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Accession #: D195066662

Document #: SD-SNF-CSRS-001

Title/Desc:

105K EAST ION EXCHANGE & CARTRIDGE FILTER RESTART
COMPUTER SOFTWARE REQUIREMENTS SPEC

Pages: 21

15

DEC 11 1995

374#19

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 605805

2. To: (Receiving Organization) Distribution		3. From: (Originating Organization) 100 K AREA PROCESS ENGINEERING		4. Related EDT No.: NA	
5. Proj./Prog./Dept./Div.: SNF		6. Cog. Engr.: R WHITEHURST		7. Purchase Order No.: NA	
8. Originator Remarks: Transmittal of the Computer Software Requirements Specification for the 105 K East Ion Exchange and Cartridge Filter Restart Project				9. Equip./Component No.: NA	
				10. System/Bldg./Facility: 105 KE	
11. Receiver Remarks:				12. Major Assm. Dwg. No.: NA	
				13. Permit/Permit Application No.: NA	
				14. Required Response Date: NA	

15. DATA TRANSMITTED					(F)	(G)	(H)	(I)
(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	Approval Designator	Reason for Trans- mittal	Orig- inator Dispo- sition	Receiv- er Dispo- sition
1	WHC-SD-SNF-CSRS-001		0	105 KE ION EXCHANGE AND CARTRIDGE FILTER RESTART COMPUTER SOFTWARE REQUIREMENTS SPECIFICATION	Q	1,2	1	

16. KEY			
Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)	
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment	4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

(G)	(H)	17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)								(G)	(H)
Reason	Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	Reason	Disp.
1,2	2	Cog.Eng. R. WHITEHURST	R3-86	12/11/95							
1,2	2	Cog. Mgr. MJ WIEMERS	X3-85	12/11/95							
1,2	2	QA PJ EDWARDS	A4-79	12/09/95							
		Safety									
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1,2	2	DW MEDFORD	X3-74	12/11/95							
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18. Signature of EDT Originator		19. Authorized Representative for Receiving Organization		20. Cognizant Manager		21. DOE APPROVAL (if required) Ctrl. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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105 K EAST ION EXCHANGE AND CARTRIDGE FILTER RESTART COMPUTER SOFTWARE REQUIREMENTS SPECIFICATION

DS SCHERMERHORN

Westinghouse Hanford Co., Richland, WA 99352

U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: 605805

UC: 605

Org Code: 2G000

Charge Code: LD043

B&R Code: EW3135040

Total Pages: 18

Key Words: Computer Software Requirements Specification Ion Exchanger
Cartridge Filter Restart

Abstract: COMPUTER SOFTWARE REQUIREMENTS SPECIFICATION FOR THE
CARTRIDGE FILTER RESTART PROJECT

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Chris Braden
Release Approval

12/11/95

Date

Release Stamp

Approved for Public Release

WHC-SD-SNF-CSRS-001

Rev. 0

**105 K East Ion Exchange and Cartridge Filter
Restart Computer Software Requirements
Specification**

Author: DS Schermerhorn
Date: September 11, 1995

Table of Contents

1.0	INTRODUCTION	4
1.1	Purpose	4
1.2	Scope	4
1.3	Requirements Overview	6
1.4	Definitions	6
2.0	GENERAL DESCRIPTION	6
2.1	Product Perspective	7
2.2	Product Functions	7
2.3	User Characteristics	8
2.4	General Constraints	9
2.5	Assumptions and Dependencies	9
3.0	SPECIFIC REQUIREMENTS	10
3.1	Functional Requirements	10
3.2	External Interface Requirements	11
3.2.1	User Interfaces	11
3.2.2	Hardware Interfaces	11
3.2.3	Software Interfaces	11
3.2.4	Communication Interfaces	11
3.3	Performance Requirements	12
3.4	Design Constraints	12
3.4.1	Standards Compliance	12
3.4.2	Resource Limitations	13
3.5	Attributes	13
3.6	Other Requirements	13
3.6.1	Data	13
3.6.2	Operations	13
3.6.3	Site Adaptation	13
3.6.4	Options	13
3.6.5	Scheduling	14
3.6.6	Reliability and Recovery	14
3.6.7	Audit	14
3.6.8	Priorities	14
3.6.9	Transferability	14
3.6.10	Conversion	14
3.6.11	Testing and Acceptance Criteria	15
3.6.12	Documentation	15

3.6.13	Training	15
3.6.14	Security and Privacy	15
4.0	REFERENCES	15
	Figure 1	16
	Block Diagram of Required System	16
	Table 1	17
	Instrumentation Requirements	17

1.0 INTRODUCTION

This document specifies the software and computer hardware requirements of the 105 K East Ion Exchange and Cartridge Filter Restart project. The project installs new and upgrades old instrumentation for the basin water processing system.

This document is required per WHC-CM-3-10 SOFTWARE REQUIREMENTS section SP-3.4 SMALL JOB DEVELOPMENT. The outline for this document was obtained from Appendix F of the CM.

The computer system will consist of a programmable logic controller (PLC) that is connected to a graphically oriented operator interface. The function of the PLC will be to collect data from field instrumentation and transform the data into engineering units for display by the operator interface. The PLC will also generate alarm signals and transmit them to the interface for display. The PLC will be responsible for actuation of audible alarms. Refer to the block diagram of the required system in figure 1 for an overview.

1.1 Purpose

The purpose of the computer/software system will be to:

1. Collect data from analog and discrete instrumentation.
2. Display data collected.
3. Provide alarm display and annunciation.
4. Provide disk storage of data collected.
5. Provide trending of data collected.

1.2 Scope

The scope of the software system is:

1. Software for the PLC: The software will transform raw data collected from the input cards to engineering units. The software will also control the detection and annunciation of alarms.
2. Software for the operator interface: The software will display engineering data collected from the PLC and accepts operator

commands to control data collection, data storage and alarm acknowledgement.

The scope of the computer system is:

1. PLC with associated input output cards: The PLC controls the input/output cards and will also perform self diagnosis. The PLC will sense a loss of communication with the operator interface and issue an audible alarm.
2. Operator interface computer: The computer will accept all data from the PLC and it will be in direct communication with the PLC at all times. If the communication link fails then the interface computer will activate an appropriate alarm. The interface computer will also be responsible for controlling the storage of data on the removable hard disk.
3. Input cards: The input cards will accept an electrical current or discrete signal from the field instrumentation and transform it into appropriate computer information.
4. Output cards: The output cards will accept computer information and transform it into appropriate voltages for use by the alarm horn relays.
5. Removable media hard disk storage: The disk will hold a minimum of one year of analog data collected from field instrumentation. All analog data will be sampled every 5 minutes and stored to disk.

1.3 Requirements Overview

The requirements for this system originated in part from WHC-SD-SNF-WP-016 105 K EAST CARTRIDGE FILTER/IX RESTART PROJECT I&C WORK PLAN.

Requirements were finalized by experience gained from other similar systems in use at Hanford. For example the 300 area treated effluent disposal facility (TEDF) and the 300 area retention process sewer collection system (307 basins).

1.4 Definitions

PLC .. Programable logic controller. The controller is responsible for transformation of instrumentation signals into engineering units and other functions related to the collection of data. The controller also controls alarm annunciation circuitry. In addition the controller COULD be employed in the future for controlling equipment. The controller typically runs at very high speeds and can scan a large number of instruments in a few milliseconds.

Operator Interface .. The operator interface will be a graphically oriented computer interface that can be controlled by a mouse device, touchscreen and keyboard. The touchscreen method provides for extremely rapid control of the interface and it mimicks the way a "real" control board is used. The interface typically uses a "menu" of graphic buttons to control selection of various screens. Each screen is used for various display or control purposes.

Sonalert .. A small alarm horn that is typically typically installed near the main operator interface. The horn has a high frequency and medium volume. The high frequency allows detection at large distances even if high background noise is present. *Sonalert is a trademark of Mallory Capacitor Company. (360 124445)*

2.0 GENERAL DESCRIPTION

The computer/software product design will utilize ease of use as the primary constraint accompanied by low cost and ease of maintenance. The system cost will be less than or equal to the cost of a typical control console (discrete instruments, relays and alarm annunciators).

2.1 Product Perspective

Future needs will require a tie in with a similliar system to be installed in the K West basin. Present needs require the system to be designed to accept 2 signals from the K West basin for K West system alarms and K West radiation alarms.

The system will be designed to enhance the ALARA concept by installation of the interface in the control room. This will minimize personnel access requirements to the basin area to obtain data from instrumentation (flow, temperature etc.).

The system will be designed to update the screen display within 3 seconds of a change (change within system resolution) in the signal from the field instrumentation.

2.2 Product Functions

The computer/software system will perform the following functions.

1. Collect data from analog instrumentation as specified in the following list.
 - Cartridge Filter Flow
 - Recirc Pump Discharge Pressure
 - Cartridge Filter Outlet Pressure
 - Basin Conductivity
 - IXM Flow
 - IXM Conductivity
 - Downcomer Flow
 - Basin pH
 - Sump C & D Pump Current
 - Skimmer Pump Status
 - Basin Level (future addition)
 - Basin Temperature
2. Using the capability of the PLC derive the following parameters using suitable equations and/or programming instructions.
 - Cartridge Filter Total Flow (flow totalizer)
 - IXM Total Flow (flow totalizer)

- Basin Flow Balance Error (difference between inlet flow and downcomer + IXM flow)
2. Display data collected using clear numerical display accompanied by associated engineering units (GPM, DEG F) etc.
 3. Provide alarm display and annunciation. The color red will be strictly for the display of alarms. The color will not be used for any other purpose. All alarms will flash red when activated and will appear solid red when acknowledged.
 4. Provide disk storage of data collected. Data will be collected from all analog instruments every five minutes and stored on disk. The disk will have a minimum of one year of storage capacity. The disk will be of the removable type.
 5. Provide trending of data collected. The trends will be constructed from continuous historical data contained on disk. The continuous data will be maintained for 125 days. The continuous data is NOT the 5 minute sampled data and is an entirely different data base. The continuous data is NOT sampled but rather it is immediately stored on disk when a parameters value changes.

2.3 User Characteristics

It is expected that the system will have four types of users as listed below. The first 2 levels (programmer and supervisor) will be controlled by passwords. A master password will be assigned to the system administrator to control all other passwords.

1. Programmer .. In charge of high level system functions and testing. Must be thoroughly familiar with the computer system. The programmer will have access to all system functions (except master password) but will be administratively limited in actuation of some features, i.e. alarm bypass, alarm acknowledge etc.

2. Supervisor .. In charge of supervisory functions such as alarm bypass or other similiar functions. Must be qualified for K Basin operation.
3. Operator .. In charge of routine operator functions. Must be qualified for K Basin operation.
4. Observer .. This user will typically use the system for observation only. The system should be designed to utilize an "observe only" feature that will prevent remote acknowledgement of alarms. The enabling and disabling of remote acknowledgement of alarms will be via a supervisory password. This feature will allow possible future placement of a remote terminal for observation only, without affecting K Basin operation. It should be noted that such a terminal is not planned at this time.

2.4 General Constraints

1. The system software design and construction must be completed within 1 month of starting the design.
2. The system must be of reasonable cost and utilize existing material where possible. The cost must be competitive with a typical control console designed for the same function as the computer system.
3. Programming software (compilers etc.) for the operator interface and PLC will be "off the shelf" with no user programming required.
4. The system design must include ease of use as a criteria to meet.

2.5 Assumptions and Dependencies

Assumptions .. Adequate resources exist for the design and construction of the software system.

Dependencies .. None.

3.0 SPECIFIC REQUIREMENTS

This section provides details of the required design to the extent that a system designer would require to construct the system.

3.1 Functional Requirements

Figure 1 serves as a context diagram for the purposes of describing the functional requirements. The function of each block in the diagram is described below.

3.1.1 Operator Interface .. The interface is used for accepting commands from the system user and for displaying system information. The typical operations required by the operator interface are listed below.

1. Read data from the various displays.
2. Recognize system and process alarms.
3. Acknowledge alarms.
4. Select various screen displays.
5. Input data using graphical numeric "keypads".
6. View lists of alarm summaries and alarm history.
7. Observe and control trends of historical data from the analog instrumentation.

3.1.2 PLC .. The PLC function is to control the input output cards and to receive data from and send data to the operator interface.

3.1.3 Input Output Cards .. The cards will translate instrumentation signals to computer information and translate computer information to discrete control signals for the alarm horns.

3.1.4 Silence Button .. The button will be used to silence the alarm horns.

3.1.5 Alarm Horns .. The horns will consist of a Sonalert that will be installed on the operator interface panel and a separate

alarm horn that is already installed as part of the existing system.

3.2 External Interface Requirements

This section describes the external interfaces that are required for the system.

3.2.1 User Interfaces

The operator interface consists of a color monitor that is has an integral touchscreen. The touchscreen will be used for control of the PLC.

3.2.2 Hardware Interfaces

The operator interface will interface with the PLC via an RS232 communications cable.

The Input output cards will interface with the plant instrumentation via shielded cabling.

The K West alarm contacts and annunciator contacts are interfaced via existing contacts within the Honeywell chart recorder. The chart recorder is currently installed in the control room and will be transferred to the operator interface panel during installation.

3.2.3 Software Interfaces

The commercial operator interface software "Wonderware/Intouch" will be the only software interface for the system.

3.2.4 Communication Interfaces

A single RS232 communications cable will connect the operator interface and the PLC.

Future plans may require connection to the HLAN or possibly a dedicated K Basin LAN.

3.3 Performance Requirements

The system must update screen displays within three seconds of changing a field parameter (flow, temp etc.) by five percent or more.

A maximum six second lag filter may be used for filtering large data spikes and other extraneous noise.

The system must store a minimum of 1 year of data sampled at 5 minute intervals.

The system must store 125 days of on line historical data.

3.4 Design Constraints

The following describe constraints that will affect the design of the system.

3.4.1 Standards Compliance

No industry standards constraints identified.

The following standards will be observed when designing the user interface.

1. The color red is to be used for the indication of alarms. No other use of this color will be allowed.
2. All text will be visibly contrasted with the background. Text color other than black is allowed but should be used only where color is meaningful to data interpretation.
3. Piping graphic mimics will show white when flow is present and gray when flow is not present.

4. Selector and control buttons will be of a consistent design throughout all the displays.

3.4.2 Resource Limitations

Use of onsite equipment (Hanford) will be utilized if at all possible.

3.5 Attributes

All software will be fully commented to the extent that such comments are meaningful.

PLC code will be combined into logical groupings for ease in troubleshooting.

3.6 Other Requirements

3.6.1 Data

Instrumentation data and requirements (ranges etc.) Are located in table 1.

3.6.2 Operations

The software system must automatically start when power is applied to the operator interface. No special operator functions (other than alarm acknowledgement) will be required during a startup.

The PLC software must automatically restart after sustaining a power loss.

3.6.3 Site Adaptation

None identified.

3.6.4 Options

None identified.

3.6.5 Scheduling

The system must be in operation continuously with no schedules planned for downtime other than planned or corrective maintenance. The software design must limit complex sections of code to limit the possibility of unexpected system downtime due to software errors.

3.6.6 Reliability and Recovery

The design requirements recognize no need for a "hot backup" for reliability however the software must be "fault tolerant" to the largest extent possible. For example the software programs will not stop due to a removable disk error.

As specified in a previous section the software will automatically restart when power is reapplied to the system.

3.6.7 Audit

Each analog instrument data file written to the removable disk must have the initials "ke" imbedded in the file name. This will mark the data as coming from the K East computer system.

3.6.8 Priorities

None identified.

3.6.9 Transferability

None identified. The software will be custom built for the K East site. The software will need to be modified slightly for use in the K West site. No other use outside of the K Basin system is planned or desired.

3.6.10 Conversion

None identified. The data files written to the removable drive must be in ASCII code to provide easy exchange between computer data systems. The data files must be in comma separated variable (CSV) format for ease in importing to spreadsheet programs.

3.6.11 Testing and Acceptance Criteria

Testing and acceptance criteria is documented in WHC-SD-SNF-TP-016 105 K EAST BASIN IX AND CARTRIDGE FILTER RESTART INSTRUMENTATION TEST PLAN.

3.6.12 Documentation

Documentation requirements are documented in WHC-CM-3-10 SOFTWARE PRACTICES.

3.6.13 Training

The system design will result in the required training being limited to no more than 4 hours of classroom instruction and no more than 2 hours of field instruction.

3.6.14 Security and Privacy

Passwords will be required for the supervisor and programmer level. No other security or privacy requirements are required.

4.0 REFERENCES

WHC-CM-3-10 SOFTWARE PRACTICES.

Figure 1
Block Diagram of Required System

Table 1
Instrumentation Requirements

Instrument Description	Instrument Number	Instrument Units	Instrument Range
Filter 1A Flow	FE-208-1	GPM	0-600
Filter 1B Flow	FE-208-2	GPM	0-600
Rec Pump Disch Pressure	PIT-207-9	GPM	0-600
Filter 1A Outlet Press.	PIT-208-1	PSIG	0-150
Filter 1B Outlet Press.	PIT-208-2	PSIG	0-150
Basin Conductivity Probe A	CE-226-1	uS	0-20
Basin Conductivity Probe B	CE-226-2	uS	0-20
IXM 1 Flow	FE-220-2	GPM	0-200
IXM 2 Flow	FE-220-3	GPM	0-200
IXM 1 Conductivity	CE-220-1	uS	0-20
IXM 2 Conductivity	CE-220-2	uS	0-20
Downcomer Flow A	FE-1	GPM	0-600
Downcomer Flow B	FE-2	GPM	0-600
Downcomer Flow C	FE-3	GPM	0-600
Basin pH	PHT-226-1	pH	0-14
Sump C Status	IT-233-1	mA	4-20
Sump D Status	IT-233-2	mA	4-20
Skimmer Pump Status	IT-204-1	mA	4-20
Basin level (future)	LE-Future	Feet	0-20
Basin Temperature A	TE-2A	DEG F	0-150
Basin Temperature B	TE-2B	DEG F	0-150

DISTRIBUTION SHEET

To Distribution	From 100 K Area Process Engineering	Page 1 of 1			
Project Title/Work Order 105 K East Ion Exchange and Cartridge Filter Restart Project		Date 12/7/95			
		EDT No. 605805			
		ECN No. NA			
Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
WIEMERS MJ	X3-84	X			
WHITEHURST R	R3-86	X			
SCHERMERHORN DS	L6-04	X			
EDWARDS PJ	A4-79	X			
MEDFORD DW	X3-74	X			
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