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J. D. Thomson	R2-76	X		
C. M. Towne	S2-02	X		
D. A. Turner	S7-15	X		
O. S. Wang	R2-32	X		
S. J. Washburn	R1-01	X		
J. H. Wicks, Jr.	S2-65	X		
G. R. Wilson	S7-14	X		
J. B. Witt	R3-49	X		
OSTI (2)	L8-07	X		
Central Files	L8-04	X		

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 615451

Proj. ECN

2. ECN Category (mark one)		Supplemental	[]	Change ECN	[]	Supersedure	[]
Cancel/Void	[]	Direct Revision	[X]	Temporary	[]	Discovery	[]

3. Originator's Name, Organization, MSIN, and Telephone No.
C. C. Scaief III I&C-7EA10 L7-06 376-0491

4. Date
9-13-94

5. Project Title/No./Work Order No.
N3TAA (Release Charge to N2C4P)

6. Bldg./Sys./Fac. No.
241-G

7. Impact Level
NA

8. Document Number Affected (include rev. and sheet no.)
WHC-SD-WM-WP-132, REV 3

9. Related ECN No(s).
None

10. Related PO No.
None

11a. Modification Work
[] Yes (fill out Blk. 11b)
[X] No (NA Blks. 11b, 11c, 11d)

11b. Work Package Doc. No.
NA

11c. Complete Installation Work
NA

Cog. Engineer Signature & Date

11d. Complete Restoration (Temp. ECN only)
NA

Cog. Engineer Signature & Date

12. Description of Change
The document is being revised to reflect current budget and work status to date. This document will be revised periodically.

13a. Justification (mark one)		Criteria Change	[X]	Environmental	[]	Facilitate Const.	[]
Design Error/Omission	[]	Design Improvement	[]	As-Found	[]	Const. Error/Omission	[]

13b. Justification Details
This is a planned year-end revision to reflect current work status.

14. Distribution (include name, MSIN, and no. of copies)
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1. ECN (use no. from pg. 1): 615451

15. Design Verification Required	16. Cost Impact						17. Schedule Impact (days)	
	ENGINEERING			CONSTRUCTION				
[] Yes	Additional	[]	$	Additional	[]	$	Improvement	[]
[X] No	Savings	[]	$	Savings	[]	$	Delay	[]

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	None	[X]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
None		

20. Approvals

	Signature	Date		Signature	Date
OPERATIONS AND ENGINEERING			ARCHITECT-ENGINEER		
Cog./Project Engineer	CC Scaief III C.C. Scaief III	9/13/94	PE		
Cog./Project Engr. Mgr.	CP Schroeder C P Schroeder	9/13/94	QA		
QA			Safety		
Safety			Design		
Security			Other		
Proj. Prog./Dept.					
Def. React. Div.					
Chem. Proc. Div.					
Def. Wst. Mgmt. Div.			DEPARTMENT OF ENERGY		
Adv. React. Dev. Div.					
Proj. Dept.					
Environ. Div.			ADDITIONAL		
IRM Dept.					
Facility Rep. (Ops.)					
Other					

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-WP-132, Revision 4
Document Title:	Tank Farm Instrumentation and Data Acquisition/Management Upgrade Plan
Release Date:	September 16, 1994

* * * * * * * * * * * * *

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

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SUPPORTING DOCUMENT

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5. Key Words	6. Author
Tank, Farm, Data Acquisition, Upgrade, Temperature, Level	Name: C. C. Scaief III C. C. Scaief III Signature Organization/Charge Code 7EA10/N3TAA

7. Abstract

This plan provides the strategy, implementation, and schedule for upgrading tank farm instrumentation, data acquisition and data management. The focus is on surveillance parameters to verify and maintain tank safety. The criteria do not necessarily constitute mandatory requirements but are based upon engineering judgment and best available information. Schedules reflect preliminary funding for FY95. For out years they are best engineering judgment.

9. Impact Level NA

10. RELEASE STAMP

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RECORD OF REVISION

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(2) Title
Tank Farm Instrumentation and Data Acquisition/Management Upgrade Plan

CHANGE CONTROL RECORD

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		(5) Cog. Engr.	(6) Cog. Mgr. Date
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WHC-SD-WM-WP-132 REV 4

TANK FARM INSTRUMENTATION AND DATA ACQUISITION/MANAGEMENT UPGRADE PLAN

Prepared by:

C. C. Scaief III
Instrumentation and Control

TABLE OF CONTENTS

1.0 INTRODUCTION

Hanford has a total of 177 underground waste storage tanks, of which 149 are of single-shell design. Fifty-seven of the 177 have been placed on a Watch List for safety concerns in accordance with Public Law 101-510, Section 3137, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation," (US Congress 1990). The specific tanks on the Watch List and a detailed status of all tanks are contained in WHC-EP-0182-74 (WHC 1994a). In addition, there are 11 tanks which are considered to have high heat loads (>40,000 btu/hr). The existing instrumentation in the tanks is generally in poor condition and requires upgrading in order to provide the necessary information to assess and assure their safety.

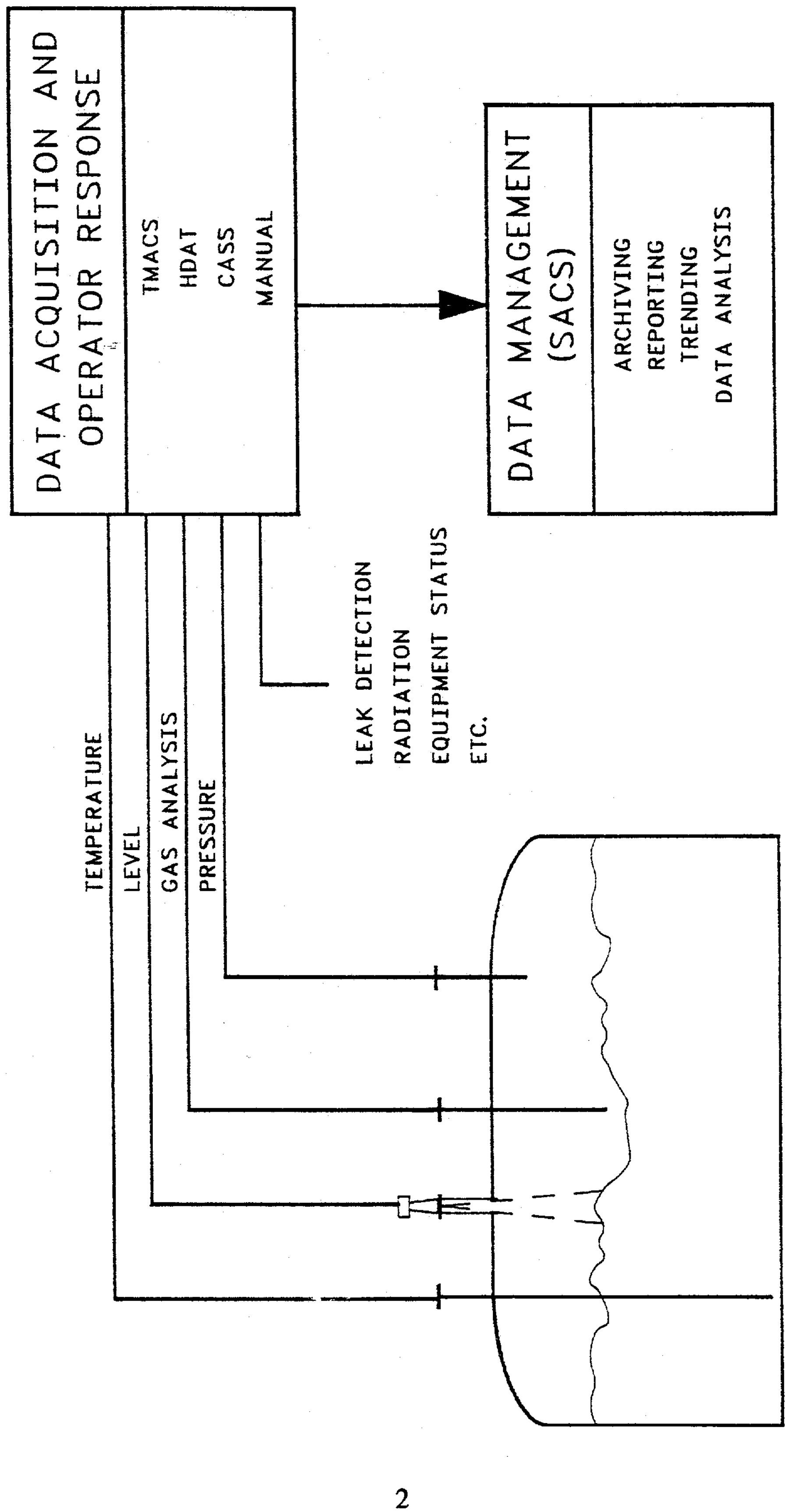
This plan provides the strategy, implementation and schedule for upgrading tank farm instrumentation, data acquisition and data management. The focus is on surveillance parameters required to verify and maintain tank safety. The work described is being accomplished over a six year period (FY91-96) and is funded by both expense and Capital Equipment Not Related to Construction (CENRTC) dollars. This plan is revised one or more times annually to reflect actual accomplishments and to adjust the scope of proposed work as the focus and available monies change. A more comprehensive plan for tank farm upgrades can be found in WHC-EP-0392 (WHC 1993a).

Instrumentation upgrades include measurement of temperature, flammable gas, tank pressure, and surface level. Improved automatic data acquisition with semi-automatic backup is being implemented for the tank farms and associated facilities. This results in a phased replacement of an existing obsolete data acquisition system. The new data acquisition system is general purpose allowing connection of other process and surveillance instrumentation. Continued implementation of an existing data management system provides a permanent data repository as well as engineering analysis capability. Criteria contained herein are based upon engineering judgement and best available information and do not necessarily constitute mandatory requirements. Activities for FY95 are based on preliminary budget submittals. For out years they represent best engineering judgement. Figure 1.0 illustrates the instrumentation upgrade process.

2.0 GENERAL UPGRADE STRATEGY

The strategy set forth in this plan provides for a systems approach to upgrading tank farm instrumentation. It includes sensors, data acquisition, and data management software. The instrumentation upgrades are prioritized on a tank basis. The priority is determined by considering the following:

- The hazard posed, i. e. Watch List tank or other safety consideration
- The condition of the existing instrumentation and data acquisition equipment
- For data acquisition, the location relative to other tanks being upgraded



TMACS - TANK MONITOR AND CONTROL SYSTEM
HDAT - HAND-HELD DATA ACQUISITION FOR TANK FARMS
CASS - COMPUTER AUTOMATED SURVEILLANCE SYSTEM
SACS - SURVEILLANCE ANALYSIS COMPUTER SYSTEM

FIGURE 1.0 UPGRADE ILLUSTRATION

As would be expected, the priority for upgrade of instrumentation for any one tank depends on the type of instrumentation. For example, the priority for receiving a level gauge on a particular tank may be very different than the priority for upgrading the temperature monitoring. As a result it is not always possible to upgrade the data acquisition and the level monitoring simultaneously. The inclusion of a tank for a particular instrument upgrade is a reflection of the tank priority based on the above parameters. As implementation progresses, it is expected that priorities will be modified as a result of not only new information on the tank status but also as a result of any work restrictions and regulatory requirements.

These instrumentation upgrades are focused on improvements in temperature sensing, gas monitoring, tank pressure monitoring, and level monitoring. The data acquisition upgrade involves expanding an existing system initially installed for monitoring of temperatures in the ferrocyanide (FeCN) tanks. In addition, improvements are being made in the manual data collection by implementing use of a portable data entry terminal. Data management is being improved by continuing the implementation of the Surveillance Analysis Computer System (SACS). This system will archive data, allow user access, and provide data analysis tools.

3.0 TANK TEMPERATURE UPGRADE

3.1 STRATEGY AND CRITERIA

Many of the existing temperature measuring devices that were installed in the waste tanks have failed or have been abandoned. The tank temperature measurement capability is being improved by reconnecting and repairing existing temperature devices when possible and by installing new sensors. Improved temperature measurement consists of installing temperature trees and multi-functional instrument trees (MIT). The MITs have provision for gas and pressure monitoring in addition to temperature. The temperature trees installed to date provide only temperature measurement, however, the design has been changed to include capability for gas or pressure monitoring. Any temperature trees installed in FY94 and beyond will include the additional capability and is referred to as the Temperature/Vapor Probe (TVP). The temperature measurement upgrade is based on the following minimum criteria:

<u>Hydrogen Watch List Tanks (~25)</u>

- At least one MIT in all DSTs and in Tank A-101 since these tanks are active or have a significant volume of waste.
- A new TVP in the remaining SSTs if the integrity of the existing sensors is in question.

<u>FeCN and Organic Watch List Tanks (~40)</u>

- At least one temperature tree with replaceable sensors.

Non Watch List Double Shell Tanks (22)

- One tree with two operable temperature sensors in the waste and one operable temperature sensor in the vapor space.

Non Watch List Single Shell High Heat Tanks (10)

- One tree with two operable temperature sensors in the waste and one operable temperature sensor in the vapor space.

All Other Single Shell Tanks (~90)

- One operable temperature sensor in the waste and one in the vapor space.

3.2 TEMPERATURE UPGRADE STATUS

During FY92 four temperature trees and one MIT were installed (Table 3.2A). During FY93 six temperature trees and one MIT were installed and the associated tanks are listed in Table 3.2B. The MIT installed in Tank 101-SY replaced the original temperature tree that was removed because of bending due to waste movement. To date, all non-leaker FeCN tanks have received new temperature trees. Table 3.2C lists temperature trees and MITs installed in FY94. This is a significant reduction from the plan at the begining of the year. The installation of trees has been delayed to ensure available risers for core sampling of the tanks. Additional TVPs and MITs will be installed in FY95 as listed in Table 3.2D. During FY95 temperature sensors in the Hydrogen SSTs will be repaired or replaced when possible. In FY 96 and beyond TVPs will be installed in Hydrogen tanks with inadequate temperature sensors. Installation of TVPs in Organic tanks will be resumed in FY96.

In addition to new temperature trees, temperature monitoring is being improved by connecting existing and new trees to the Tank Monitor and Control System (TMACS). A detailed list of these connections by tank and year is provided in the data acquisition section (6.0).

TABLE 3.2A TANK TEMPERATURE UPGRADE FY92 (5)		
Tank	Type Tree	Safety Concern
101-SY	MIT	Hydrogen
104-BY	Temperature Tree	FeCN
110-BY	Temperature Tree	FeCN
109-C	Temperature Tree	FeCN
112-C	Temperature Tree	FeCN

TABLE 3.2B TANK TEMPERATURE UPGRADE FY93 (6)		
Tank	Type Tree	Safety Concern
101-SY	MIT	Hydrogen
118-TX	Temperature Tree	FeCN/Organic
108-C	Temperature Tree	FeCN
101-BY	Temperature Tree	FeCN
111-BY	Temperature Tree	FeCN
112-BY	Temperature Tree	FeCN
106-BX	Temperature Tree	FeCN

TABLE 3.2C TANK TEMPERATURE UPGRADE FY94		
Tank	Type Tree	Safety Concern
101-AW	MIT	Hydrogen
103-SY	MIT	Hydrogen
107-BY	TVP	FeCN

TABLE 3.2D TANK TEMPERATURE UPGRADE FY95		
Tank	Type Tree	Safety Concern
A-101	MIT	Hydrogen
AN-103	MIT	Hydrogen
AN-104	MIT	Hydrogen
AN-105	MIT	Hydrogen
103-BY	TVP	FeCN
108-BY	TVP	FeCN
111-C	TVP	FeCN
107-T	TVP	FeCN
101-TY	TVP	FeCN
103-TY	TVP	FeCN
104-TY	TVP	FeCN

Most of the waste storage tanks have some in-tank temperature measurement capability, however, many of the temperature trees have been abandoned and in some cases it may not be possible to recover the connection to the sensors. In addition, many of the TC sensors have failed. When possible, repair of these existing trees and readout stations is being implemented. Most of these repairs occur during connection to TMACS.

In order to assess the need for additional temperature trees or MITs and to determine whether existing sensors are available for connection to the data acquisition system, a program of TC testing is being conducted. This testing was completed on the 24 FeCN tanks in FY91. The results of the testing are reported in WHC 1992b. The procedures and techniques developed during the FeCN testing are being used to expand the testing to other tanks. Temperature sensors in 50 tanks scheduled for connection to the data acquisition system in FY93 (see Section 6.2) were tested prior to connection. Section 3.3 discusses the testing and repair in more detail.

3.3 DISCUSSION

The new temperature trees are fabricated from existing designs with modifications as required. Modifications include changing the temperature sensor from type J to type K thermocouples. An instrument enclosure has also been added to the tree head for terminating the TCs. The enclosure contains a selector switch and connector for making local measurements with a portable thermometer. In addition, each design has some tank specific dimensional values as well as flange adaption. A decision has been made to change from type K thermocouples to resistance temperature detectors (RTD) in future trees. This decision is based on an engineering study that reported better accuracy and sensor lifetimes for RTDs. The TVP installed in BY-107 (Table 3.2C above) has RTDs rather than thermocouples.

The MIT was designed and constructed by Los Alamos National Laboratory (LANL). The design is for installation primarily into 4 inch risers with the capability to be adapted to 12 inch risers. The MIT can contain up to 24 thermocouples spaced vertically along the tree (dependent on the liquid and sludge level within a waste tank) and includes the capability to sample gas from three locations above the waste and to determine the differential pressure between the tank and atmosphere. In addition the MIT has provision for inserting a validation probe down the center of the assembly to verify the temperature at any elevation. The MIT design requirements are specified in WHC-SD-WM-RD-014 (WHC 1991a) which provided the requirements for the design and fabrication effort performed by LANL.

Testing of the TCs in FeCN tanks was completed and results have been reported (WHC 1992b). The thermocouple testing uses an existing test plan and procedure for the work. This requires technicians to enter the various farms, locate the existing temperature trees, inspect, photograph, and test. The testing requires measurements of thermocouple lead resistance as well as output voltage and equivalent temperature. Results are then analyzed and a written report is issued. The testing is scheduled to coincide with the expansion of the TMACS, since the results are required to perform the TMACS installation design.

The repair of thermocouple trees to date has not involved replacement of the TC sensor and can be categorized into three techniques. The first is simply the recovery of abandoned trees. In some cases the wires have been disconnected from the local selector switch or from the central readout station. Secondly, some local selector switches have failed or wires have broken in the termination box. A third method of repair consists of using the iron pipe of the probe as a replacement for failed positive (iron) TC wires. This is possible because the TC junctions are welded to a common iron pipe. Tests have determined that the iron pipe is an adequate substitute for the iron TC wire.

4.0 TANK LEVEL MEASUREMENT UPGRADE

4.1 STRATEGY AND CRITERIA

Waste tanks have level monitoring criteria which are established specifically for each tank. The criteria consist in general of both decrease and increase of level and a required minimum monitoring frequency. Tanks which have had all of the pumpable liquid removed do not have a level decrease criterion, but have an increase criterion to detect liquid intrusion.

These criteria were established primarily as a basis for leak detection. Level monitoring is also used as an operational tool in active (double shell) tanks. New criteria are needed that address operational as well as surveillance requirements. In addition, the level monitoring surveillance criteria need to be reassessed for single shell tanks, especially for stabilized tanks where no liquid supernate exists.

A task team was formed and worked on solutions to tank waste level measurement problems (WHC 1993c). This included establishing level monitoring requirements and a complete examination of technologies that are viable. Many different types of level gauges were purchased, tested and one was selected (Enraf-Nonius 854 ATG) for installation. A more detailed discussion of this activity is contained in Section 4.3 below. The current strategy for upgrade of level monitoring is as follows:

<u>Stabilized and non-stabilized single shell tanks with surface liquid</u>

- Install a new level monitoring device and connect to TMACS.

<u>Stabilized and non-stabilized single shell tanks without surface liquid</u>

- Install a liquid intrusion device
- Install Liquid Observation Wells (LOW) for determination of interstitial liquid level.

<u>Hydrogen Watch List Tanks (DST and SST)</u>

- Install a new level monitoring device and connect to TMACS.

Double Shell Tanks

- Install a new level monitoring device and connect to TMACS.

4.2 LEVEL UPGRADE STATUS

An Enraf-Nonius radar level gauge was installed on Tank SY-101 in FY91. Discrepancies in tank level between the radar gauge and the conductivity gauge in Tank SY-101 have raised questions about the applicability of the radar gauge. As a result there are no present plans for additional installations of radar gauges.

In FY93 the Enraf-Nonius 854 ATG level gauge (see 4.3 below) was scheduled for installation on Tank S-107 for field testing. This was delayed when work stopped due to the tank farm "administrative hold" order and was completed in FY94 (March). In FY94 20 (including S-107) new 854 ATG level gauges were installed as listed in Table 4.2. In FY95, an additional 64 level gauges will be installed to include the remaining 16 Hydrogen tanks as well as 48 SST and DST selected on a priority bassis. The list of actual tanks to be connected is still being finalized. In FY96 and beyond, additional gauges will be installed on any remaining tanks with surface liquid.

TABLE 4.2 TANK LEVEL UPGRADE FY94

Tank	Safety Concern	Tank	Safety Concern
SY-101	Hydrogen	S-106	None
SY-102	None	S-107	None
SY-103	Hydrogen	S-111	Hydrogen
AW-101	Hydrogen	SX-106	Hydrogen/Organic
AZ-101	None	T-107	FeCN
BX-106	FeCN	U-103	Hydrogen
BX-107	None	U-105	Hydrogen
C-103	Organic	U-106	Organic
C-106	High Heat	U-107	Hydrogen/Organic
S-103	None	U-109	Hydrogen

4.3 DISCUSSION

The tank level monitoring instrument has trditionally been a reel type conductivity gauge. It also has a lengthening history of maintenance problems. The gauge uses a probe that lowers down to contact the surface. When contact is detected the reading is the height of the probe from the tank bottom. On a frequency of once per minute, the gauge automatically raises until contact is broken and then lowers again until conductivity is reestablished. Because the probe contacts the surface, the salt solution of most of the tanks causes crystal growth that interferes with the ability of the probe to detect the change in conductivity that marks the surface. The raise and lower action causes mechanical wear that results in a repair and upkeep problem. In addition, the gauge requires a constant instrument air purge to prevent moisture from interfering with the conductivity sensing. In many of the single-shell tank farms this is the only use of instrument air and air system maintenance is also expensive.

To solve these problems and prevent similar problems in the future, the use of radar level technology was investigated in Tank SY-101. The readings from the radar gauge vary with movement of material on the surface due to changes in surface height and reflectivity. Discrepancies between the gauge and the conductivity level gauge occurred. The discrepancies were greatest during periods of surface upheaval (episodic gas release). Additional testing was performed in the laboratory to include three different manufacturers. The testing determined that none of the units is suitable for our application. As a result, additional installations of radar gauges are not planned.

A task team was formed to investigate the waste tank level monitoring needs and determine applicable level monitoring instrumentation. The goal of the team was to determine suitable level monitoring devices for the tanks. Level measuring technologies which have been examined are radar, conductivity, buoyancy/tension wire, and optical/laser. A number of level devices were procured and tested by PNL. The buoyancy/tension wire gauge (Enraf-Nonius 854 ATG) is considered the best option presently available based on the testing. It will operate on non-conductive liquids or solids and requires no air purge. The build up of salt precipitates on the buoyancy float is minimal and the effect of precipitates on the measured level is also minimal. A final report which summarizes the preliminary evaluations as well as final in-tank testing of the 854 ATG has been written (WHC 1994b).

The installation design includes ports for connection of a differential pressure transmitter for sensing of tank vapor space pressure. This eliminates the need for a separate riser for pressure monitoring.

4.4 LIQUID OBSERVATION WELL INSTALLATIONS

In FY94 three tanks (S-104, B-110, and B-111) received new LOWs. Table 4.4 lists the tanks to receive LOWs in FY95.

TABLE 4.4 LOW INSTALLATIONS FOR FY95			
Tank	Safety Concern	Tank	Safety Concern
B-101	None	SX-109	Hydrogen/HH
B-107	None	SX-111	HH
BX-110	None	SX-114	HH
BY-108	FeCN	TX-105	Organic
C-102	None	TX-116	None
SX-104	Hydrogen	U-110	None

5.0 VAPOR MONITORING

5.1 FLAMMABLE GAS UPGRADE STATUS

A Standard Hydrogen Monitoring System (SHMS) is being installed on selected tanks with a potential for hydrogen gas generation. In FY92 two SHMSs were installed on Tank SY-101. In FY93 the SHMS was installed on SY-103, however, final connection of the sample ports was not completed until FY94. Problems encountered with the solid state detectors during operation of the SHMS at SY-101 has led to a redesign of the detector stream (see 5.2 below). In FY93 six additional monitor systems, for use on potential hydrogen generating tanks, were procured and fabrication to the new design by Kaiser Engineers Hanford (KEH) was begun. To date (FY94) KEH has completed fabrication of 12 systems. In FY94 hydrogen monitoring systems were installed on Tanks AN-103, -104, -105, and AW-101. The monitors will also be connected to TMACS. In FY95 the remaining flammable gas Watch List tanks (all single shell) will receive SHMSs.

In addition to flammable vapors, detection and characterization of other hazardous vapors will be accomplished using a mobile laboratory (WHC 1993b). Also equipment for continuous monitoring of ammonia has been installed on the primary ventilation exhaust for SY Farm. Plans are to install a monitor on AN and AW Farm primary ventilation exhaust in FY95. The monitor in SY is connected to the SY Farm Data Acquisition and Control System (DACS). The AN and AW monitors will have an analog output and will be connected to TMACS.

5.2 FLAMMABLE GAS DISCUSSION

The SHMS is designed to monitor specifically for hydrogen in the waste tank atmosphere which may also contain (but not limited to) unknown quantities of air, nitrous oxide (N_2O), ammonia (NH_3), water vapor, carbon dioxide (CO_2), carbon monoxide (CO) and other gaseous constituents.

The system consists of hydrogen specific monitors, a grab sampler to identify other gaseous constituents, and the gas sampling system (tubing, valving, vacuum pumps etc.) necessary to support the operation of the instrumentation. The system is located in an environmentally controlled cabinet for placement local to the tank.

The system installed at Tanks SY-101 and -103 used an electrochemical cell for higher concentrations and two solid state sensors for both a low range and a redundant high range. Problems of drift and sensitivity to other trace gases has led to the abandonment of the solid state detectors and a new design employs only electrochemical cells. It was determined that the cell could be operated successfully at a lower range. The SHMS installed on SY-103 was retrofitted during FY94 to the new design.

In the current design the sample stream is divided into two loops - the main flow loop, and the grab sampling loop. The main loop contains two hydrogen monitors employing an electrochemical cell that measures concentration of hydrogen with nominal ranges of 10 to 2,000 ppm and 0.2 to 5.0 % by volume. The main loop is intended to be operated continuously except for periods of calibration or maintenance. Calibration is performed using standard certified gas concentrations near the instrument minimum and full scale ranges. The grab sample loop provides a method for collecting gas samples in cylinders for lab analysis of other gaseous constituents besides hydrogen, without interrupting the normal system operation.

All of the monitors have 4-20 ma output signals for remote monitoring. Local indication and strip chart recording are provided for operator interface and trending. In addition, other parameters such as sample flow rate and sample gas, calibration gas, and cabinet temperatures are monitored and alarm annunciation is provided for out of range values.

5.3 GENERIC STACK EFFLUENT MONITOR

On December 15, 1989, a new regulation, denoted as NESHAP (40 CFR 61, Sub-part H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities"), came into effect. This regulation dictates the design of the radionuclide sample collection and measurement systems and measuring methods if the potential emission levels from that particular emission point could cause an off-site dose above specified levels.

Shortly thereafter, DOE/WHC undertook a two year task to determine which emission points exceeded the specified levels. The AP Tank Farm Primary Stack and the 242-A Evaporator Stack were initially determined to exceed the specified levels and were thus classified as regulated by NESHAP, meaning that the sampling system must comply with the regulatory design criteria.

The current stack monitors used on the Hanford Site are not in compliance with the new regulations. A task has been initiated to design a new Generic Stack Monitor system which would meet all the current/near-future regulatory requirements. In addition to design, the project will establish the necessary documentation required in order to verify compliance. This monitoring system will initially be utilized on the regulated stacks in the tank farms and will ultimately be utilized as required throughout the site.

The Engineering Task Plan and Functional Requirements Document were completed in FY94. The current schedule requires completion of the Conceptual Design and Detailed Design in FY 95; and total system completion by December of 1996 (installed and operational on the AP Farm main stack). The December 1996 milestone is driven by the Federal Facilities Compliance Agreement (FFCA) recently submitted by WHC to the EPA.

6.0 AUTOMATIC DATA ACQUISITION

6.1 STRATEGY AND CRITERIA

The Tank Monitor and Control System (TMACS) was installed in FY91 to monitor temperature in tanks containing FeCN. In FY93 the software was upgraded to allow future expansion to include monitoring of all tank farm parameters. This upgrade consisted of replacing the monitoring computers and associated software (see Section 8.0 below). During FY93 connection of parameters other than temperature began in AN and SY Farms. In addition, the expansion included all tanks within a farm rather than selected tanks. This ensures that hardware is strategically placed to allow the future connection of other tank farm parameters. The strategy is to migrate sensors presently being monitored by the Computer Automated Surveillance System (CASS) to TMACS over a period of years. This will allow the retirement of the CASS which is old and difficult to maintain (see Section 6.4 below). During FY 94 a software driver to connect some alarm annunciators to TMACS was developed and tested. During FY95 the annunciators at A and C Farms will be connected. Some tank farm water meters (raw water usage) will also be moved from CASS to TMACS.

6.2 UPGRADE STATUS

Five tanks were connected in FY91 and an additional 9 tanks were connected in FY92. All of the 14 are FeCN tanks. In FY93 54 tanks were scheduled for connection. This included four tanks with no temperature sensors, however, the TMACS will be available for connection of instrumentation at these tanks and they are therefore counted. The field installations for these tanks was nearing completion when an "administrative hold" order was issued by Tank Waste Remediation System (TWRS) management. This order remained in effect until safety investigations and safety training of personnel was completed. As a result, completion of this work was delayed until FY94. Table 6.2A lists the 14 tanks connected in FY 91/92. Table 6.2B lists 54 tanks connectioned in FY93/94. In FY 95 tanks in A, AW, AX, S, SX, and U Farms are planned for connection. This is a total of 59 tanks as listed in Table 6.2C.

TABLE 6.2A TANKS CONNECTED TO TMACS IN FY91/92 (14 TANKS)			
Tank	Safety Concern	Tank	Safety Concern
101-BY*		111-BY	FeCN
103-BY	FeCN	112-BY	FeCN
104-BY*	FeCN		
105-BY*	FeCN	118-TX*	FeCN
106-BY	FeCN		
107-BY	FeCN	101-TY	FeCN
108-BY	FeCN	103-TY	FeCN
110-BY*	FeCN	104-TY	FeCN

* Tanks with two TC Trees.

6.3 DISCUSSION

The TMACS utilizes remote input/output (I/O) processors located at each tank of interest. The I/O processors accept industry standard analog or digital inputs and outputs. They share a common communication cable which allows additional units to be added as required. This shared cable is routed to all tanks as well as to an instrument building adjacent to the tank farm.

At the instrument building the signal is coupled via telephone modem to a central monitoring facility which has an operator on duty around the clock. The central facility has a computer based monitoring system with CRT operator interfaces for data collection, alarm management, and reporting (see Section 8.0 below).

Generic designs now exist for the terminal boxes which house the I/O signal conditioners and the mounting supports for placement at the tank. However, tank specific installation design is required for each tank and farm. This includes placement of the terminal boxes, routing of power wire, communications cable, and I/O signal cable as well as wiring and termination diagrams for all connections. For each new farm the installation of the telephone modems and associated interfaces must be specified.

The communication cable as well as power wiring for the remote I/O processors must be installed in buried conduit within the tank farm. In addition, all wiring from the sensors to the processors must also be contained in buried conduit. Because of existing buried services contained within the tank farms, all excavation must be done by hand. In addition, some farms have areas of contaminated soil which makes excavating very expensive or even prohibitive. Because of the expense involved, alternatives to new buried conduit have been investigated.

Some of the tank farms have existing cable for both power and signal which may have been abandoned or have spare capacity. If these cables can be utilized, new buried conduit from the instrument building to the tank area could be avoided. Conduit from the sensors to the I/O processor would, in general, still be required. During the connection of tanks in TX and TY

Farms to the data acquisition system, existing conduit and in some cases existing cable were utilized. In addition, 115 VAC power was available local to the tanks. It is expected that many other farms have available power, conduit, and cable. These existing cables will be investigated and used as appropriate during the TMACS expansion.

TABLE 6.2B TANKS CONNECTED TO TMACS IN FY93/94 (54)

Tank	Safety Concern	Tank	Safety Concern
101-AN		109-C	FeCN
102-AN		110-C	
103-AN	Hydrogen	111-C	FeCN
104-AN	Hydrogen	112-C	FeCN
105-AN	Hydrogen	201-C	
106-AN		202-C	
107-AN		203-C	
		204-C*	
101-BX			
102-BX	FeCN	101-SY	Hydrogen
103-BX		102-SY	
104-BX*		103-SY	Hydrogen
105-BX			
106-BX	FeCN	101-T	
107-BX		102-T	
108-BX		103-T	
109-BX		104-T*	
110-BX		105-T*	
111-BX		106-T	
112-BX		107-T	FeCN
		108-T	
101-C		109-T	
102-C		110-T	Hydrogen
103-C		111-T	Organic
104-C		112-T	
105-C	High Heat (>40k BTU/hr)	201-T	
106-C	High Heat (Watch List)	202-T	
107-C		203-T	
108-C	FeCN	204-T	

* These tanks have no temperature sensors, however, the TMACS field I/O processors will be available for connection of other parameters.

TABLE 6.2C TANKS PLANNED FOR CONNECTION TO TMACS IN FY95			
Tank Farm	Safety Concern	Tank Farm	Safety Concern
A (6 Tks)	High Heat (2) Hydrogen (1) None (3)	S/SX (27 Tks)*	Hydrogen (10) Organics (2) High Heat (7) None (11)
AX (4 Tks)	Hydrogen (2) None (2)	U (16 Tks)*	Hydrogen (5) Organics (3) None (9)
AW (6 Tks)	Hydrogen (1) None (5)		

* Some tanks have more than one safety concern.

In addition to existing cables, the use of radio frequency (RF) transmission has been evaluated as an alternative to installing new conduit. The feasibility of this approach at any specific location is predicated on the availability of electrical power in the tank area. The use of RF could eliminate some of the cable required from the instrument building to the tank area.

This alternative was examined and included the purchase and testing of RF modems. Formal testing was completed and results indicate that an RF modem technology called "spread spectrum" can be utilized successfully for this application. This technology is low power and has limited transmission distance, however, it appears ideal for the short distances required from the tanks to the farm perimeter. From the farm perimeter to the central facility land lines (telephone) are available. These modems are relatively inexpensive and require no FCC licensing. The tests indicate a very high data integrity and good throughput for these short distance applications. The first use of one of these RF modems was designed in FY93 for installation in early FY94. The installation was to allow the connection of a new tank level gauge to TMACS in S Farm via the RF link. Due to the "administrative hold" the installation was delayed and subsequently cancelled since S Farm will be connected to TMACS in FY95.

6.4 CASS REPLACEMENT

The CASS is a tank farm data acquisition system which was installed in 1978. It consists of six remote (at the tank farms) data monitoring computers that monitor thermocouples, alarms, farm raw water usage, and tank level. These remote computers communicate with a Central Surveillance Computer (CSC) located in Building 2750E in 200E area. Although the CSC has been upgraded, the remote computers and field hardware have not been changed since the initial installation except for addition of monitored points.

CASS was developed with custom field interface hardware as well as custom software at both the remote computers and at the CSC. This has resulted in a system that is now inflexible to change and expansion. Most of the field hardware for monitoring TCs is inoperable and spare parts cannot be obtained.

At the CSC, the operator interface has no graphics capability and consists of an ASCII CRT terminal. The terminal provides messages to the operator regarding alarm status on occurrence. In general, status information can be obtained by entering commands from the keyboard. Hard copy is provided for all information. This operator interface is very poor by current standards. It requires the operator to rely on memory and/or piece together hard copy textual information to create the current status of the tank farm facility. New information must continually be processed mentally to maintain this picture. This is too much to ask of an operator for any but a very simple facility.

The new TMACS software (Section 8.0) provides an excellent operator interface for presentation of tank farm status. The use of high resolution graphics allows information to be presented on a high level with a hierarchy of displays that move from the general to the specific. Alarms are displayed graphically (by facility or equipment) and summarized textually in chronological order. Real time and historical trending are available to the operator for any parameter on request. The displays are dynamically updated whenever equipment or measured parameter status changes. This collection of features can continually provide the operator with a total picture of tank farm and facility status.

The TMACS software upgrade has resulted in a system capable of replacing the CASS. The commercial field hardware being installed to upgrade the temperature monitoring has the capability to monitor all CASS parameters. The remote terminal units (RTU) are easy to configure for expansion of points. The software changes necessary to add new RTUs are minimal compared to what is presently required with CASS. In addition, the upgraded TMACS software can accommodate RTUs from different manufacturers. This is accomplished by providing a software communications driver specific to the RTU. This prevents total dependence on a specific technology or manufacturer.

In addition to the upgrades discussed in this plan, replacement of the CASS with TMACS is an additional strategy for overall improvement of tank farm data acquisition. New instrumentation will be connected to TMACS as proposed and instrumentation will be migrated from CASS to TMACS as funding allows. This will be accomplished on a phased basis over several years. Subsequent revisions of this plan will propose specific strategies for implementing this transfer.

7.0 HANDHELD DATA ACQUISITION FOR TANK FARMS

7.1 JUSTIFICATION AND OBJECTIVES

The drivers for the Handheld Data Acquisition for Tankfarms (HDAT) work include numerous audits, both internal and external, plus various tank farm incidences that indicate the accuracy, quality and integrity of the data collected from instrumentation by Nuclear Process Operators (NPO) does not meet the needs to assure the safe storage mission. A central assumption is the manual (datasheet) methods of instrument data collection by NPOs results in substantial errors by misreading, transcription, wrong location/instrument, and misinterpretation of readings or complex procedures. Much of this will be eliminated by the automatic instrument data collection systems such as TMACS. However, the expectation is that NPOs will still proceed on regular rounds, observing system operations, performing operational duties to prescribed procedures. They will still record instrumentation and equipment operational readings to determine status, verify TMACS collected values, collect additional data points that are not cost effective to automate, and provide backup during automation system preventative or remedial maintenance. A handheld computer "assistant" for the NPO eliminates many errors and substantially improves conduct of operations by assuring rounds and collection schedules are met, collecting and forwarding instrumentation/equipment readings, providing real-time verification/validation of the readings, and ensuring procedure compliance and availability on their rounds in the field.

The objective of the Handheld Data Acquisition for Tankfarms (HDAT) project is to improve the quality and integrity of the instrumentation and equipment readings collected by NPOs in the tank farms, and to provide a backup and verification for continuous automated collections systems such as TMACS. A secondary objective is to improve efficiency and cost effectiveness in the operations and tank surveillance areas. To fully meet these objectives, the system addresses far more than scratchpad collection and transfer of instrument readings. It begins by providing authorized and up-to-date procedures for the rounds performed by the NPO in easily carried format. It provides a system for systematic scheduling of activities by supervision, ensures procedures are carried out, with a easily used mechanism for operations supervision to verify the results. During field data collection, it captures the value entries electronically, verifies/validates the values against historical trends and published limits, provides NPOs with specific actions on deviations, and provides error detecting/correcting transfers directly into TWRS data management system(s). When complete, the system will support all normal rounds in all tank farms.

7.2 IMPLEMENTATION STRATEGY

The HDAT system is a multi-year, expense funded development. Equipment is primarily office ADP equipment and low value (<5K) handheld computers. A demonstration pilot program was implemented in FY '92 and FY '93. Full implementation is occurring in FY '94-'97.

HDAT was initially piloted in the S and SX tank farms, collecting only tank temperatures. The pilot was extended to A, AX and U farms for FY '93. Results from the pilot evaluation indicated two critical changes were necessary. First, it was not practical to only partially automate the data collection in a work assignment area (farm or group of farms.) Requiring NPOs to carry both paper forms and the handheld computer was not practical. If the handheld computer could not support all regular rounds and data collection duties, it would not be successful. Second, it was found that the limited screen and computer memory of the integrated barcode scanner/computer could not support the diversity and quantity of work procedures and requirements desired by operations personnel.

To accommodate the pilot project results, the program is being redesigned using the latest technology - industrial versions of handheld pen-based computers. With high performance processors and high capacity disk drives, these recently available units will support full procedural availability to the NPO, and eliminate all paper forms in the field for normal duties. This change does not modify the overall scope or deliverables of the program, its schedule or cost.

In FY '94, the HDAT project will have developed the basic system architecture, design and implemented the system for the T and TX farms. In FY '95, the basic architecture will be enhanced with additional features, and tank farms C, S, SX, SY and TY will be added. In FY '96, additional features to support B, BX, BY and U farms will be added. In FY '97, the remaining tank farms of A, AN, AP, AW, AY, AX and AZ are added, completing the project. No additional development/engineering funding requirements beyond FY '97 are anticipated, although the hardware is expected to support addition of maintenance activities if funded through other programs.

Table 7.2 displays the major deliverables/milestones for HDAT.

Table 7.2 HDAT Deliverables

MS ID	Deliverable/Milestone Description	Date Complete
1	HDAT Implemented in T and TX Farms (all routines)	9/30/94
2	HDAT Implemented in C, S, SX, SY, TY Farms (all routines)	9/30/95
3	HDAT Implemented in B, BX, BY, U Farms (all routines)	9/30/96
4	HDAT Implemented in A, AN, AP, AW, AX, AY, AZ Farms (all routines)	9/30/97

7.3 UPGRADE STATUS

At this writing, the implementation for T and TX tank farms, scheduled for completion in FY'94, is nearing completion. Operational startup is scheduled for late FY94/early FY95. During FY '92-93, a pilot program was completed in S, SX, A, AX and U tank farms. The pilot project only provided for tank temperatures, and did not support complete procedure recall.

7.4 DISCUSSION

Traditional facility operation data collection requires an Operator to make rounds, read instruments, and write the information on data sheets. This manual process has always resulted in an inherent level of erroneous information. This is due to the nature of the process, wherein the opportunity for errors exists. The Operator may read the wrong instrument, be in the wrong location (e.g., wrong tank), or may misread the correct instrument (usually via an order-of-magnitude or digit transposition). In addition, the transcription of the information onto the data sheet provides an avenue for error. The information can be entered into the wrong place on the data sheet (which has the same effect as reading the wrong instrument or location).

When the data collection is completed, the data are typically transcribed (typed) into a computer database from the data sheet. Here, the data are subjected to another set of risks; including misreading (sometimes due to unreadable writing), transposition, mistyping, etc. These errors are generally detected and sometimes are correctable by statistically reviewing the data, usually by computer. However, trying to detect and correct data, at times several days later, is costly, time consuming, and may still result in an unacceptable level of data error. Many times, Operators are asked to perform a recheck to confirm data quality, defeating the As Low As Reasonably Achievable (ALARA) exposure program in the process. Placing quality control in the hands of the field Operator during the actual data collection is the preferred method to avoid and correct the majority of these errors and associated problems.

With the HDAT system, manual data collection has been improved. An Operator no longer transcribes data onto a data sheet, but inputs information into a Data Collection Unit (DCU) a pen-based personal computer that provides history data, performs criteria checks during the time of data collection, and provides on-screen viewing of actual tank farm operational procedures. With the DCU, the Operator becomes the primary point of surveillance and is provided a tool for quality control and task specific information . Directly in the tank farms and at the time of data collection. Any potential data anomalies and DCU instructions for responding to them, are brought to the attention of the Operator via the DCU which reduces the time to perform rechecks.

When an Operator finishes data collection, the DCU is placed into a communications cradle located in the 200W Shift Office. The cradle is connected to the Personal Computer (PC) in the Shift Office. The cradle permits downloading of the data to the PC. The shift manager may now review data anomalies and/or safety alerts at their office and approve the data for distribution. The PC may then send the data to other databases and authorized users (e.g., SACS) via the existing Hanford Local Area Network (HLAN). A printed data report of collection activities may also be generated by Operations. This entire process improves and maintains data integrity during data transfers and eliminates the data transcription from data sheets and error potential.

8.0 TMACS SOFTWARE UPGRADE

8.1 STRATEGY AND ACTION PLAN

TMACS will continue to be developed as the primary, electronic tank farm data acquisition and monitoring system. The TMACS Software Upgrade project addresses the software application portion of TMACS, which is responsible for collecting data from the I/O processors in the field and making those data available to the tank farm operators and the SACS.

The first implementation of TMACS, in 1991, was designed to monitor only a limited number of tanks. Its success made it the selection for expanding automatic data collection to other tank farms. Although the I/O processors in TMACS could be scaled for this new role, the application package used for the data collection and monitoring in TMACS was insufficient. The original DOS-based application had several limitations that did not make it conducive to expanding TMACS from 14 tanks to possibly all 177 tanks.

In FY92 a new version of the TMACS software was developed by configuring a commercial, real-time, expert system, software package to the specific needs of the project. This software was tested and accepted, however, it was not placed into operational use pending completion of operator training. The new, UNIX-based, TMACS software has the capability to process several thousand sensors, over multiple communication lines, and can serve more than one type of I/O processor. In addition, it can more efficiently log sensor readings and pass them on to the SACS.

In FY93, the TMACS Software Upgrade project was put into production following completion of operator training and procedural updates. The TMACS Central Facility system was then evaluated to determine whether it was capable of performing the functions necessary to replace the existing Computer Automated Surveillance System (CASS) functions. Functional requirements were gathered for processing the types of sensors used on CASS, feasibility was demonstrated, and a Phase I CASS Replacement plan was partially implemented. This plan included TMACS processing of several sensor types in the SY farm, plus processing of alarms previously connected to CASS through the Panalarm Series 90 alarm annunciators. The SY farm instruments were readied for installation, but delayed until FY94 due to the tank farm "administrative hold" order. The Panalarm alarm processing function was also rescheduled to FY94.

The TMACS software was also developed at this time to support TMACS tank farm instrument installations, TMACS maintenance and operations activity, and to optimize the software performance. The rest of the FeCN Watch List tanks (9 in BX, T, and C farms) were readied for installation on TMACS, but delayed by the tank farms "administrative hold" order.

In FY94, the remaining FeCN Watch List tanks were installed, plus two of the 11 High Heat and four of the 22 Hydrogen Watch List tanks. The number of tanks installed that were not on the Watch List totalled 33, for a total of 62 tanks on TMACS. The software capability to display and process Panalarm Series 90 alarms was completed, however the field connection was not completed. Five Enraf level sensors were connected to TMACS using the Acromag stations. Graphics display and processing of the level data was also provided, and levels for the remaining 57 tanks were processed on a daily basis from SACS. A tank farm maintenance user login capability was planned to allow the user to query the TMACS Acromag stations and download configuration data from the central facility, however, this was deferred to FY95.

The FY95 plan is to provide connection to the TMACS installations (see Section 6.0), including a software interface to the Enraf CIU controllers, to install remote user terminals in the 242-A/ 242-S evaporators and 272-AW/272-WA shift offices, to retire the CASS temperature monitoring software, and complete other items carried over from FY94.

In the following years, TMACS will continue adding functions to replace current CASS functions. These include liquid levels, which are scheduled for installation in FY96, and the remaining water meters and alarms in FY96-FY98. The CASS drywell data will be migrated to the SACS in FY96-FY97 (see Section 9.0 below).

8.2 IMPLEMENTATION AND DISCUSSION

Replacement of CASS with TMACS, both in the field and in the control room has been proven, and is being planned in stages. The first stage was to connect SY farm instruments, measuring hydrogen concentration, air flow, pressure, and structural tank temperatures, as well as passing discrete alarms to TMACS. These instruments were readied for connection in FY93, but delayed by testing of the 101-SY mitigation pump. In its place, AN Farm was connected in FY94 with these same instruments.

Discrete sensor processing functions were also developed in this stage, to continuously maintain the status of the sensors and process those states with consideration of certain alarm criteria. These functions were included in the SY farm software release (2.0), and will be used to process discrete alarms from the Panalarm annunciator boxes. The Panalarms were not included in FY94, due to delays in the Panalarm communications hardware installation. This work is being scheduled for FY95.

The TMACS software is continually being enhanced to improve performance and the number of sensors monitored by TMACS expands. Future optimizations will include modification of the data structures to allow array processing, disk and memory management enhancements, and multiple workstation configurations.

The next stage of TMACS development has been planned for FY95. This will be accomplished through three software releases with fixed release dates, but with some flexibility on the scope of each release. This flexibility will allow the TMACS software developers to be responsive to changes by its users and customers. The software release schedule is:

TMACS Release 6.0	Completed January 13, 1995
TMACS Release 7.0	May 15, 1995
TMACS Release 8.0	September 15, 1995

These releases will implement the following change requests:

- Connect Enraf CIU Controllers to TMACS
- Provide tank parameter query from SACS (alarm set-points and baselines, sensor locations, etc.)
- Provide maintenance user login functions, which will include query of Acromag stations and network and parameter downloading.

- Add new data points to TMACS via the Acromags, Panalarms, Enraf CIUs and SACS.
- Install remote user terminals at 242-A and 242-S evaporators.
- Install remote user terminals at 272-AW and 272-WA Shift Offices.
- Upgrade TMACS workstations to handle increased workload.

9.0 DATA MANAGEMENT

9.1 STRATEGY AND ACTION PLAN

The SACS will continue to be developed as the primary, electronic data management system for tank farm surveillance data. SACS is a computerized database management system. The operation goals of SACS are to alleviate the dependencies on hard-copy records and to help analysts rapidly recognize tank anomalies. SACS provides access to tank farm surveillance data arriving from an expanding number of data sources; a user can query the database and get reports and raw data. The SACS database currently contains temperature data, surface level, and Interstitial Liquid Level (ILL) data.

The SACS is being developed in phases to provide useful functions to the end user as soon as the functions are developed. The advantage of this type of development is:

- the end user gets a useful function sooner;
- the functions will be better designed to current business practices and structure;
- function design can take advantage of new technology and off the shelf products which can lower costs; and
- future functions will be developed on a priority basis.

Work on SACS during FY95 will continue with this phased approach.

9.2 IMPLEMENTATION AND DISCUSSION

In 1988 a prototype database was built to store temperature data. This system was rapidly built to address immediate data requests. The prototype database was not anticipated to be long lasting. A permanent database (SACS) was later designed and built to be long lasting, handle additional data types, and fit with current surveillance business practices.

SACS development was originally outlined in three phases. The first two phases were planned to be worked during FY92. Subsequent budget restrictions limited the original scope of work and moved the scheduled completion dates:

- Phase 1 development work was completed in September 1992
- Phase 2 was completed November 1992

- Phase 3 started in FY93.

Phase 1 developed the Temperature Database System. Since the database design was to be generic, expandable, and applicable to other sensor-type databases, it is also referred to as the Base System. Along with the new temperature database, this phase included the development of a specialized form to input manual temperatures for tank SY-101, a graphing utility to plot these readings, and provided multiple reports showing tank temperature readings.

Phase 2 developed a surface-level database (for level readings from TMACS), an interface with HDAT for temperature data, and an interface with TMACS for temperature and surface-level data.

Phase 3 development during FY93 completed the following:

- Loaded available physical configuration data for all tank farms into the SACS tables so that the user can generate reports.

- Reports that were originally written for manually entered data were modified to accept data from all sources that provide data to SACS.

- Modified to the automatic archiving process between SACS and TMACS to handle the anticipated increase in data.

- The customer interface was moved to the PC environment so HLAN users are able to access SACS through their PC.

- The SACS development team prepared a temporary connection to the Tank Waste Information Network System (TWINS) (developed by PNL), for development, so the SACS data can be viewed by all of the DOE sites in the future.

- Data were migrated to SACS.

- A data feed from CASS to SACS was created to send the calculated ILL value to SACS.

Phase 3 development during FY94 included the following:

- Modifying SACS processing to support limit criteria checking. This allows the user to know when data are approaching or surpassed limit criteria. This function supports a moving baseline by storing a line equation which will be the limit criteria calculated for a given day.

- Provide user with information on frequency of data collected. This allows the user to know when data are required to be gathered and when data were gathered.

- Provide manual input capability using the PC interface for temperature data, surface level data, and ILL data. Allowing wider accessibility to the system and lowering costs by using a PC instead of a UNIX workstation.

- Provided capability to allow the user to review the data and indicate on the system which data are suspect.

- Added configuration data to support additional data from TMACS.

- Created an interface from SACS to Tank Waste Information System (TWINS) resulting in SACS data being displayed through TWINS. TWINS is a DOE-HQ system that looks at information about tank waste from all DOE sites. Washington Department of Ecology also used TWINS to access data within SACS (a TPA requirement).

Phase 3 for FY94 had also identified the need to provide storage and retrieval capability of processed and raw spectral gamma data. The spectral gamma project was canceled and this scope of work will not be performed.

Phase 3 development during FY95 is expected to include the following:

- Develop data retrieval forms and reports to allow users to verify that data are being collected as required by OSD-T-151-00031, "Operating Specification for Tank Farm Leak Detection".

- Provide TMACS with surface level data.

- Add configuration data as needed to expand with the additional temperature data TMACS will gather in FY95.

- Improve data edit and entry forms to allow user to perform functions on groups of data instead of one data point at a time.

In addition to the tasks identified above for FY95, SACS will be maintained as an operating production system. Ongoing work will include maintaining configuration control, maintaining software, and servicing problem reports.

Phase 3 work is expected to extend beyond FY95. At this time, no priority or schedule has been set for development work beyond FY95, but additional data types are expected to be added because they play an important role in the tank farm surveillance activities. Additional sensor types include flow, differential (delta) pressure, hydrogen concentration, and leak detection. Moving the calculation of interstitial liquid levels (ILLs) onto SACS will be required to retire the CASS system.

Work on automation of the determination of ILLs, originally part of Phase 2, which was put on hold in FY92, was restarted and again placed on hold in FY93. Three methods for calculating ILL were placed on CASS in FY93 and FY94. The electronic data feed of the calculated ILL to SACS was in place in FY94. Remaining tasks are to move the calculation process from CASS to SACS, load historical drywell scan profiles and manually-calculated ILL values into SACS and build the interface to the drywell vans. This will allow the end-user to recalculate manually-calculated ILL values and make comparisons. This task was unfunded for FY95 and will be scheduled when funding becomes available.

The SACS Phase 2 development schedule (FY92) originally identified implementation of statistical analysis functions in SACS. This work scope was dropped due to resource limitations and work priorities. It is expected, however, that since data can now be downloaded from SACS to Excell (a PC spreadsheet), statistical analysis functions will be done by the end user on the PC using off the shelf software.

10.0 SCHEDULE

The schedule on the following pages summarizes the proposed upgrades for each fiscal year. Past upgrade accomplishments are also tabulated.

11.0 REFERENCES

US Congress 1990, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation", Section 3137 of *National Defense Authorization Act for Fiscal Year 1991*, Public Law 101-510.

WHC, 1991a, *Requirements for Design of a Multifunctional Instrument Tree for Waste Tank Surveillance*, WHC-SD-WM-RD-014, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992a, *Fiscal Year 1992 Program Plan for Evaluation and Remediation of the Generation and Release of Flammable Gases in Hanford Site Waste Tanks*, WHC-EP-0537, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992b, *Engineering Evaluation of Thermocouples in FeCN Watchlist Tanks*, WHC-SD-WM-ER-134, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993a, *Tank Farms Restoration and Upgrades Program Plan*, WHC-EP-0392, Rev 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993b, *Status Report on Resolution of Waste Tank Safety Issues at the Hanford Site*, WHC-EP-0600, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993c, *Waste Storage Tank Level Detection Report*, WHC-SD-WM-TI-589, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994a, *Tank Farm Surveillance and Waste Status Report*, WHC-EP-0182-74, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994b, *Waste Storage Tank Level Detection Replacement Final Report*, WHC-SD-WM-TI-636, Westinghouse Hanford Company, Richland, Washington.

SCHEDULE

Upgrade	FY91/92	FY93	FY94	FY95	FY96
Temperature Trees	FeCN 4	FeCN 6	Organic 4 FeCN 8	7	
Multifunctional Instrument Trees (MITs)	Hydrogen 1	Hydrogen 1	Hydrogen 2	4	
Level Gages	Hydrogen 1	0	15 SST 5 DST	64	
Modular Gas Monitoring	Hydrogen 1	0	Hydrogen 4	Hydrogen 19	

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SCHEDULE

Upgrade	FY91/92	FY93	FY94	FY95	FY96
Tank Monitoring and Control System	FeCN 14	0*	54	59	
Surveillance Analysis Computer Systems (SACS)		All New Sensor Data	All New Sensor Data	All New Sensor Data	All New Sensor Data
Handheld Data Aquisition	Tanks 27	Tanks 26	(All Routines) 2 Tank Farms	(All Routines) 5 Tank Farms	(All Routines) 4 Tank Farms

*54 in progress, not completed due to tank farm stop work order.

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