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1	1	Cog. Mgr. EJ Shen	<i>[Signature]</i>	11-11-94	S4-58	JY Yount	<i>[Signature]</i>	11-11-94	S4-58	3	
		QA				MJ Brackett	<i>[Signature]</i>	11-11-94	S3-08	3	
		Safety				TC Schneider	<i>[Signature]</i>	11-11-94	L7-04	3	
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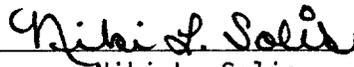
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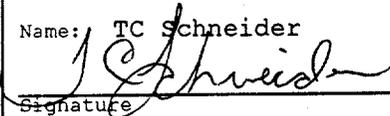
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PROJECT W-340
LONG REACH ARM RETRIEVAL SYSTEM
BALANCE OF PLANT INSTRUMENTATION WORKSHOP
ENGINEERING STUDY

WHC-SD-W340-ES-002
Rev. 0

January, 1994

ELECTRICAL ENGINEERING INSTRUMENTATION AND CONTROLS
CONTROL SYSTEMS ENGINEERING

T.C. Schneider

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1.0 OBJECTIVE

The objective of the workshop was to identify process monitoring requirements for project W-340 site, tank operational safety parameters and those of interest to the retrieval system operators for use in developing a procurement specification.

1.1 BACKGROUND AND SCOPE

The W-340 Balance of Plant (BOP) Instrumentation workshop was held in an attempt to resolve Issue #26 generated at an Arm Based Retrieval Functional Analysis Value Engineering Session. The issue was stated: "Retrieval processes that require monitoring and potential options for implementing monitoring requirements need to be defined. The extent of process monitoring required will impact the conceptual design and procurement specification."

The scope included the Project W-340 BOP control and monitoring requirements, instrumentation and their interfaces. The scope did not include the parameters that are already the vendor's responsibility, such as, instrumentation required to operate the hydraulic retrieval arm.

1.2 PURPOSE

The workshop was conducted to support the development of the project procurement specification. The team clarified the project instrumentation scope and needs by gathering facts and ideas about the proposed retrieval process monitoring and control requirements. The system requirements include the identification of instruments, as well as, their interfaces and alarms. A listing of instruments, their sources, and control and monitoring requirements were obtained using a retrieval function process matrix based upon information presented in WHC-SD-W340-ES-001, "Project W-340 Manipulator Retrieval System Tank 241-C-106".

2.0 SUMMARY

In preparation for the detailed workshop activity, assumptions were made to clarify the system scope. The following are the critical system assumptions presented:

1. The W-340 system will be designed to remove the existing waste in tank C-106 as if the sluicing of project W-320 did not occur.
2. The project will provide all of its own ventilation systems.
3. The Long Reach Arm (LRA) retrieval system will not be required to sample tank waste.
4. Decontamination solutions will be captured and routed to a holding tank.

5. Leak detection, level monitoring and temperature control of the tank contents will be required.

6. The procurement scope will include the waste process system, including the transport pump, but excluding the transport pipeline.

The primary W-340 system interfaces will exist with tank C-106 ventilation systems and project W-314. Project W-314A will provide a physical interface with the data network link and a logical interface with the process data packets. The interface will provide for alarm reporting, automatic remote monitoring of tank instruments and limited system control. Project W-314C will provide both physical and control interfaces for waste material transfer to the receiving system.

General system design considerations and specific instrumentation requirements were identified as a result of working through the Retrieval Function Matrix. Those items will be discussed in the Recommendations and Conclusions section of this document for consideration or incorporation in the procurement specification.

The entire workshop notes are included as Appendices to this report. The list of specific instrumentation identified by the Retrieval Function Matrix has been compiled separately and is presented in the Recommendations and Conclusions section.

3.0 RECOMMENDATIONS AND CONCLUSIONS

3.1 RECOMMENDATIONS

The Project W-340 BOP instrumentation recommendations are compiled from the workshop notes presented in the appendices. The recommendations will be presented in three sections for easy review and application. The first section contains general project unresolved and open issues that may impact the system procurement specification and should be evaluated prior to preparing the specification. The second section includes general issues related to the specification. The final section will present the BOP instrumentation input in a Construction Specification Institute (CSI) section format to aid in the procurement specification preparation. The CSI section input will not be complete specification inputs, but will present the topics discussed in the workshop.

3.1.1 Unresolved and Open Issues

The workshop Action Plan, presented as Appendix F, includes 5 items that should be reviewed and implemented. The following issues directly relate to Project W-340, but are only partially represented by the workshop Action Plans.

3.1.1.1 The project should consider including the waste process function in the procurement scope to simplify the system interfaces. This is a priority issue and is considered part of Action Item 1.

3.1.1.2 The project should provide for the removal of interstitial and excess liquids from the tank during waste retrieval. This feature may affect the procurement specification and is considered part of Action Items 1 and 2.

3.1.1.3 The project should determine the pH balancing requirements for the waste processing function. If pH control (OH and NO₂) is required, then a chemical make-up module will be needed. The system equipment and interface provisions will need to be factored into the procurement specification, especially if the project includes the Process Waste function in the specification. The project may wish to consider the module as an optional feature to the specification. This feature may affect the project schedule as well as the procurement specification, and is listed as Action Item 4.

3.1.1.4 The project should obtain waste transfer requirements for input into the waste process portion of the procurement specification. Since the waste transport systems may use raw water, the project should also consider including a process water recovery system to minimize additional waste.

3.1.1.5 The project should consider the need for post retrieval monitoring and isolation and include schedule and funding for support. This is a priority issue and is considered part of Action Item 3.

3.1.1.6 The LRA manipulator control specification should contain any additional level of detail required by the project. An example would be joint level diagnostics which the vendor may not consider necessary for proper system operation.

3.1.1.7 The LRA manipulator control specification should require implementation of various mining strategies.

3.1.2 General Issues Relate to the Procurement Specification

3.1.2.1 The project should provide a panic button system to include several strategic locations including the tank farm control room, the retrieval system control room and the remote manned enclosures.

3.1.2.2 The project should coordinate the location of system control stations with projects W-314C and W-188. The system procurement specification should include input for control flexibility.

3.1.3 CSI Section Input

PART A GENERAL

A.1 Summary

Not Addressed By this study.

A.2 References
Not Addressed By this study.

A.3 Definitions
Not Addressed By this study.

A.4 System Description

This system is composed of instrumentation required to provide monitoring, alarm, control and interlocks to interface the LRA retrieval systems and facility process systems. The retrieval ventilation and pneumatic systems shall interface with the waste tank ventilation system to assure hazardous material confinement. The facility data network shall interface with the retrieval process and control instrumentation to provide operations personnel current status of critical parameters. The processed waste transport systems will have a physical and logical interface with the facility waste transport systems.

A.5 Submittals
Not Addressed By this study.

A.6 Quality Assurance
Not Addressed By this study.

A.7 Delivery, Storage and Handling
Not Addressed By this study.

A.8 Project/Site Conditions
Not Addressed By this study.

A.9 Sequencing and Scheduling
Not Addressed By this study.

A.10 Warranty/Guarantee
Not Addressed By this study.

A.11 Maintenance

System equipment shall be designed to permit maintenance on all major components. The system design shall incorporate modular construction to the extent possible for ease of maintenance. The design shall minimize the potential for the spread of radiation and direct exposure of workers to levels As Low As Reasonably Achievable (ALARA). The system shall provide for routine placement of a radiation shield plug in the LRA access riser between the waste tank and end effector exchange module.

PART B PRODUCTS

B.1 System Performance

The BOP systems shall include the following provisions:

B.1.1 The process systems feedwater supply design shall present a high confidence to prevent backflow. The system shall provide radiation monitoring capabilities to detect contaminated backflow.

B.1.2 The retrieval system modules shall be designed with provisions to prevent toxic or explosive gas buildup to critical levels.

B.1.3 All system valves shall be fully instrumented to include both local and remote position indication. Isolation valves shall indicate open and closed and intermediate positions. Control valves shall include percent open indication. Position interlocks shall be provided from separate position switch contacts.

B.1.4 The system shall be designed for transport between retrieval sites. The design shall incorporate containment seals in all the major equipment assemblies to confine potential contamination during transport.

B.1.5 The systems shall be designed with provisions to prevent bird nesting on the equipment towers.

B.1.6 The control and monitoring system shall be designed to provide an interface with project W-314A to allow automatic remote monitoring of critical facility waste tank instruments. The interface with W-314 shall also include provisions for video feed from the retrieval system cameras to various plant display locations.

B.1.7 The system shall be designed to include operator communications between strategic habitable module locations and the system control room.

B.1.8 The retrieval ventilation, waste conveyance and other pneumatic systems shall control the air usage to be compatible with their associated exhaust design. The pneumatic control systems shall be designed to preclude pressurizing the waste tank or any waste retrieval modules and compromising the waste confinement barrier.

B.1.9 The system design shall provide for separate exhaust system pressure control for each assembly module that may be isolated and must maintain waste confinement.

B.2 Components

The BOP systems shall include as a minimum the following set of instrumentation functions.

COMPILED MATRIX INSTRUMENTATION			
Sensor Type	Description	Monitor Level	Supplied By
R1	Area Radiation Monitoring - Material survey exterior of End Effector Exchange Module (EEEM)	M	On-Site
R2	Continuous Air Radiation Monitoring - During riser modifications	M	On-Site
R3	Area Radiation Monitoring - Site survey	M,A	On-Site
A4	Air Quality Monitoring - Toxic gas - Explosive gas	M,A I	On-Site W-340 & Vendor
WE	Live Load Monitor - Truck scales on tank farm	M,A	W-340
R2	Continuous Air Radiation Monitoring - During arm deployment in Decon and EEEM	M	W-340
R3	Area Radiation Monitoring - During arm deployment in Decon and EEEM	M	W-340
PDE-3	Tank Differential Pressure - Prevent pneumatic source from pressurizing tank	M,A,I	W-340
LD	Waste Transport Line Leak Detection	M,A,I	W-340
PDE-1	Mast to Environment Differential Pressure	M,A,I	Vendor
PDE-2	Mast to Tank Differential Pressure	M,A,I	Vendor
R2-1	Continuous Air Radiation Monitoring - Decon and EEEM areas	M,A	Vendor
PDE-4	Tank to Environment Differential Pressure - Maintain Waste Confinement	M,A,I,C	Vendor
R1-1	Area Radiation Monitor - Interior Decon/EEEM	M,A,I	Vendor
WE-1	Shield Plug Load Monitor	M,A,I	Vendor
FE-1	Mobilize Waste Feed Water Supply Flow Monitor	M	Vendor
LE-1	Retrieval Arm Hydraulic Fluid Supply Level	M,A,I	Vendor

COMPILED MATRIX INSTRUMENTATION			
Sensor Type	Description	Monitor Level	Supplied By
LD-1	Liquid Leak Detection in the EEEM	M,A,I	Vendor
VE-1	In-Tank Acoustic Monitoring	M	Vendor
LE-2	Process Receiving Tank Level	M,A,I	Vendor
WE-1	Process Receiving Tank Weight	M,A,I	Vendor
A5-1	Process Receiving Tank pH	M,A,I,C	Vendor
A2-1	Process Receiving Tank Waste Viscosity	M,A,I,C	Vendor
A3-1	Process Receiving Tank Waste Density	M,A,I,C	Vendor
TE-1	Process Receiving Tank Waste Temperature	M,A,I,C	Vendor
LD-2	Leak Detection in Process Module	M,A,I,C	Vendor
R5-1	Process Module Air Sampling (Routine Sample)	M	Vendor
FE-2	Waste Transport Line Discharge Flow	M,A,I,C	Vendor
TE-2	Waste Transport Line Discharge Temperature	M,A,I,C	Vendor
PE-1	Waste Transport Line Discharge Pressure	M,A,I,C	Vendor
A3-2	Waste Transport Line Discharge Density	M,A,I,C	Vendor
SE-1	Waste Transport Pump Speed	M,A,I,C	Vendor
WE-2	Bridge, Mast and Riser Load and Strain Monitoring (Multiple Instruments)	M,A,I	Vendor
I/L-1	Tank Exhauster Interlock (Tank Pressure Control)	I	Vendor
I/L-2	End Effector Attachment Verification	I	Vendor
I/L-3	Prevent Waste Mobilization During Slurry Transfer to Receiver Station	I	Vendor
I/L-4	Permissive from Waste Receiving System	I	Vendor
I/L-5	Material Balance with Receiver	M,A,I,C	Vendor
I/L-6	Permissive from Waste Sending System	M,A,I,C	Vendor

LEGEND:

1. The Monitor Level designators are defined as:

M = Monitor, A = Alarm, I = Interlock, and C = Control.

2. The Sensor Type designators are defined as:

A1 = Analytical Sensor - Hydrogen	R1 = Area Rad. Monitoring
A2 = Analytical Sensor - Viscosity	R2 = Continuous Air Rad. Monitoring
A3 = Analytical Sensor - Density	R3 = Survey Rad. Monitoring
A4 = Analytical Sensor - Air Quality	R4 = Process Stream Rad. Monitoring
A5 = Analytical Sensor - pH	R5 = Air Sample Rad. Monitoring
FE = Flow Monitoring	SE = Speed Monitoring
LD = Leak Detection	TE = Temperature Monitoring
LE = Level Monitoring	VE = Acoustic Monitoring
PDE = Differential Pressure Monitoring	I/L = Process Interlock
PE = Pressure Monitoring	

B.3 Source Quality Control
Not Addressed By this study.

PART C EXECUTION

C.1 Examination
Not Addressed By this study.

C.2 Preparation
Not Addressed By this study.

C.3 Installation/Application/Erection
Not Addressed By this study.

C.4 Field Quality Control
Not Addressed By this study.

C.5 Adjusting and Cleaning
Not Addressed By this study.

C.6 Protection
Not Addressed By this study.

C.7 Schedules
Not Addressed By this study.

3.1.4 Evaluation Criteria

The preparation of the specification and the bid review process should consider the evaluation criteria to be used. There are certain aspects of the procurement that must be met for the bidder to be considered. Other major areas of the procurement proposal should be weighted to determine overall rating. The following statements are presented to aid in the development of the proposal evaluation criteria that relates to the balance of plant instrumentation. Weighting for each criteria section is suggested to aid in a consistent evaluation. All the suggested points are awarded for total

compliance. Portions are awarded for partial compliance. 100 points are assigned for convenience.

3.1.4.1 Does the bidder have experience in development of instrumentation systems for use in or near radioactive and hazardous environments?

- * Do the proposed systems indicate understanding of and compliance with the required application of appropriate national electrical and instrumentation codes and standards? (Yes/No)
- * What percentage of the instrumentation is located in the radiation and hazardous areas? (10 pts.)
- * Does the system design consider the impact of maintenance activities on potential contamination spread and work in hazardous areas? (10 pts.)

3.1.4.2 How well does the proposed system show that the instrumentation needs are understood?

- * Does the proposed system meet the instrumentation requirements? (Yes/No)
- * Are the correct types of instruments being applied to meet the requirements? (20 pts.)
- * Has standard process signal conditioning and signal transmission been proposed or is all the signal processing imbedded into an overall proprietary control and monitoring system? (10 pts.)
- * Does the proposed instrumentation system allow for partial instrumentation upgrades without significant hardware and software changes? (10 pts.)

3.1.4.3 How well does the proposed system meet the requirements for reliability and availability?

- * Does the proposed design include single point failures in critical areas of the instrumentation system? (10 pts.)
- * Does the instrumentation system proposal use a modular design for ease of maintenance and repair? (10 pts.)

3.1.4.4 Does the proposed instrumentation system consider human factors?

- * Is the interface consistent with other control, monitoring and alarm parameters that will be managed by the system operator? (10 pts)
- * Are operator actions easily understood based upon the process displays and alarms? (10 pts.)

3.2 CONCLUSIONS

The use of the retrieval function matrix to determine the BOP requirements provided the listed recommendations and the responses captured in the appendices. The recommendations and appendices should be considered in preparing the system procurement specification. Considerable detail will be required from the project prior to preparing the complete instrumentation specification. It is anticipated that other related workshops will provide needed additional input.

The Action Item List of Appendix F provides some scheduled direction that must be addressed prior to the procurement specification preparation.

4.0 REFERENCES

- * WHC-SD-W340-ES-001, Project W-340 Manipulator Retrieval System Tank 241-C-106

APPENDIX A

W-340 BALANCE OF PLANT INSTRUMENTATION WORKSHOP
DEFINITIONS

- MONITOR is a measured variable for operator viewing.
- CONTROL means to adjust the process.
- INTERLOCK is a permissive to operate.

APPENDIX B

W-340 BALANCE OF PLANT INSTRUMENTATION WORKSHOP
ASSUMPTIONS

1. The W-340 system will be designed to remove the existing waste in tank C-106 as if project W-320 did not happen.
2. Dry wells will not be required to monitor for leakage during waste retrieval.
3. Liquid Observation Wells (LOW) will not be required for project W-340.
4. Project W-340 will provide its own ventilation systems.
5. Project W-340 will require leak detection, level detection and temperature control of the tank contents.
6. Decontamination solutions will be captured and routed to a holding tank. (AS)
7. The Long Reach Arm will not be required to sample waste.
8. The procurement scope will include the waste process system, including the transport pump, but excluding the transport pipeline. (AS)

NOTES:

- I. The (AS) in the appendix is defined as an action item related to the procurement specification preparation.
- II. Assumptions 6 and 8 will need to be reviewed by the project and should be part of Action Items 1 and 2.

APPENDIX C

W-340 BALANCE OF PLANT INSTRUMENTATION WORKSHOP
ISSUES AND CONCERNS

1. The system waste transport may use raw water, which will not minimize secondary waste.
2. The vendor air usage should be limited to be compatible with the exhauster design. (AS)
3. The mast assembly requires an exhauster when isolated from the tank. (AS)
4. The specification should contain the level of detail required for the manipulator control section. (Example: Joint level diagnostics) (AS)
5. The control system must be able to implement various mining strategies. (AS)
6. Consider the removal of interstitial and excess liquids from the SST during waste retrieval. (AS)
7. Excluding the process waste function from the procurement scope will complicate the interface.

NOTES:

- I. The (AS) in the appendix is defined as an action item related to the procurement specification preparation.
- II. Items 2 through 6 were determined to affect the preparation of the specification and should be considered part of Action Item 2.
- III. Item 7 must be considered and resolved prior to the preparation of the system specification. This should be performed as part of Action Item 1.
- IV. Item 1 is a plant interface concern and was presented for project review and action.

APPENDIX D

W-340 BALANCE OF PLANT INSTRUMENTATION WORKSHOP INTERFACES

1. Project W-314A provides a physical interface with the data network link and a logical interface with process data packets. The interface will include alarm reporting, monitoring and limited system control.
2. Project W-314C provides both physical and control interfaces for waste material transfers. The waste transport pipe is supplied by project W-340.
3. The vendor supplied equipment will have an interface with W-340 tank ventilation systems.

APPENDIX E

W-340 BALANCE OF PLANT INSTRUMENTATION WORKSHOP
MEMORIES

1. There will be interfaces with project W-320, W-314A and existing site conditions.
2. The project should consider including a panic button system. (AS)
3. Project W-320 is scheduled to be complete 10/96.
4. Project W-314A is scheduled to be complete by 2001.
5. Project W-340 is scheduled to be complete by 2002.
6. The project shall consider post retrieval monitoring and isolation.
(A)
7. The specification shall consider that the feedwater supply design presents a high confidence to prevent backflow and radiation detection.
(AS)
8. The mast housing containment and other equipment assemblies must be sealable for transport. (AS)
9. The system shall include a shielded plug for maintenance. (AS)
10. The specification shall include direction to prevent bird nesting on equipment towers. (AS)
11. The specification shall include provisions to prevent toxic or explosive gas build-up in the system. (AS)
12. The specification shall include directions that all valve positions will be fully instrumented. (AS)
13. The project should consider including operator communications in the specification. (AS)
14. The project should consider automatic remote monitoring for tank instruments. (AS)
15. The project should consider video feed to the plant (eg. W-314A) from system cameras. (AS)
16. The project should obtain waste transfer requirements for input to the process system. (AS)

17. The location of the system control stations needs to be coordinated with projects W-314C and W-188. The specification should include input for control flexibility. (AS)

18. If pH control (OH and NO₂) is required, then a chemical make-up module will be required. The project should consider the module as an optional feature to the specification.

19. Project W-340 personnel should be taken on a tour of the Grout facility for assessment of chemical make-up design specification, etc.

20. The volume of the system leaks must be quantified and the leaks must be recovered. (AS)

21. LIMIT sensors must be separate and distinct from PROCESS CONTROL sensors. (AS)

NOTE:

I. The (AS) in the appendix is defined as an action item related to the procurement specification preparation.

II. Item 6 directly relates to Action Item 3.

APPENDIX F

W-340 BALANCE OF PLANT WORKSHOP ACTION PLAN		
WHAT	WHO	WHEN
1. Define the process requirements that can be included in vendor scope, then incorporate those items into the procurement specification.	Dave Ramsower, Lowell Hill and Dave Bowers	1-15-1994
2. Consolidate all "AS" items from the MEMORIES, ISSUES/CONCERNS, and ASSUMPTIONS appendices, for incorporation into the procurement specification.	Dave Ramsower, Tom Schneider and Lowell Hill	1-30-1994
3. Communicate to program personnel (G. Meyers and M. Henderson) the need to define post retrieval monitoring and isolation requirements.	Tom Schneider and Lowell Hill	1-15-1994
4. Determine pH balancing requirements and add equipment provisions to the project schedule as required. NOTE: Add interface requirements to the procurement specification.	Larry McDaniels	1-15-1994
5. Coordinate a tour of the Grout Processing Plant for interested W-340 project personnel.	Larry McDaniels	TBD