STUDENT SUMMER INTERNSHIP TECHNICAL REPORT

Preventative Maintenance Procedures for Sensors along PC-5000 Condensate Transfer Line

DOE-FIU SCIENCE & TECHNOLOGY WORKFORCE DEVELOPMENT PROGRAM

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ABSTRACT

During the internship in the Hanford Site, various tasks were completed in order to support the Waste Transfer and Storage Engineering department for Washington River Protection Solutions (WRPS). These tasks consisted of generating Preventative Maintenance (PM) procedures and Engineering Change Notices (ECN's) that were crucial to the safety and continued operations of the Hanford Site. These tasks were also essential for the preparation of the next 242A-Evaporator campaign. Evaporator campaigns are conducted in order to create space within the Double Shell Tanks (DST) within the site by removing excess condensation from the waste. One of the most difficult tasks consisted of the compilation of a set of PM procedures for the sensors embedded within the PC-5000 condensate transfer line extending between the 242A-Evaporator and the Liquid Effluent Retention Facility (LERF). This task was imperative for the monitoring and diagnostic of the PC-5000 line. At the end, all of the ECN and PM were approved and would go into effect in a safe and efficient manner.

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ACRONYMS AND ABBREVIATIONS

DOE	Department of Energy
US	United States
WRPS	Washington River Protection Solutions
DST	Double-Shell tanks
SST	Single-Shell tanks
ORP	Office of River Protection
HLW	High Level Waste
LLW	Low Level Waste
WTP	Waste Treatment Plant
PM	Preventative Maintenance
LERF	Liquid Effluent Retention Facility
ECN	Engineering Change Notice
JHA	Job Hazard Analysis
ETF	Effluent Treatment Facility
PMID	Preventative Maintenance Identification

1. INTRODUCTION

The United States Department of Energy (US DOE) acquired the Hanford Site, a 586-square-mile area of shrub-steppe desert, in the year 1943. DOE used the Hanford Site to produce plutonium during World War II and the Cold War. Unfortunately, the production process of plutonium from uranium left behind solid and liquid waste that posed a risk to the local environment, including the Columbia River. Figure 1 shows the massive structure of the B Reactor Core along with its 2004 aluminum tubes for the injection of uranium bars while Figure 2 represents the B Reactor fully operational from 1944-1968 [3].

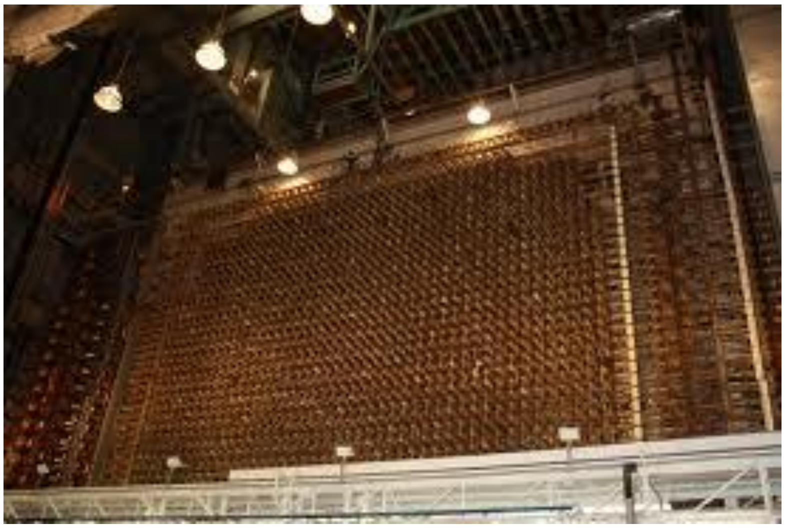

Figure 1. B Reactor core.

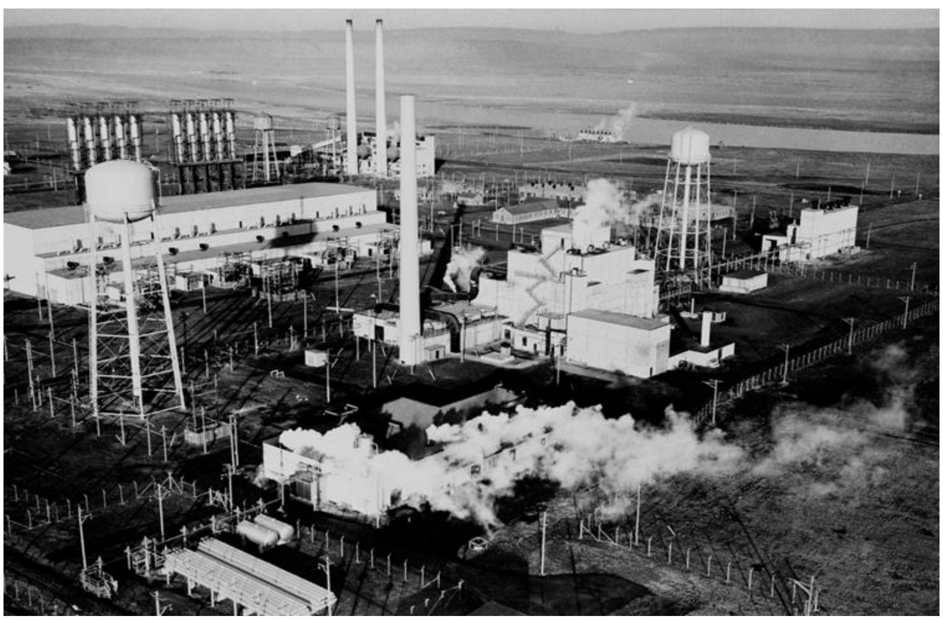

Figure 2. B Reactor operating.

Today, there is a reported 53 million gallons of radioactive waste stored in underground waste depository tanks. Throughout the years, certain tanks have been discovered to be leaking some of this stored waste. In 1989, the United States Department of Energy, Environmental Protection Agency, and Washington State Department of Ecology entered into a legally binding agreement to clean up 99.9% of the waste found in the 177 underground waste depository tanks. This agreement was called the Tri-Party Agreement [3].

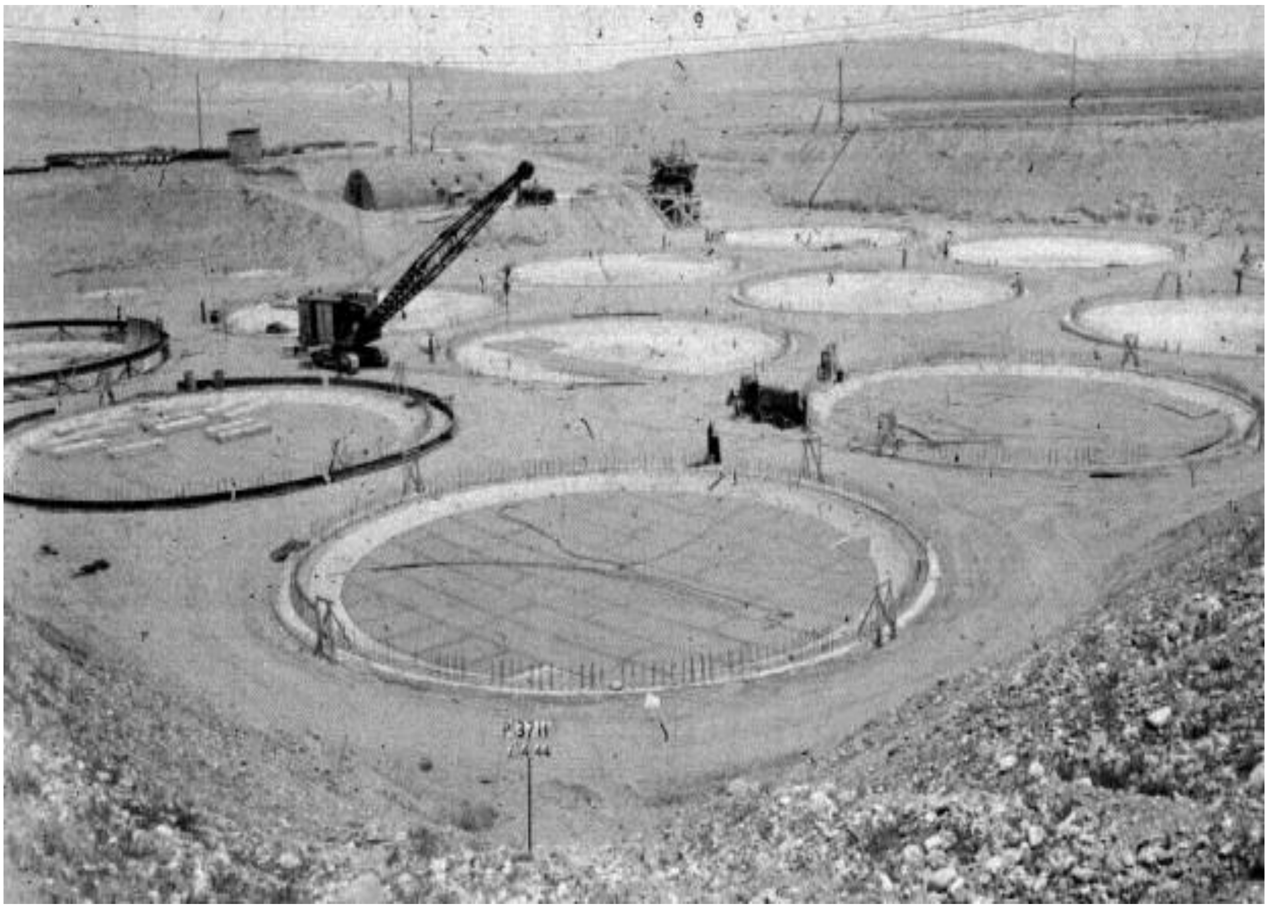

Figure 3. Tank farm under construction.

The United States Department of Energy Environmental Management Division has been charged with this task. In order to do so, a one of a kind Waste Treatment Plant (WTP) is currently under construction. Along with the primary contractor, Bechtel National Inc., the US DOE is designing and currently building the WTP. The WTP is capable of separating radioactive liquid waste into different categories of high level waste (HLW) and low level waste (LLW) for treatment and processing into stable glass forms suitable for permanent, safe disposal. The process of treating this waste into a safe glass state is known as vitrification. Even though vitrification processes have been conducted at other DOE sites such as Savannah River Site, the WTP in Hanford will be a project on a larger scale covering approximately 65 acres of the Hanford Nuclear Reservation. The WTP will be fully operational by 2019 [3].

Figure 4. Waste Treatment Plant under construction.

2. EXECUTIVE SUMMARY

This research work has been supported by the DOE-FIU Science & Technology Workforce Initiative, an innovative program developed by the US Department of Energy's Environmental Management (DOE-EM) and Florida International University's Applied Research Center (FIU-ARC). During the summer of 2013, a DOE Fellow intern, Dayron Chigin, spent 10 weeks doing a summer internship at the United States Department of Energy's Hanford Site in Richland, Washington. He worked for Washington River Protection Solutions under the supervision and guidance of Ruben Mendoza, Waste Storage and Transfer Engineering Manager, and Richard Nelson, Base Operations Engineer. The intern's project was initiated on June 08, 2013, and continued through August 17, 2013 with the objective of producing preventative maintenance (PM) procedures for the sensors along the PC-5000 condensate transfer line. This transfer line is connected to the Liquid Effluent Retention Facility (LERF) and originates from the 242A-Evaporator. Dayron supported the project by generating PM procedures that abided to the standards and regulations set by Washington River Protection Solution's document control department. In order to successfully complete this task, Dayron became knowledgeable of WRPS's document database in order to review technical drawings along with engineering change notices (ECN) in order to determine the current status and location of the sensors along the system. After drafting a proper set of procedures, the system will undergo a yearly maintenance run to ensure proper calibration for future evaporator campaigns.

3. RESEARCH DESCRIPTION

For my internship, I was assigned to the Waste Transfer and Storage Engineering group under the management of Ruben Mendoza and the guidance of Rick Nelson. Throughout the summer, I generated several ECN and PM procedure forms for several systems throughout the 200-East site. One of these included a PM procedure for the sensors embedded within the PC-5000 condensate transfer line running from the 242A-Evaporator to the LERF facility. Figure 5 shows the 242-A Evaporator while Figure 6 shows the LERF Facility.

Figure 5. 242A-Evaporator.

Figure 6. Liquid Effluent Retention Facility (LERF).

For this task, I researched several technical drawings having to do with the PC-5000 condensate transfer line along with its sensor components. I was also instructed to review the manufacturer's user manual for the sensors used along the PC-5000 line. The sensors used are called TT-MINI Probe Sensors as seen in Figure 7 below. These sensors are manufactured by TycoThermal, a California based company.

Figure 7. TycoThermal Tracetek TT-MINI Probe.

There are 6 TT-MINI probes embedded within the PC-5000 line. All six of the sensors are connected to a TTDM-128 TraceTek Leak Detection Master Module which can be equipped with an analog 4-20mA interface that can communicate the status of the selected SIM channel. The TTDM-128 adjusts its current output based on whether an alarm condition exists in the selected channel and on the location of the leak [2]. The TTDM is displayed below in Figure 8.

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Figure 8. TTDM 128 Leak Detection Master Module.

The TTDM-128 is able to locate where leaks occur along its sensors by sending out a range of currents. Below, Figure 9 provides a draft chart for the individuals conducting the PM to verify that each sensor is working properly and outputting the accurate current based on its actual location along the system.

MAINTENANCE DATA TABLE 1

Description Identifier	Normal Output Current Based on H-2-88766 Sheet 001	Current Output (mA)		Inspection	
		Tests	*Average*	*Pass*	*Fail*
LDE-A1-01 Located at JB-LDE-02	~20.16mA-22.46 mA	*Test 1:*		☐	☐
		Test 2:			
		Test 3:			
		Test 4:			
		Test 5:			
LDE-A1-02 Located at JB-LDE-04	~17.45mA –19.75 mA	*Test 1:*		☐	☐
		Test 2:			
		Test 3:			
		Test 4:			
		Test 5:			
LDE-A1-03 Located at JB-LDE-05	~14.74 mA –17.04 mA	*Test 1:*		☐	☐
		Test 2:			
		Test 3:			
		Test 4:			
		Test 5:			
LDE-A1-04 Located at JB-LDE-07	~11.85 mA –14.15 mA	*Test 1:*		☐	☐
		Test 2:			
		Test 3:			
		Test 4:			
		Test 5:			
LDE-A1-05 Located at JB-LDE-08	~9.26 mA –11.56 mA	*Test 1:*		☐	☐
		Test 2:			
		Test 3:			
		Test 4:			
		Test 5:			
LDE-A1-06 Located at JB-LDE-09	~6.45 mA –8.75 mA	*Test 1:*		☐	☐
		Test 2:			
		Test 3:			
		Test 4:			
		Test 5:			

***Notes**: (0 mA = Loss of Power) (2.0 mA = Cable Break) (3.0 mA = Cable Loop imbalance / Service Needed) (3.5 mA = Service Required Alarm) (5.05mA= System Normal)

Individual Conducting Reading	Field Supervisor
Print Name: ______________________	Print Name: ______________________
Signature: ______________________	Signature: ______________________

Figure 9. Draft Preventative Maintenance Procedure Maintenance Data Table 1.

The TTDM-128 adjusts its current loop output based on the leak detection status of the sensors. The default outputs range from 0-4mA in order to indicate fault conditions or normal operations. To avoid confusion, current outputs for each sensor location range from 5-20mA. Below is the table which provides the meaning of each current output from the TTDM-128 leak detector master control module.

Table 1. Default Current Output Values

Fault Conditions coded into the 0-4mA range:	
Output (mA)	**Description**
0	Electronics fail or loss of power
1.0	Fault – SIM communications
2.0	Fault cable break
3.0	Fault cable damage
3.5	Service Require Alarm (loop imbalance)
Normal condition and leaks:	
Output (mA)	**Description**
4.0	System Normal
5.0-20.0	Leak – value scaled to indicate locations of leak

The TTDM-128 Master Control Module is located in the LERF electrical control room as displayed in Figure 10. From here the master control module will be operated in order to provide proper current output for each sensor.

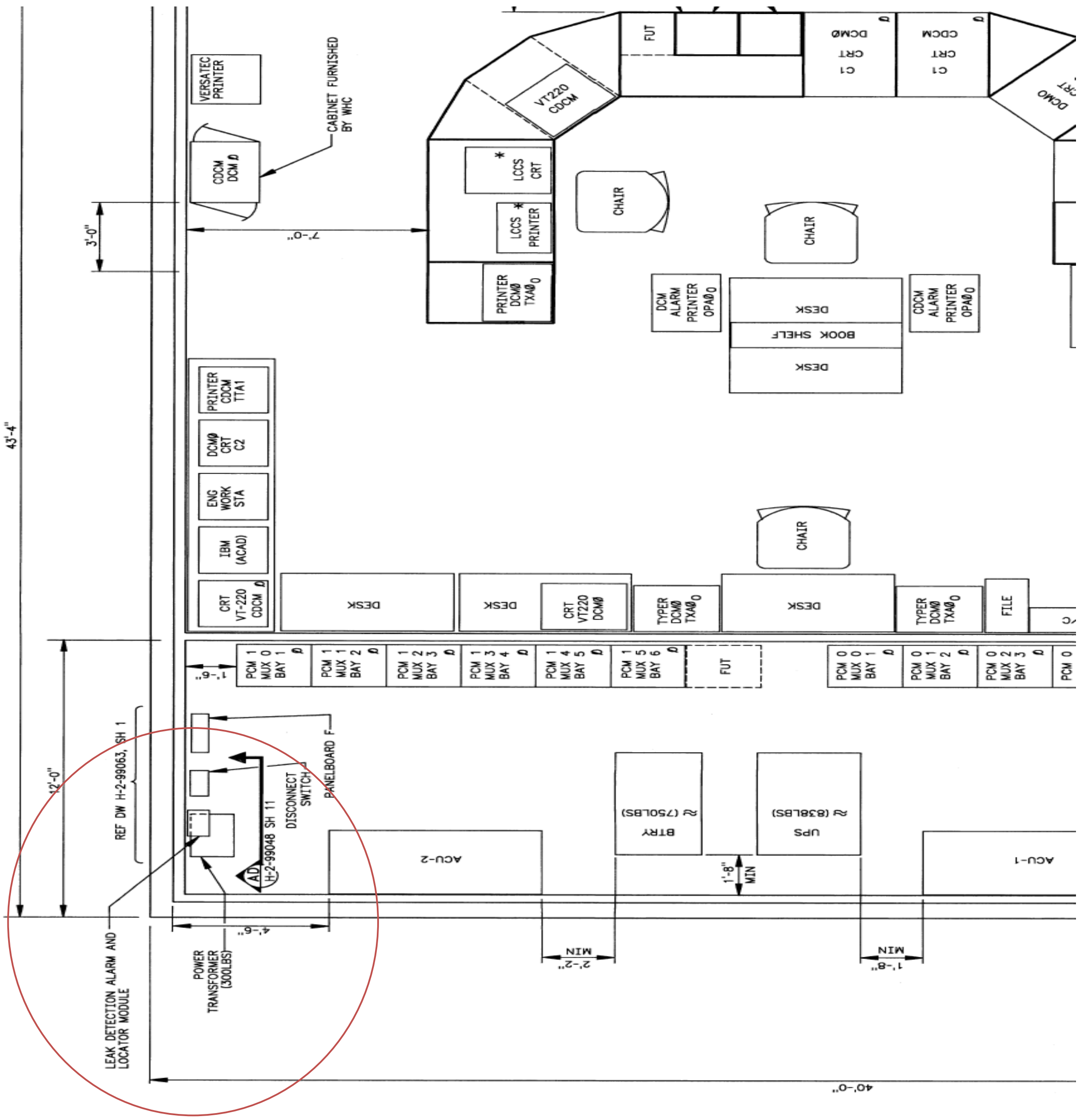

Figure 10. Location of TTDM-128 leak detection master control module.

Figure 11 below represents the plan view of the 242A-Evaporator condensate stream. Along the line, the six sensors can be seen along with their preventative maintenance identification number (PMID's).

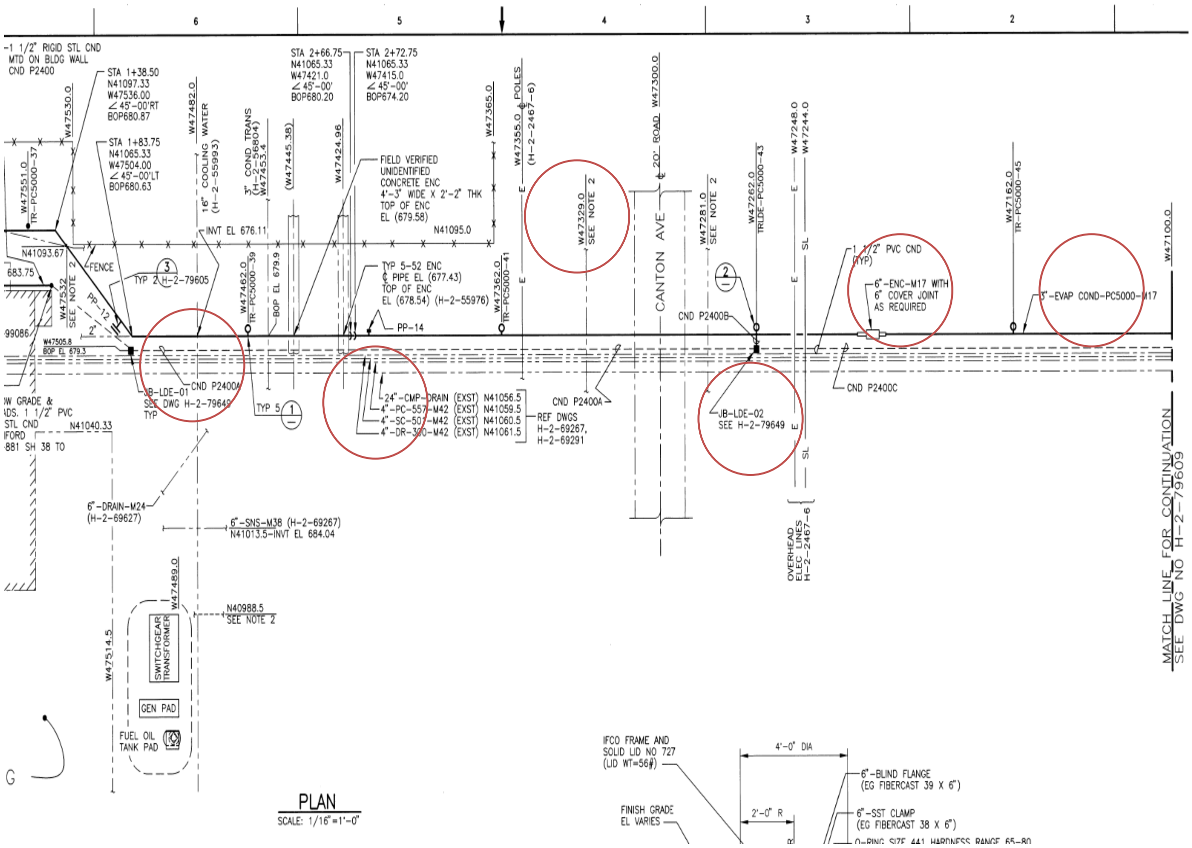

Figure 11. Piping plan view for 242A-Evaporator condensate stream.

4. RESULTS AND ANALYSIS

After the completion of extensive research to compile a PM procedure for the PC-5000 condensate transfer line, all the acquired information was submitted to a procedure specialist. This procedure specialist compiles all the information into a set of logical steps and includes the demands of other departments around the Hanford Site such as the Radiological Control Department and the Craft Department along with any demands set by the Tri-Party Agreement. After the procedures specialist compiled an adequate set of procedures, these procedures were then submitted to a Job Hazard Analysis (JHA) meeting in which all parties joined to recommend any amendments necessary to the proposed procedures. Once the procedures were approved, the team will have a walk down of the job and begin training on safety procedures.

5. CONCLUSION

The conclusion of this summer internship is the completion of a set of Preventative Maintenance Procedures to ensure proper operation of the sensors along the PC-5000 condensate transfer line between the 242A-Evaporator and the Liquid Effluent Retention Facility along with the approval and completion of all other engineering change notices. All of the changes were implemented safely and in a timely manner. The changes made to several locations within the Hanford Site were all in preparation for the upcoming 242A-Evaporator campaign. The 242-A Evaporator is critical to Hanford's cleanup mission since there are no current plans to build more underground waste storage tanks at the site, and the space within the existing double-shell tanks at Hanford is limited. By boiling off the liquids, the evaporator process creates space in the existing tanks which will be used to store waste being retrieved from the aging single-shell tanks. The evaporator sends its liquid to LERF which is capable of holding 23,000,000 gallons of material. LERF accepts and stores waste water from a number of Hanford sources. From here the waste water is then routed to the Effluent Treatment Facility (ETF) for treatment (Figure 12) [3]. All evaporator campaigns and current tasks are in preparation for the upcoming Waste Treatment Plant which will be able to treat HLW and LLW.

Figure 12. Effluent Treatment Facility (ETF).

6. REFERENCES

Hanford Site DMCS database [1]

www.tracetek.com [2]

www.hanford.gov [3]

Electrical Reference Drawings:
- H-2-99049 (Sht 1, REV 4)
- H-2-79608 (Sht 1, REV 3)