC-based package works within the Microsoft Windows NT®² environment to provide graphic displays of process parameters. Required for data logging.

PC: Personal computer used with HMI software to provide the human-machine interface.

PLC: The Programmable Logic Controller is the microprocessor-based industrial controller capable of real-time control.

Real-time: Indicates that monitoring and control signals are being processed and implemented in an acceptable time frame which is usually after an imperceptible time delay after the actual process events.

RTD: Resistance Temperature Detector.

RPP: River Protection Project

TCP/IP: Transmission Control Protocol /Internet Protocol (de facto Ethernet standard for UNIX and Microsoft Windows communications)

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

2 GENERAL DESCRIPTION

2.1 INSTRUMENTATION (See Figure 1)

Two 100 ohm Pt Resistance Temperature Detectors (RTD's) are used to measure the upper and lower bearing temperatures at pump 702A. The RTD's are connected to a multiplexer contained in junction box JB101-100.

Three 10 ohm Cu RTD's are used to measure the motor phase stator winding temperatures of pump 702A (1 per phase). The RTD's are connected to a multiplexer contained in junction box JB101-100.

Two 100 ohm Pt RTD's are used to measure the upper and lower bearing temperatures at pump 701A. The RTD's are connected to a multiplexer contained in junction box JB101-101.

Three 10 ohm Cu RTD's are used to measure the motor phase stator winding temperatures of pump 701A (1 per phase). The RTD's are connected to a multiplexer contained in junction box JB101-101.

Six strain gauge transmitters are used to measure the stress/strain of the temperature profile probe installed in riser 15E, that may occur as a result of the operation of the mixer pumps. The six analog signals are connected to a multiplexer contained in junction box JB-15E.

¹Citect® is a registered trademark of Ci Technologies, Pty.

²Windows NT® is a registered trademark of Microsoft Corp.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

Six strain gauge transmitters are used to measure the stress/strain of the temperature profile probe installed in riser 15F, that may occur as a result of the operation of the mixer pumps. The six analog signals are connected to a multiplexer contained in junction box JB-15F.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

FIGURE 1

241-AZ-156 MIXER PUMP CONSOLE

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

The AY and AZ tank farm tank temperatures are measured using thermocouples, which are connected to a Westronics®³ SDI-310 in the 241-AY-801A building. The Westronics® Multiplexer (MUX) communicates with the PLC in AY-801A via Modbus®⁴. The Mixer Pump Test DAS PC communicates with the AY-801A PLC over HLAN to retrieve the 101-AZ tank temperatures.

Existing instrumentation signals associated with the 241-AZ-702 HVAC System are connected to a UNIX Sun Microsystems®⁵ Station located in the 702AZ control room. The Sun Microsystems® Station communicates with the DAS PC via HLAN.

2.2 DAS HMI SCREEN FUNCTIONS

The purpose of this section is to describe the DAS HMI screens. The actual startup and sequence of operations for the tank 241-AZ-101 retrieval system has been addressed in the Operational Test Procedure (OTP) document.

The HMI provides continuous historical trending and reporting for all process variable inputs. Operations has the option of copying the data on the hard disks of the PC to a compact disk (CD) using a CD recorder (CD-R), which is provided with the PC.

The main screens for the retrieval system DAS can be selected by clicking on "folder tabs" that appear at the top of each screen. Clicking on a tab brings that screen to the front. The following options are available:

- Overview
- Pump status
- Strain
- Temp profiles (7 total accessible from this tab)
- Micon Data
- Alarms

The following sections describe the contents of each screen and give the options available from each. See Appendix S for a screen-print of each screen. All screens are included except the trending chart popup screens.

2.2.1 OVERVIEW

This is the HMI screen displayed on system startup. A diagram of tank 241-AZ-101 is displayed showing a plan view of the tank and the status of the two mixing pumps contained in it. Other screens are accessed by clicking on the appropriate screen targets (e.g. clicking on Mixer 1 causes that screen to be displayed) or by using the tab menu at the top of the screen. The login screen and the about screen are also accessible from this screen.

³Westronics® is a registered trademark of Westronics Inc.

⁴Modbus® is a registered trademark of Square D Corp.

⁵Sun Microsystems® is a registered trademark of Sun Microsystems Corp.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

2.2.2 PUMP STATUS

This screen is monitored for information associated with the operation of the mixing pumps WST-P-702A (Pump #1) and WST-P-701A (Pump #2).

2.2.3 STRAIN

This screen is monitored for information associated with the thermocouple trees contained in tank risers 15E and 15F. The stress/strain measurements quantify the effects of the mixer pump operation. Right clicking on an individual data point activates a historical (trending) popup chart for that measuring element.

2.2.4 TEMPERATURE PROFILES

There are seven screens for monitoring tank 241-AZ-101 temperatures. Tank AZ-101 temperatures are monitored at various points in the tank: airlift circulators, insulation concrete, sludge, and drywell. Each portion of the tank and waste is associated with a button that causes the current data to be displayed. For example, pressing the AIRLIFT CIRCULATORS button shows the entire available tank thermocouples associated with airlift circulators. Right clicking on an individual data point causes a historical (trending) chart to popup for that temperature element. Only thermocouples listed in the Appendix E - DAS I/O list will be displayed.

In addition to the individual tank temperatures, an average of selected tank temperatures is calculated and shown as the "Running Average Temperature". Above each individual temperature indication is a green or red bar. If the bar is green, then that temperature is included in the average. If it is red, it is not.

2.2.5 MICON®⁶ DATA

This screen is for monitoring information associated with the 241-AZ-702 HVAC system which provides tank ventilation for AY and AZ tank farms.

2.2.6 ALARMS

The alarm screen contains a combination of alarm annunciators and a text list of active alarms to provide quick notification and access to alarms. The operator may acknowledge individual alarms as needed or clear an entire category/area at once. See section 3.1.4, Alarm Handling, for details.

2.3 USER CHARACTERISTICS

⁶ Micon® is a registered trademark of Micon Corp.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

2.3.1 OPERATORS AND SUPERVISORS

Process operators design the HMI for use. All computer displays and windows are representative of process parameters and flow. All persons who operate the DAS must receive training.

2.3.2 SYSTEM ENGINEERS

System Engineers are River Protection Project (RPP) engineers trained to provide support for the Tank 241-AZ-101 Retrieval System. The System Engineers must be familiar with the Windows NT® environment, and the Citect® human-machine interface software. The System Engineers will have access to all of the process control documentation, software, keys and passwords required to build/rebuild/modify graphic screens, databases and any other software components of the system.

2.3.3 REMOTE MANAGER NODE

The Tank 241-AZ-101 Retrieval System DAS data and process views are made available to data users through use of Citect's Manager Node functionality. A hardware key connected to the parallel (printer) port on the DAS server workstation contains authorization for running the server and up to 10 manager nodes simultaneously.

The manager node provides most of the functions available on the server, EXCEPT that no alarm acknowledgement or totalizer/accumulator reset is allowed. When connected as a manager node, the user need not log into the system, and aside from the restrictions noted above, has "operator" accessed privileges.

The manager node computer must be configured to connect to the server. The Citect® Explorer's Computer Setup Wizard is used to configure the following parameters:

Network Computer: Manager Client

Primary Server Name: 101_AZ_DAS

Disable Events

Startup Cicode Function: Startup

(All other settings can be left at their defaults.)

3 SPECIFIC REQUIREMENTS

3.1 INTERFACE REQUIREMENTS

3.1.1 HUMAN-MACHINE INTERFACE (HMI)

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

The HMI is a graphical user interface primarily designed to be used with a two-button pointing device, such as a mouse or trackball. Most functions require an appropriate pointing device.

- 3.1.1.1 Frequently used functions are provided with keyboard shortcuts.
- 3.1.1.2 The HMI screens allow the user to select a new screen or control the display of data by clicking on designated buttons and icons.
- 3.1.1.3 Data points defined in the Tank 241-AZ-101 Retrieval System DAS I/O list are displayed on the HMI monitor.
- 3.1.1.4 The HMI has historical trending/plotting capabilities.
 - 3.1.1.4.1 Real-time variable inputs are stored for online graphical viewing and extraction.
 - 3.1.1.4.2 Trend history files (more detailed than CSV text reports) are stored on the HMI PC hard drive. Twelve individual, month-long files are stored on the hard drive for a full year of data storage.
 - 3.1.1.4.3 The trend data may be plotted, saved to a CSV file, or copied for use in other applications (e.g., Microsoft Excel⁷).
 - 3.1.1.4.4 Trend plot configurations may be saved and recalled. The trend configurations are stored in the project folder as TRENDSEL.DBF.
- 3.1.1.5 Security – To prevent unauthorized personnel from accessing the DAS, a login sequence is established which, upon a successful login, assigns the user to a predefined access group. Table 1 lists the user groups and their access to different types of functions.
 - 3.1.1.5.1 A user may not quit or send the DAS to the background unless his/her access group is permitted to do so.
 - 3.1.1.5.2 The DAS PC operating system software (Windows NT® Workstation 4.0) is configured to automatically log in to a default account and start the DAS program *in place of* the normal log screen. To log on normally, hold down the shift key to bypass autologin.

Table 1. User Groups and Accessible Functions	
User Group	Accessible Functions
Not Logged In	Monitor data and alarms only.
Operator	Monitor all data and alarms, acknowledge alarms, view alarm setpoints, change trend configurations.

⁷Excel is a registered trademark of Microsoft Corp.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

Table 1. User Groups and Accessible Functions	
User Group	Accessible Functions
Shift Supervisor	All Operator functions plus enable/disable alarms, change alarm setpoints.
Remote Manager Node	All Operator functions except acknowledge alarms, view alarm setpoints, change trend configurations
System Engineer	All Shift Supervisor functions plus the ability to make software changes in the PLC and HMI PC add users and edit user security levels.

Note: Use of the terms Operator, Shift Supervisor, and System Engineer refers to a DAS security access level only, not job titles or other functions.

3.1.2 SYSTEM INTERFACES

The Citect® HMI software is capable of exporting data to another program running on the HMI PC.

3.1.2.1 The DAS periodically stores most direct inputs in CSV (Comma Separated Values) format, which can be ported to Microsoft Windows®-based spreadsheets (i.e., Excel®).

3.1.2.1.1 The report file organization is based on the report period and tagnames listed in the Tank 241-AZ-101 Retrieval System DAS I/O list.

3.1.2.1.2 Each report file contains a header row, which lists the tags recorded therein.

3.1.2.1.3 The report files may be accessed remotely over the Hanford Local Area Network (HLAN).

3.1.3 COMMUNICATION INTERFACES

The following paragraphs describe requirements for implementation of communication links described in Figure 1 of this document.

3.1.3.1 **AY-801A PLC:** The Allen-Bradley®⁸ PLC-5/20E processor communicates with the Tank 241-AZ-101 Retrieval System DAS PC via Transmission Control Protocol/Internet Protocol (TCP/IP) over HLAN. Process values originating in the PLC will be transferred to the DAS PC at least once each report period.

⁸Allen-Bradley® is a registered trademark of Rockwell Automation.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

3.1.3.2 **AY-801A Westronics MUX:** The Westronics® MUX (SDI-310) communicates with the PLC in AY-801A via Modbus® protocol using the ProSoft®⁹ Modbus Communications Module in the PLC rack.

3.1.3.3 **AZ-702 Ventilation System DCS in AZ-271 Control Room:** The Micon® Distributed Control System (DCS) also communicates with the Tank 241-AZ-101 Retrieval System DAS PC via TCP/IP over HLAN.

3.1.3.4 **101-AZ Mixer Pump Variable Frequency Drives (VFD's):** Discrete inputs from the mixer pump VFD's are connected to a SixNet EtherTrak®¹⁰ ET-16DI2 I/O module. The module communicates with the DAS PC by TCP/IP. The hardware connection is an Ethernet LAN.

Analog inputs from the mixing pump VFD's are connected to a Sixnet EtherTrak® ET-8INS I/O module. The module communicates with the DAS PC by TCP/IP. The hardware connection is an Ethernet LAN.

3.1.3.5 **101-AZ Mixer Pump Bearing and Stator Winding Resistance Temperature Detectors (RTD's):** The RTD's are connected to SixNet SixTrak modules which are connected to a SixNet Ethernet Gateway module which communicates with the DAS PC over an Ethernet LAN.

3.1.3.6 **101-AZ Risers 15E and 15F T/C Tree Strain Gages:** The Strain Gages are connected to a SixNet Ethernet Gateway module which communicates with the DAS PC over an Ethernet LAN.

3.1.4 ALARM HANDLING

This section defines the alarm handling requirements. See the Tank 241-AZ-101 Retrieval System DAS I/O list for a list of alarms.

3.1.4.1 Alarm annunciators are color-coded based on priority.

3.1.4.2 Alarm annunciators flash when unacknowledged.

3.1.4.3 An unacknowledged alarm will continue to flash even after the alarm condition has cleared.

3.1.4.4 An acknowledged alarm's annunciator will hold the alarm color code until the alarm condition has cleared.

3.1.4.5 Changes to alarm conditions, including acknowledgements, create a new line in the alarm log, as listed in the Tank 241-AZ-101 Retrieval System DAS I/O list.

3.1.4.5.1 The alarm log is available on the HMI (from the Alarms screen).

⁹ ProSoft is a registered trademark of ProSoft Technology Inc.

¹⁰ EtherTrak is a registered trademark of SixNet Corp.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

- 3.1.4.5.2 Log entries are listed in chronological order (new entries are added to the bottom).
- 3.1.4.6 A new alarm produces the following:
 - 3.1.4.6.1 A red flashing HMI monitor graphic display symbol.
 - 3.1.4.6.2 A message box alerting the Operator to the alarm. The message box will give the user the option of going to the Alarms page, going to the page where the variable tag is shown, or ignoring the alarm. System Engineers may disable this feature.
 - 3.1.4.6.3 Audible beeps from the PC.
- 3.1.4.7 On the page where the variable tag is displayed, the boxes where the digital tag display is located will have a color and flashing properties identical to the annunciator windows on the Alarms screen (see sections 3.1.4.1-3).
 - 3.1.4.7.1 Individual alarms may be acknowledged by clicking on flashing alarm icons.
 - 3.1.4.7.2 The operator may acknowledge all alarms listed on the current screen by clicking on the acknowledge button in the active HMI window or by pressing F12 on the keyboard.
 - 3.1.4.7.3 Once acknowledged, the flashing of an alarm annunciator light that is still active stops.
 - 3.1.4.7.4 When the alarm condition clears on an acknowledged alarm, the color-coded alarm indication automatically clears.
 - 3.1.4.7.5 An unacknowledged alarm indication will not clear (i.e., will remain colored and flashing) until acknowledged.
- 3.1.4.8 The Alarm screen shows the status for all active and unacknowledged alarms.
 - 3.1.4.8.1 Alarm annunciator windows may be for individual alarms or groups of alarms.
 - 3.1.4.8.2 The text list of active alarms shows the most recent alarm at the top.
- 3.1.4.9 The Shift Supervisor as necessary may modify alarm parameters.
 - 3.1.4.9.1 Alarm setpoints may be set for DAS inputs currently configured with alarms (as listed in the Tank 241-AZ-101 Retrieval System DAS I/O list).
 - 3.1.4.9.2 One real-time set point profile is available.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

3.1.4.9.3 Alarm setpoints may be returned to default values from the alarm setpoints screen.

3.1.4.9.4 Alarm capability may be disabled and enabled.

3.1.5 CONTROL

Currently, the DAS is not being used for process control.

3.2 ANALOG SIGNAL PROCESSING

This section describes requirements for display linearity, reliability, and precision for analog inputs connected to the DAS.

3.2.1 RESISTANCE TEMPERATURE DETECTOR (RTD) INPUTS

RTD inputs required to be recorded by the DAS are simulated with an appropriate signal-generating device during the acceptance testing process. The following conditions are tested.

3.2.1.1 Out of range response on the DAS will initiate the appropriate alarm.

3.2.1.2 DAS screen display agreed with all simulated inputs within 4°F.

3.2.2 STRAIN GAUGE INPUTS

Each strain gauge input value on the DAS screen is simulated with an equivalent scaled value from 0 to 32,767 (raw data range of EtherTrak registers) during the acceptance testing process.

The following conditions are tested:

3.2.2.1 Out of range response on the DAS will initiate the appropriate alarm.

3.2.2.2 Response on the DAS at 0 – 50 – 100% of the input signal is the 0 – 50 – 100% values calculated from DAS I/O list +/- 1% of the span.

3.2.2.3 Precision on the DAS is < 0.1% of the full range.

3.2.3 ANALOG INPUTS

Each analog input value on the DAS screen is simulated with an equivalent scaled value from 0 to 32,767 during the acceptance testing process. The following conditions are tested:

3.2.3.1 Out of range response on the DAS will initiate the appropriate alarm.

3.2.3.2 Response on the DAS 0 – 50 – 100% of the input signal is the 0 – 50 – 100% values calculated from DAS I/O list +/- 1% of the span.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

3.2.3.3 Precision on the DAS is < 0.1% of the full range.

3.3 DISCRETE SIGNAL PROCESSING

Each discrete input value on the DAS screen is simulated during the acceptance testing process

3.4 HISTORICAL TRENDS AND DATA BACKUP

All thermocouple and strain gauge inputs are configured for historical logging.

3.5 TESTING AND ACCEPTANCE CRITERIA

The software and hardware are tested to ensure that all requirements documented in Section 3 are met. The tank 241-AZ-101 retrieval system DAS is considered a General Service Design. All software documentation is prepared in accordance with LMH-PRO-2778 (IRM Application System Life Cycle Standards) and LMH-PRO-309 (Computer Software Quality Assurance Requirements).

4 REFERENCES

4.1 DOCUMENTS

- 4.1.1 LMH-PRO-2778 (IRM Application System Life Cycle Standards)
- 4.1.2 LMH-PRO-309 (Computer Software Quality Assurance Requirements).
- 4.1.3 Cortez, Laurie N., LMHC to Steen, R.T., FDNW, "Contract #4978, Requisition #35780, Release #29, 101-AZ Mixer Pump Test Engineering Support, Rev. 0; dated October 27, 1999.
- 4.1.4 Westronics®, Inc. User Manual for model SDI-31-/340, with special section on Modbus communications (P/N M01 00044-01).
- 4.1.5 Prosoft Technology, Inc. User Manual for models 3100/3150-MCM Modbus Communications, Revision 2, April 1997.
- 4.1.6 RPP-5529, Revision 0 (User Manual for DAS).
- 4.1.7 RPP-5530, Revision 0 (Programmers Guide).

4.2 DRAWINGS:

H-2-68330 SH2	Tank AZ-101 Elec/Inst Equipment Conduit Schedule
H-2-68330 SH3-4	Tank AZ-101 Elec/Inst Equipment Wire Run List
H-2-78948 SH2-3	Tank AZ-101 Elec/Inst Equipment Interconnection Diagram
H-2-78975 SH1-2	Tank AZ-101 Inst. Junction Box Assembly
H-2-78975 SH3	Tank AZ-101 Inst. Junction Box JB101-100 Wiring Diagram
H-2-78975 SH4	Tank AZ-101 Inst. Junction Box JB101-101 Wiring Diagram

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

H-2-78977 SH1-2	TC/Strain Gauge Junction Box 15E Wiring Diagram
H-2-78978 SH1-2	TC/Strain Gauge Junction Box 15F Assembly
H-2-78978 SH3	TC/Strain Gauge Junction Box 15F Wiring Diagram

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX A – FUNCTION KEYS

GENERAL KEYS FOR DAS		
Key	Name	Description
F1 or Home	Overview	Displays the RPP DAS PROCESS OVERVIEW screen.
F2	Pump Status	Displays the Mixer Pumps STATUS screen.
F3	Strain	Displays the Tank 241-AZ-101 thermocouple tree stress/strain information screen.
F4	Temp Profiles	Displays the Tank 241-AZ-101 Temperature Profile screens.
F5	Micon Data	Displays the Tank 241-AZ-101 HVAC Screen.
F6	Alarms	Displays the ALARMS screens.
F7	Hardware Alarm	Displays the Hardware Alarm Screen.
F8	Alarm Summary	Displays the Alarm Summary Screen.
F9	Login	Displays the Login Screen.
F10	Information	Displays the Information Screen.
F12	ACK	Acknowledges all active alarms on the current screen

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX B – DAS/WESTRONICS® MUX COMMUNICATIONS

The Westronics® multiplexer/data logger (model SDI-310) that is installed in AY-801A scans thermocouples installed in AY- and AZ-Farm tanks (totaling 360 points). The MUX is equipped with special firmware that provides Modbus protocol.

The ProSoft® Modbus Communication Module has two ports which may be configured independently (for speed, parity, stop bits and for RS-232, or RS-485 input). In the master mode, Port 1 on the ProSoft® module will be used to communicate with the SDI-310 at 4800 baud rate. The SDI-310 emulates a Modbus RTU slave.

The Allen-Bradley® PLC used block transfer commands to poll the Minimum Critical Mass (MCM) through the PLC backplane. Ladder logic is used to configure the MCM for the particular application.

Each data point and status in the Westronics memory that is required for the DAS (see Appendix B) may be requested individually by referring to the address structure described in SPECIAL 95E031DE at the front of the Westronics® User Manual (Ref. 4.1.3).

To make a data request, the Modbus® RTU address and point numbers must be known. The SDI-310 with Modbus allows addresses between 1 and 255, and defaults to an address of 001. Point numbers may be determined by adding 87 to the temperature element number, listed in the DAS I/O list. A request for data consists of an address, a transfer command, and an input register address (the point number). The commands entered into the AY-801A PLC logic consist of blocks of these data requests. See the manual on the Prosoft® MCM (Ref. 4.1.4) for a description of Modbus command formatting and port configuration.

Note: All AY and AZ thermocouples scanned by the Westronics® unit in AY-801A were added to the periodic data request sent to the MCM. This is to allow future wireless access to the temperature data.

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX C - DAS STARTUP/RECOVERY

Actions required for successful system startup/recovery following a system crash or related failure are largely determined by the Citect® HMI system.

Step-by-step instructions for system recovery will be given in the DAS Users Manual. An outline of the files required is provided here.

A. CITECT® HMI SOFTWARE

The Citect software used to display and record DAS instrumentation values is separated into two portions: the Project File and the configuration applications (Citect® Explorer, Project Editor, Graphics Builder, and Cicode® Editor). To recover the DAS configuration, first verify that Citect® has been installed, then use the Recover option in the Citect® Explorer Tools menu to uncompress the backup from the Tank 241-AZ-101 Retrieval System DAS configuration CD. When uncompressed, the backup file (CTBackup.001) contains numerous files used to control the behavior of the Citect runtime application (Citect® 32.3x3). These include the file types listed in the following table.

FILE EXT.	DESCRIPTION	EXAMPLE
DBF	DBase III files created by Project Editor	Variable.dbf
RDB	Runtime database files for page animation, variable display, historical trends, and alarming.	_trend.rdb
CTG, CTF	Citect graphics files created by Graphics Builder (one of each is created with each screen/page)	Enraf.ctg, tanktemp.ctf
TXT	Text report definition files	Vent.txt
INI	General configuration settings	Citect.ini
CI	Cicode source files created in Cicode Editor	Trendsel.ci
CTT	Template libraries for Graphics Builder	Special.ctt
CTM, CTL	Genie/Supergenie libraries for Graphics Builder	Global.ctm, gobal.ctl
DAT	System log files	Syslog.dat
SQX, NDX	Supporting files for Graphics Builder/Project Editor	Anaalm.sqx, pgbutton.ndx

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX D – DAS DOCUMENTATION

The following table lists and describes the documentation trail completed during the DAS development, as required by the procedure "IRM Application System Life Cycle Standards", LMH-PRO-2778, Rev. 0.

DAS Documentation Per LMH-PRO-2778, IRM Application System Life Cycle Standards		
PROJECT PHASE	DOCUMENTATION	DESCRIPTION
Work Planning	Task Order Dated October 27, 1999	Statement of Work from LMHC to FDNW describing DAS scope.
Concept	RPP-5572, Revision 0, Section 1.3	Describes the functions that the DAS will accomplish at a systems level.
Requirement	RPP-5572, Revision 0, Section 3	Describes specific requirements that are utilized to generate testing documentation for validation.
Design	1) RPP-5572, Revision 0, Appendix A – C 2) DWGS. H-2-78948, H-2-78978, H-2-78977, and H-2-78978	Describes the HMI design for screens, taglists, function buttons, and general operations. Wiring Diagrams for DAS
Testing	1) DAS QTP/ATP (RPP-5571, Revision 0)	Qualification/Acceptance Test Procedure documents to perform initial tests of DAS
Turnover	1) RPP-5529, Revision 0 2) RPP-5530, Revision 0	User Manual for DAS Programmers Guide

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX E – DAS I/O													
Alarm priority (pri): 1 = Red, 2 = Yellow, 3 = White													
Tag	Description	Units	Range		Process alarm		Alarm Hi		Alarm HiHi	Alarm Low		Alarm LoLo	
			lo	hi	min	db	setpnt	Ed		setpnt	p r i		
FI AZ1 K1 2	AZ1OtPV Flow	SCFM	0	700	1	3			-	0	100	3	50
PDI AZ K18 1	PVCdsr Dp	IN WC	0	20	1	0.1	11	2	-	0			-
PDI AZ K14 1A	PVHepa1A Dp	IN WC	0	6	1	0.03	3	2	5	1			-
PDI AZ K14 2A	PVHepa2A Dp	IN WC	0	6	1	0.03	3	2	5	1			-
PDI AZ K110 1A	PVHega1A Dp	IN WC	0	5	1	0.03	2	2	2.25	1			-
FI AZ K1 3	PVStk Flow	SCFM	0	1100	1	6			-		400	3	
RI AZ K1 1	PVStk Rad	DPM/ft3	0	10000									
PDI AZ K14 1B	PVHepa1B Dp	IN WC	0	6	1	0.03	3	2	5	1			-
PDI AZ K14 2B	PVHepa2B Dp	IN WC	0	6	1	0.03	3	2	5	1			-
PDI AZ K110 1B	PVHega1B Dp	IN WC	0	5	1	0.03	2	2	2.25	1			-
TI AZ K18 1A	PVCdsrInVapTemp	DEG F	0	150									
TI AZ K18 1B	PVCdsrOtVapTemp	DEG F	0	100									
RI AZ K19 1	PVHeme Rad	Mrem/Hr	0	1000	1	0.02	270	2					
PDI AZ K19 1	PVHeme Dp	IN WC	0	20	1		10	2	15				
TI AZ1 K48 1A	AZ1CdsrInVapTemp	DEG F	0	200									
TI AZ1 K48 1B	AZ1CdsrOtVapTemp	DEG F	0	200									
TI AZ1 EWR 1	AZ1CdsrEWRtnTemp	DEG F	0	150									
TI AZ1 EWS 1	AZ1CdsrEWSupTemp	DEG F	0	150									
PI AZ1 K1 1	AZ1Tank Press	IN WC	-6	4	1	0.05	-0.5	2	-0.25	1	-3.5	2	-4.0
PDI AZ1 K45 1	AZ1Rec FanDp	IN WC	0	25									
PDI AZ1 K48 1	AZ1Rec CdsrDp	IN WC	0	20	1	0.1	18	2			2	1	
FI AZ1 EWR 1	AZ1 EW RtnFlow	GPM	0	400	1	2					295	2	
TI AZ1 P701A A	AZ101P2WindingTemp-Phase A	DEG F	0	400			330	2	340	1			
TI AZ1 P701A B	AZ101P2WindingTemp-Phase B	DEG F	0	400			330	2	340	1			

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX E – DAS I/O														
Alarm priority (pri): 1 =Red, 2 = Yellow, 3 = White														
Tag	Description	Units	Range		Process alarm		Alarm Hi		Alarm HiHi		Alarm Low		Alarm LoLo	
			lo	hi	u	db	setpnt	pr	setpnt	pr	setpnt	pr	setpnt	pr
TI AZ1 P701A C	AZ101P2WindingTemp-Phase C	DEG F	0	400		4	330	2	340	1				
TI AZ1 P702A A	AZ101P1WindingTemp-Phase A	DEG F	0	400		4	330	2	340	1				
TI AZ1 P702A B	AZ101P1WindingTemp-Phase B	DEG F	0	400		4	330	2	340	1				
TI AZ1 P702A C	AZ101P1WindingTemp-Phase C	DEG F	0	400		4	330	2	340	1				
TI AZ1 P701A DE	AZ101P2LowerBearingTemp	DEG F	0	300		4	195	2	205	1				
TI AZ1 P702A DE	AZ101P1LowerBearingTemp	DEG F	0	300		4	195	2	205	1				
TI AZ1 P701A ODE	AZ101P2UpperBearingTemp	DEG F	0	300		4	195	2	205	1				
TI AZ1 P702A ODE	AZ101P1UpperBearingTemp	DEG F	0	300		4	195	2	205	1				
II AZ1 P702A 1	AZ101P1Current	AMPS	0	400		15	320	2	364	1				
II AZ1 P701A 1	AZ101P2Current	AMPS	0	400		15	320	2	364	1				
SI AZ1 P702A 1	AZ101P1Speed	RPM	0	1230										
SI AZ1 P701A 1	AZ101P2Speed	RPM	0	1230										
XA AZ1 P702A 1	AZ101P1Fault	DISCRETE		Fault										
XA AZ1 P701A 1	AZ101P2Fault	DISCRETE		Fault										
PDIS 750 HI	AZ101DifferentialPressHigh	DISCRETE		Hi										
PSL 750 LOW	AZ101P1WaterPressLow	DISCRETE		Low										
PSL 751 LOW	AZ101P2WaterPressLow	DISCRETE		Low										
VSH_AZ1_P701A_1	AZ101P2UpperVibration	DISCRETE		Hi Vib										
VSH_AZ1_P701A_2	AZ101P2LowerVibration	DISCRETE		Hi Vib										
VSH_AZ1_P702A_1	AZ101P1UpperVibration	DISCRETE		Hi Vib										
VSH_AZ1_P702A_2	AZ101P1LowerVibration	DISCRETE		Hi										

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX E – DAS I/O

Alarm priority (pri): 1 = Red, 2 = Yellow, 3 = White											
Tag	Description	Units	Range		Process alarm		Alarm Hi		Alarm HiHi		Alarm LoLo
			lo	hi	alm	db	setpnt	pt	setpnt	pt	
WI AZ1 15E 701A	AZ101StrainGage15ETop	uV	-62000	Vib							
WI AZ1 15E 702A	AZ101StrainGage15EMid	uV	-62000	62000							
WI AZ1 15E 703A	AZ101StrainGage15EBot	uV	-62000	62000							
WI AZ1 15E 704A	AZ101StrainGage15ETop	uV	-62000	62000							
WI AZ1 15E 705A	AZ101StrainGage15EMid	uV	-62000	62000							
WI AZ1 15E 706A	AZ101StrainGage15EBot	uV	-62000	62000							
WI AZ1 15F 707A	AZ101StrainGage15FTop	uV	-62000	62000							
WI AZ1 15F 708A	AZ101StrainGage15FMid	uV	-62000	62000							
WI AZ1 15F 709A	AZ101StrainGage15FBot	uV	-62000	62000							
WI AZ1 15F 710A	AZ101StrainGage15FTop	uV	-62000	62000							
WI AZ1 15F 711A	AZ101StrainGage15FMid	uV	-62000	62000							
WI AZ1 15F 712A	AZ101StrainGage15FBot	uV	-62000	62000							
TI AZ1 15E 1	JB 15E Internal Temp	degrees F	-40	212					80	2	
TI AZ1 15F 1	JB 15F Internal Temp	degrees F	-40	212					80	2	
EI AZ1 15E 1	JB 15E Excitation Voltage	V	0	16							
EI AZ1 15F 1	JB 15E Excitation Voltage	V	0	16							
EI AZ1 P702A 1	AZ101Pump1Volts	V	0	460							
EI AZ1 P701A 1	AZ101Pump2Volts	V	0	460							
SFI AZ1 P702A 1	AZ101Pump1Frequency	Hz	0	62							
SFI AZ1 P701A 1	AZ101Pump2Frequency	Hz	0	62							
ZT AZ1 P702A 1	AZ101Pump1NozzlePos	degrees	-100	100							
ZT AZ1 P701A 1	AZ101Pump2NozzlePos	degrees	-100	100							
YS AZ1 P702A 1	AZ101Pump1Running	DISCRETE		Run							

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX E – DAS I/O													
Alarm priority (pri): 1 = Red, 2 = Yellow, 3 = White													
Tag	Description	Units	Range		Process alarm		Alarm Hi		Alarm HiHi	Alarm Low		Alarm LoLo	
			lo	hi	db	setpnt	setpnt	setpnt		setpnt	setpnt	setpnt	setpnt
YS AZ1 P701A 1	AZ101Pump2Running	DISCRETE		Run									
PDIS 750 NORM	AZ101DifferentialIPressNormal	DISCRETE		Norm									
PSL 750 NORM	AZ101P1WaterPressNormal	DISCRETE		Norm									
PSL 751 NORM	AZ101P2WaterPressNormal	DISCRETE		Norm									
TI_101_AZ_1 to 13	Insulating Concrete	F	0	300									
TI_101_AZ_15 to 24	Insulating Concrete	F	0	300									
TI_101_AZ_25	Tank Knuckle	F	0	300									
TI_101_AZ_28 to 36	Tank Foundation	F	0	300									
TI_101_AZ_37	Airlift Circulator - 1	F	0	300	1	2	190	2	200	1			
TI_101_AZ_38	Airlift Circulator - 2	F	0	300	1	2	190	2	200	1			
TI_101_AZ_39	Airlift Circulator - 3	F	0	300	1	2	190	2	200	1			
TI_101_AZ_40	Airlift Circulator - 4	F	0	300	1	2	190	2	200	1			
TI_101_AZ_41	Airlift Circulator - 5	F	0	300	1	2	190	2	200	1			
TI_101_AZ_42	Airlift Circulator - 6	F	0	300	1	2	190	2	200	1			
TI_101_AZ_43	Airlift Circulator - 7	F	0	300	1	2	190	2	200	1			
TI_101_AZ_44	Airlift Circulator - 8	F	0	300	1	2	190	2	200	1			
TI_101_AZ_45	Airlift Circulator - 9	F	0	300	1	2	190	2	200	1			
TI_101_AZ_46	Airlift Circulator - 10	F	0	300	1	2	190	2	200	1			
TI_101_AZ_47	Airlift Circulator - 11	F	0	300	1	2	190	2	200	1			
TI_101_AZ_48	Airlift Circulator - 12	F	0	300	1	2	190	2	200	1			
TI_101_AZ_49	Airlift Circulator - 13	F	0	300	1	2	190	2	200	1			
TI_101_AZ_50	Airlift Circulator - 14	F	0	300	1	2	190	2	200	1			
TI_101_AZ_51	Airlift Circulator - 15	F	0	300	1	2	190	2	200	1			
TI_101_AZ_52	Airlift Circulator - 16	F	0	300	1	2	190	2	200	1			

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX E – DAS I/O														
Alarm priority (pri): 1 = Red, 2 = Yellow, 3 = White														
Tag	Description	Units	Range		Process alarm		Alarm Hi		Alarm HiHi		Alarm Low		Alarm LoLo	
			lo	hi	setpnt	db	setpnt	pt	setpnt	pt	setpnt	pt	setpnt	pt
TI_101_AZ_53	Airlift Circulator - 17	F	0	300	1	2	190	2	200	1				
TI_101_AZ_54	Airlift Circulator - 18	F	0	300	1	2	190	2	200	1				
TI_101_AZ_55	Airlift Circulator - 19	F	0	300	1	2	190	2	200	1				
TI_101_AZ_56	Airlift Circulator - 20	F	0	300	1	2	190	2	200	1				
TI_101_AZ_57	Airlift Circulator - 21	F	0	300	1	2	190	2	200	1				
TI_101_AZ_58	Airlift Circulator - 22	F	0	300	1	2	190	2	200	1				
TI_101_AZ_59	AZ101 Profile SE 300	F	0	300	1	2	190	2	200	1				
TI_101_AZ_60	AZ101 Profile SE 158	F	0	300	1	2	190	2	200	1				
TI_101_AZ_61	AZ101 Profile SE 4	F	0	300	1	2	190	2	200	1				
TI_101_AZ_62	AZ101 Profile SW 300	F	0	300	1	2	190	2	200	1				
TI_101_AZ_63	AZ101 Profile SW158	F	0	300	1	2	190	2	200	1				
TI_101_AZ_64	AZ101 Profile SW 4	F	0	300	1	2	190	2	200	1				
TI_101_AZ_65	AZ101 Profile NW 300	F	0	300	1	2	190	2	200	1				
TI_101_AZ_66	AZ101. Profile NW 158	F	0	300	1	2	190	2	200	1				
TI_101_AZ_67	AZ101 Profile NW 4	F	0	300	1	2	190	2	200	1				
TI_101_AZ_68	AZ101 Profile NE 300	F	0	300	1	2	190	2	200	1				
TI_101_AZ_69	AZ101 Profile NE 158	F	0	300	1	2	190	2	200	1				
TI_101_AZ_70	AZ101 Profile NE 4	F	0	300	1	2	190	2	200	1				
TI_101_AZ_71	Sludge Temp SE	F	0	300	1	2	190	2	200	1				
TI_101_AZ_72	Sludge Temp SW	F	0	300	1	2	190	2	200	1				
TI_101_AZ_73	Sludge Temp N	F	0	300	1	2	190	2	200	1				
TI_101_AZ_74	Tank Dome W	F	0	300										
TI_101_AZ_75	Tank Dome NE	F	0	300										
TI_101_AZ_76	Tank Dome SE	F	0	300										

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TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX E – DAS I/O											
Alarm priority (pri): 1 = Red, 2 = Yellow, 3 = White											
Tag	Description	Units	Range		Process alarm		Alarm Hi		Alarm HiHi		Alarm LoLo
			lo	hi	alm	db	setpnt	pri	setpnt	p r i	
TI_101_AZ_77	Tank Dome W	F	0	300							
TI_101_AZ_78	Tank Dome NE	F	0	300							
TI_101_AZ_79	Tank Dome SE	F	0	300							
TI_101_AZ_80	Tank Dome W	F	0	300							
TI_101_AZ_81	Tank Dome E	F	0	300							
TI_101_AZ_82	Tank Dome SE	F	0	300							
TI_101_AZ_83	Tank Dome W	F	0	300							
TI_101_AZ_84	Tank Dome NE	F	0	300							
TI_101_AZ_85	Tank Dome SE	F	0	300							
TI_101_AZ_86	Tank Wall W	F	0	300							
TI_101_AZ_87	Tank Wall NE	F	0	300							
TI_101_AZ_88	Tank Wall SE	F	0	300							
TI_101_AZ_89	Tank Wall W	F	0	300							
TI_101_AZ_90	Tank Wall NE	F	0	300							
TI_101_AZ_91	Tank Wall SE	F	0	300							
TI_101_AZ_92	Tank Wall W	F	0	300							
TI_101_AZ_93	Tank Wall NE	F	0	300							
TI_101_AZ_94	Tank Wall SE	F	0	300							
TI_101_AZ_95	Tank Wall W	F	0	300							
TI_101_AZ_96	Tank Wall NE	F	0	300							
TI_101_AZ_97	Tank Wall SE	F	0	300							
TQI_101_AZ_01	Average of 37 TCs	F	0	300							
Note: Shaded thermocouples can be included in the running temp average for TQI_101_AZ_01											

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX F – HLAN COMMUNICATIONS

The control system for the AZ-702 Ventilation System is a Micon Distributed Control System (DCS) running on Sun Sparc workstations under SunOS 4.1.4 (UNIX). Some of the data collected by the DCS is used in WRSS thermal balance calculations. A "Third Party Software Interface" (TPSI) program on the DCS is configured to provide the required data in a semicolon-delimited format which Citect can use as an input database.

To access these files on the UNIX system, a special network protocol is required. A standard method for connecting Windows 95 and NT workstations using TCP/IP is Server Message Block (SMB) protocol. UNIX systems do not use SMB by default, but a freely available and well-supported package, Samba, provides SMB connectivity for UNIX systems. Samba allows Windows 95 and NT workstations to mount a remote UNIX directory as a network volume (e.g., X:) through the **Map Network Drive...** or **NET USE** functions without any additional software, e.g.:

```
C:\> NET USE X: \\130.97.111.25\PUBLIC
```

Two Micon workstations are configured to provide a redundant connection between the AZ-702 ventilation system and the WRSS DAS. The directories where the data is stored are mapped as drives X: and Y:. The WRSS DAS attempts to acquire data every 60 seconds from the most recently successful network connection. If this connection is unsuccessful, the WRSS DAS automatically switches to the other network connection. The following IP addresses have been assigned for equipment associated with the WRSS DAS and the Mixer Pump Test DAS:

Hostname (DNS)	IP Address	Description
wbm211	130.97.111.3	WIRELESS BRIDGE IN MO-211 (HLAN ACCESS POINT)
wb241ay	130.97.111.5	WIRELESS BRIDGE IN AY-801A (FOR AY-FARM PLC)
wb241az	130.97.111.7	WIRELESS BRIDGE IN DCS/CONTROL ROOM
plc241ay	130.97.111.21	PLC IN AY-801A
plcm211	130.97.111.22	PLC IN MO-211
micon02	130.97.111.23	DCS OPERATOR INTERFACE STATION #1
micon11	130.97.111.24	DCS OPERATOR INTERFACE STATION #2
micon126	130.97.111.25	DCS OPERATOR INTERFACE STATION #3
micon14	130.97.111.26	DCS ENGINEERING STATION
	130.97.111.X	WRSS DAS HMI IN MO-211 (IP ADDRESS DYNAMICALLY ASSIGNED BY DHCP)
101_az_das	130.97.111.X	241-AZ-101 MIXER PUMP TEST DAS HMI IN 241-AZ-156 MIXER PUMP CONSOLE (IP ADDRESS DYNAMICALLY ASSIGNED BY DHCP)

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX S – OPERATOR INTERFACE SCREENS

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX S – OPERATOR INTERFACE SCREENS

TANK 241-AZ-101 RETRIEVAL DAS SYSTEM DESCRIPTION

APPENDIX S – OPERATOR INTERFACE SCREENS

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