0254
2715

0031186 Bin 2715

DOCUMENT NO.	RHO-MA-230 110254
DATE	COPY NO.

CLASSIFICATION

ISSUING FILE

Rockwell Hanford Operations
Richland, WA 99352

TITLE AND AUTHOR

Tank Farm Surveillance Operations Training Manual
Production Operations

DISTRIBUTION

NAME	BUILDING	AREA	NAME	BUILDING	AREA
Rockwell Hanford Operations					
C. Carter, Production Operations (17)					

SEP 1993
RECEIVED
EDMC

ROUTE TO	PAYROLL NO.	LOCATION	FILES ROUTE DATE

CLASSIFICATION

(TO BE USED ON UNCLASSIFIED AND OFFICIAL USE ONLY DOCUMENTS)

54-6100-151 (6-77)

SUBJECT: OPERATING MANUALS AND PROCEDURES - CHEMICAL PROCESSING AND DEFENSE WASTE MANAGEMENT

1.0 PURPOSE

This Management Guidance Letter provides authorization for the continuing use of existing manuals and procedures required to support CPD and DWMD operations.

2.0 SCOPE

Operational requirements for Chemical Processing and Defense Waste Management are implemented through RHO-GM-MA-2, Standard Requirements and Procedures Manual, Section 43, "Operations;" RHO-PO-MA-1, Administrative Manual for Plant Operations, and specific task-related procedures. Other manuals and technical documents provide supporting information, guidance, and criteria.

3.0 GUIDANCE AND REQUIREMENTS

3.1 SPECIFIC GUIDANCE

Documents approved for continued use on June 29, 1987 are specified in Attachment A. For information, cancelled or superseded documents are listed in Attachment B. It is recognized that additional existing documents required for continuing operations may be identified, and the list of approved documents will be periodically updated. In concept, all such documents apply until specifically cancelled or superseded.

Administration of the on-going manuals and procedures will be the responsibility of the Division Managers as assigned. The manuals will be retired as they are superseded by new WHC manuals. This interim authorization will expire on September 30, 1988.

3.2 PROCEDURE GUIDANCE

The proper use of written procedures is one of the most important elements to the accomplishment of a consistent performance of operations and maintenance in a safe and efficient manner. A clear understanding of the requirements for and the understanding of procedure compliance is the key element of proper use of procedures. Providing this understanding is a major line management responsibility.

Responsible Organization: Chemical Processing & Defense ~~Waste Management~~

Authorizing Manager: Ronald E. Lerch Roger Wright

Compliance to authorized procedures without deviation is required for all operations and maintenance performed by or for the Chemical Processing and Defense Waste Management Divisions. When a procedure cannot be followed as written or unexpected results occur, work must be stopped. If necessary, actions may be taken to ensure that the system is restored to a safe condition. The appropriate maintenance or operations supervisor must be notified immediately for direction.

MGL-049 REV. 0
ATTACHMENT A

ACTIVE MANUALS AND PROCEDURES REQUIRED FOR CONTINUATION OF CHEMICAL PROCESSING AND DEFENSE WASTE OPERATIONS UNDER DOE CONTRACT DE-AC06-87RL10930

Document Number	Title
ARH-MA-102	241-AY Tank Farm Information Manual
ARH-MA-103	Technical Manual Waste Encapsulated
ARH-MA-119	242-S Evaporator-Crystallizer
ARH-MA-169	Core Sampling System Information
ARH-MA-177	B-Plant Computer Program Users Manual
MG-137	Hazardous Mat. Packaging and Ship. Man.
RHO-GM-MA-1	Operations
RHO-HS-MA-3	Tank Farm Surveillance Analysis
RHO-MA-1111	PUREX Emergency Plan
RHO-MA-11119	231-Z Building Emergency Proc.
RHO-MA-1112	UO_3 Emegency Plan
RHO-MA-11121	T-Plant Emergency Proc.
RHO-MA-11122	Emergency Plan - Treatment
RHO-MA-1113	B-Plant Emergency Plan
RHO-MA-1114	Z-Plant Emergency Plan
RHO-MA-1114	PFM Operations Emergency Plan
RHO-MA-1115	Tank Farm Emergency Plan
RHO-MA-1116	222S Lab Emergency Plan
RHO-MA-116 Vol. 1 & 2	PUREX Technical Manual
RHO-MA-138	Emerg. Sys. Group Analy. Lab Op. Proc.
RHO-MA-140	Energy Sys. Group 241 & SX Salt Well Sys.
RHO-MA-148	Z-Plant Routing Sample Schedule
RHO-MA-156	Californium Multiplier/Delayed
RHO-MA-201	Hazardous Material Packaging, Shipping and Transportation
RHO-MA-213	Power Manual PUREX Facility Rev. 1
RHO-MA-222	Hanford Radioactive Solid Waste Rev. 3
RHO-MA-230	Tank Farm Surveillance Operations
RHO-MA-231	Tank Farm Processing and Services
RHO-MA-235	General Radio-Chemical Training

Document Number	Title
RHO-MA-246	Plutonium Reclamation Facility
RHO-MA-250	Users Manual Deep Release Vado
RHO-MA-251	Users Manual Saturated/Unsaturated
RHO-MA-252	User Manual, Near-Surface Vadose Zone
RHO-MA-257	Process Specifications, Waste WESF
RHO-MA-259	RHO Energy Systems Group 241-T
RHO-MA-266	Process Design Department Laboratory
RHO-MA-270	Operating Procedure Format and Operation
RHO-MA-271	B-Plant/WESF Plant Administration
RHO-MA-272	Tank Farm Surveillance and Operations
RHO-MA-273	Plutonium Operations Administration
RHO-MA-274	PUREX Operations Administrative Directives and Procedures
RHO-MA-281	Nuclear Criticality Alarm Manual
RHO-MA-282	Research & Eng. Admin. Guide
RHO-PO-MA-1	Plant Operations Administrative
RHO-RE-MA-10	Plant Engineering Department
RHO-RE-MA-13	Non-Radioactive Hazardous Chemicals
RHO-RE-MA-15	User's Manual for Remote-Handling
RHO-RE-MA-16	Waste Information Data System
RHO-RE-MA-2 Vol. 3	Computer Automated Surveillance
RHO-RE-MA-2 Vol. 2	Computer Automated Surveillance
RHO-RE-MA-5 Add. II	PUREX Records Plan
RHO-RE-MA-5	PUREX Process Control Manual
RHO-RE-MA-6	Research and Engineering Emergencies
RHO-RE-MA-7	User's Manual for Remote-Handling
RHO-RE-MA-8	Herbicide Use Guidelines
RHO-SS-MA-21	PUREX/2736-ZB Support Facility Rev. 1
RHO-SS-MA-21	PUREX 2736-Z Support Facility
RHO-SS-MA-24	PUREX Laboratory Procedures
RHO-SS-MA-7	PUREX Rover Duties
RHO-SS-MA-73	Nuclear Material Source Data Forms
UNI-M-29	Shipment Radioactive and Hazard. Mater.

INACTIVE MANUALS AND PROCEDURES WHICH ARE OBSOLETE ON JUNE 29, 1987

Document Number	Title
ARH-MA-122 Vol. 1	PUREX Laboratory Services
ARH-MA-122 Vol. 2	PUREX Laboratory Services
ARH-MA-122 Vol. 3	PUREX Laboratory Services
PP 10-09	Hazardous Material Shipments
RHO-MA-108	Laboratory Quality Control Procedures
RHO-MA-111 Draft	RHO Energy Systems Emergency Plan
RHO-MA-116 Add	PUREX Technical Manual Plutonium
RHO-MA-120	Laboratory Standards and Reference
RHO-MA-132 Vol. 1 & 2	Essential Materials Manual
RHO-MA-134	PWR Core 2 - T-Plant
RHO-MA-162	Standards Laboratory Reference
RHO-MA-170	Z-Plant Standard Practices Manual
RHO-MA-171	Z-Plant Power and Ventilation
RHO-MA-173 Vol. 1	236-Z Operating Procedures Manual
RHO-MA-173 Vol. 2	236-Z Operating Procedures Manual
RHO-MA-173 Vol. 3	236-Z Operating Procedures Manual
RHO-MA-173 Vol. 4	236-Z Operating Procedures Manual
RHO-MA-173 Vol. 5	236-Z Operating Procedures Manual
RHO-MA-174	Z-Plant Oxide Line Manual
RHO-MA-175	Z-Plant Waste Handling Manual
RHO-MA-176	Z-Plant - Special Processing
RHO-MA-177	Z-Plant - Unique Procedures
RHO-MA-178	Z-Plant - Product Handling Manual
RHO-MA-179 Vol. 1 & 2	T-Plant Special Services Manual
RHO-MA-184	Z-Plant Process Specifications
RHO-MA-186	NDA Calibration Procedures Manual
RHO-MA-215	204-AR Customer Waste Unloading
RHO-MA-222	Hanford Radioactive Solid Waste Rev. 2
RHO-MA-222	Hanford Rad. Solid Waste
RHO-MA-242	Production Support Standards

Document Number	Title
RHO-MA-263	Computer Automated Surveillance
RHO-MA-264	Nuclear Material Sealing
RHO-MA-265	Guide - Nuclear Materials
RHO-MA-278	ALARA Program - As Low as Reasonably
RHO-MA-284	242-A Evaporator-Crystallizer
UNI-M-100	10.7 Environmental Control

CLASSIFICATION	DOCUMENT NO. RHO-MA-230
	DATE 12-79 COPY NO. 201

ISSUING FILE

Rockwell Hanford Operations
Richland, WA 99352

REFERENCE COPY
NOT FOR CIRCULATION
JUN 25 1980
RECEIVED-ROCKWELL
DOCUMENT CONTROL

TITLE AND AUTHOR

Tank Farm Surveillance Operations Training Manual
Production Operations

DISTRIBUTION

NAME	BUILDING	AREA	NAME	BUILDING	AREA
Rockwell Hanford Operations					
C. Carter, Production Operations (17)					

ROUTE TO	PAYROLL NO.	LOCATION	FILES ROUTE DATE
REFERENCE COPY			

CLASSIFICATION

(TO BE USED ON UNCLASSIFIED AND OFFICIAL USE ONLY DOCUMENTS)

54-6100-15

RHO-MA-230

TANK FARM SURVEILLANCE OPERATIONS TRAINING MANUAL

Production Operations

December 1979

Prepared for the United States
Department of Energy
Under Contract DE-AC06-77RL01030

Rockwell International
Energy Systems Group
Rockwell Hanford Operations
Richland, WA 99352

LEGAL DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced from the best available copy.

Printed in the United States of America

DISCLM-2.CHP (1-91)

RHO-MA-230

TANK FARM SURVEILLANCE
TRAINING MANUAL

Approved:

Operations Department Manager

Training Department

Operations Production Control

Prepared by

CONTENTS

	Page
Introduction	1-1
Purpose of Present Operation	1-2
Hanford Tank Farms	1-2
Charter Tank Farm Surveillance	1-15
Responsibilities	1-15
Testing Emergency Signals	2-1
Criticality (Nuclear Excursion)	2-1
Outdoor Sirens	2-1
Telephone Crash Alarm Systems	2-1
Emergency Tests and Drills	2-2
Purex/B-Plant Radio Communications	2-2
Evacuation Busses	2-3
Responsibilities - Bus Drivers	2-3
Information	2-3
Tank Farms Emergency Chain of Command	2-4
Responsibility	2-4
Personnel Accounting	2-4
Planning	2-4
Tank Farm-Evacuation	2-5
Evacuation	2-5
Bomb Threat Response Tank Farms	2-6
Introduction	2-6
Response Authority	2-6
What to do upon Receiving a Bomb Threat	2-6
What the EAC is to do	2-6
Management Responsibilities	2-8
Tank Farms - Nuclear Excursion (Criticality)	2-9
Nuclear Excursion	2-9
Tank Farms-Fire and/or Explosion	2-10
Fire and/or Explosion	2-10
Tank Farm - Loss of Electricity	2-12
Loss of Electricity	2-12
Loss of Electricity - Tank Farms	2-14

Page

Loss of Electricity - Tank Farms 2-15

Loss of Water-"A" Farm Complex 2-16
A-AX-AY-AZ Tank Farms. 2-16

Loss of Steam-A Farm Complex 2-19
Introduction 2-19
Immediate Action 2-19
Restoring to Normal Operation. 2-19

Loss of Steam - SY Farm. 2-20
Introduction 2-20
Immediate Action 2-20

Loss of Air - A Farm Complex 2-21
A-AX-AY-AZ Tank Farms. 2-21

Loss of Air - S and SX Tank Farms. 2-23
Introduction 2-23
Immediate Action 2-24
Recovery 2-24

Loss of Air - SY Tank Farm 2-25
Introduction 2-25
Immediate Action 2-25
Recovery 2-25

Radioactive Gaseous Discharges-Tank Farms. 2-26
Introduction 2-26
Action Required. 2-26

Radioactive Liquid Discharges - Tank Farms 2-29
Introduction 2-29
Liquid-Discharge Radioactivity Level Determination 2-29
Action Required. 2-29
Liquid Release Levels to Cribs 2-32

Criticality and Radiation. 3-1
General Fissile Locations. 3-1
General Radiation Areas. 3-1
Criticality Safety Principles. 3-1

Criticality Prevention Guide Rules 3-5

Criticality Prevention Terms 3-6

Page

Criticality Prevention Specification 3-7
Introduction and Uniform Limits. 3-7
Limits 3-8
Criticality Alarm and Dosimetry Systems. 3-10
Training and Qualification 3-12
Criticality Safety Glossary. 3-17

Contamination Control. 3-22
Airborne Radioactivity and Control 3-22
Controlling Surface Contamination. 3-26
Environmental Protection 3-28

RWP's Applicable to TFS Plant Assignments. 3-29

Index to Radiation Work Procedures (RWP) Tank Farm
Surveillance 3-30

Rockwell Hanford Operations Radiation Work Procedure 3-31
Tank Farms, Diversion Boxes, Other Liquid Disposal
Areas and Plant Roadways Within 200 East and
200 West Areas 3-32
Rockwell Dry Waste Burial Grounds and Plant Roadways
Within and Between 200 East and 200 West Areas 3-34
All Tank Farm Radiation Zones. 3-36
Rockwell Facilities. 3-39

Industrial Safety. 4-1
Introduction 4-1
Policy and Responsibility. 4-1
Safety Programs. 4-4
Program Objectives 4-7
Principles and Objectives. 4-7
Procedures 4-9
Accident Reporting 4-11
Emergency Medical Aid. 4-12
Safety Meeting 4-14
Housekeeping 4-14
Personal Protective Equipment. 4-15

Fire Protection. 4-18
Introduction 4-18
Fire Prevention. 4-20
Pre-Emergency Fire Planning. 4-29
Protable Fire Extinguishers. 4-31
Fire Extinguishment and Control. 4-34

Page

Master Safety Rules from Pu Processing Manual. 4-38

General Safety Rules Tank Farm Operations. 4-39

Tank Farm Fire Plan. 4-40

Safety Rules Dry Well Monitoring 4-41

241-BX, 241-BY Tank Farms Safety Rules 4-42

243-C Tank Farm Safety Rules 4-43

241-SY Farm Safety Rules 4-44

Lunchroom Safety Rules 224-U 4-45

2707-C (Change House) Safety Rules 4-46

Elevator Safety Rules 224-U. 4-47

Ladders. 4-48

201-C (Hot Shop) Safety Rules. 4-49

Security 5-1
Introduction 5-1

Concept of Security at Hanford 5-1

Access Authorization and Security Badge. 5-2

TFS Plant Operations and Equipment 6-1
Introduction 6-1

Tank Farm System 6-2
Storage Facilities 6-2
Operating Practices. 6-4
Tank Auxiliaries 6-7
Waste Volume Monitoring. 6-11
Automatic Liquid Level Monitoring. 6-12
Manual Liquid Level Measurement. 6-17
Leak Detection Pits and Annulus Leak Detection 6-23
Monitoring of Water Levels in Ponds. 6-29
Subsurface Monitoring. 6-33
Dry Well Monitoring. 6-33
Neutron Probe Scans in Internal Dry Wells. 6-42
Lateral Monitoring Operations. 6-42

Page

CASS (Computer Automated Surveillance System 6-51
Remote Visual Imagery. 6-56

Glossary 7-1

NPO Progression Exam Study Questions 8-1

Forty-two Month Progression Exam Study Questions 8-9

Six Month Progression Exam Study Questions 8-24

Eighteen (18) Month Progression Exam Study Questions 8-28

FIGURES

1-1. Typical Storage Tank Design. 1-5

1-2. A Tank Farm. 1-7

1-3. Double Shell Storage Tank. 1-8

1-4. Tank Farm Surveillance Organization Chart. 1-9

1-5. Organization Chart Tank Farm Surveillance and Operations Department. 1-10

1-6. Location of Hanford Reservation. 1-11

1-7. Map of Hanford Reservation 1-12

1-8. Chemical Processing Areas. 1-13

1-9. Hanford Tank Farm Facilities 1-14

3-1. Basic Fissile Material Symbol. 3-4

4-1. Safety Cans. 4-24

4-2. Location of the Fire Extinguisher. 4-32

4-3. Dry-chemical Fire Extinguisher, Stored Pressure Type, Combination Handle 4-35

4-4. Stored Pressure Water Fire Extinguisher. May be Labled "loaded stream" if Charged with a Special Alkali-metal Salt Solution Instead of Water 4-35

Page

5-1. Hanford Controlled Access Areas. 5-3

6-1. Waste Storage Tank Designs 6-3

6-2. Double-shell Storage Tank. 6-5

6-3. Liquid Level Gauge - Diagram of Major Components 6-14

6-4. Liquid Level Measurements (Flow Diagram) 6-15

6-5. Transport Line Surveillance (Data Flow Diagram). 6-22

6-6. Leak Detection Pits and Tank Annulus (Data Flow Diagram). 6-25

6-7. Waste Tank Auxiliary and Support Facilities Surveillance 6-25

6-8. Area Map: Location of B Pond and Gable Mountain Pond 6-30

6-9. To Gable Mountain Pond - 216 - A - 25. 6-31

6-10. Area Map: U-Pond and Source Processing Facilities . . . 6-32

6-11. Dry Well Data Flow 6-37

6-12. A Tank Farm Laterals 6-43

6-13. SX Tank Farm Laterals 6-44

6-14. Lateral Well Data Flow 6-50

6-15. Onsite Radioactive Shipment Record Xerox 6-62

TABLES

1-1. Waste Storage Tanks at Hanford 1-4

3-1. Training Requirements for Fissile Material Handlers and Those Who Supervise Fissile Material Handlers. . . . 3-16

3-2. Routinely Handled Materials in Z Plant and the H/Pu Ratio Assigned to the Material 3-20

3-3. Respiratory Protective Devices Required for Given Concentrations of Airborne Radioactivity 3-24

Page

4-1. DOE-RL Fire Experience 4-19

4-2. Summary of Fire Extinguisher Characteristics 4-33

PHOTOS

6-1. Automatic Liquid Level Gauge 6-16

6-2. Manual Liquid Level Tape and D.C. Meter. 6-18

6-3. Close-up of Manual and D.C. Meter. 6-19

6-4. Leak Detection Pit Panelboard. 6-26

6-5. SY Annulus Leak Detection Board. 6-27

6-6. Control and Alarm Panelboard 6-28

6-7. Vertical Dry Well. 6-34

6-8. Inserting Probe in Well. 6-38

6-9. Dry Well Van 6-39

6-10. Dry Well Van Equipment 6-40

6-11. Lateral Building 6-46

6-12. Interior - Laterial Building 6-47

6-13. Lateral Monitoring Equipment 6-48

6-14. Eclipse Computers 6-52

6-15. CASS Terminal 6-53

6-16. Tank Farm Microprocessors 6-54

6-17. 12" Camera Package 6-57

6-18. Site Preparation 6-58

6-19. Inserting the Camera Package into a 12" Riser 6-59

INTRODUCTION - TANK FARM SURVEILLANCE PLANT

Tank Farm Surveillance was created as a direct result of the 241-T-106 leak which occurred in 1973. Prior to this incident, the responsibility for waste tank leak detection was shared between Tank Farm Operations and Tank Farm Process Control (Engineering).

Because the 106-T leak was quite severe and remained undetected for an extended period of time, the Atlantic Richfield Hanford Company (ARCHO), who was the contractor at the time, felt the need for the establishment of a separate department to have primary responsibility for early leak detection.

In the fall of 1973, a reorganization of the Tank Farm Operations was initiated. This reorganization saw the creation of a new department called Surveillance and Effluent Monitoring. This new department had primary responsibility for early leak detection in underground storage tanks, dry well readings, liquid level readings, lateral monitoring, and swab riser monitoring.

The name of the Surveillance and Effluents Department was changed to Tank Farm Surveillance (TFS) in 1974. In April of 1975, an Analysis Unit was formed to evaluate the incoming field data for potential leaks in the tanks. Other duties of the Analysis Unit include: (1) record and analyze underground waste storage tank and associated facilities data; (2) investigate and report all deviations from waste tank and associated facilities monitoring data; (3) define the operating and reporting requirements for the Computer Automated Surveillance System (CASS); (4) maintain the "Waste Tank Status and Leak Detection Criteria Manual" (RHO-CD-213); and (5) ensure the latest investigation techniques and tools are utilized in analysis of surveillance data. The present Analysis Unit consists of a Manager, a Surveillance Specialist, and three technicians.

Surveillance field data is obtained by TFS Operations. An operations group is located in 200 East and West Areas. These groups are comprised of a manager and five operators. They are responsible for performing the various surveillance monitoring activities, such as waste tank liquid level readings, dry well readings, lateral monitoring, and swab riser monitoring.

The Tank Farm Surveillance Department was merged with Tank Farm Operations in May 1978 to form a combined Tank Farm Surveillance and Operations Department. Also, in October of 1978 the Remote Imagery activity was assigned to TFS from Tank Farm Process Control. The Remote Imagery Unit provides photographs of the waste storage tank's interior and surface condition. Photographs of the tank interior are another valuable tool used by TFS for waste tank monitoring and early leak detection.

PURPOSE OF PRESENT OPERATION

It is the responsibility of Tank Farm Surveillance to: (1) provide for the timely collection of underground waste storage tanks and associated facilities surveillance data; (2) perform trend analysis, conduct investigations, and make reports on criteria deviations so as to ensure prompt detection of possible leaks in storage tanks and associated facilities; (3) ensure immediate response and expediate initiation of corrective actions should analysis and investigation indicate a breach of containment; (4) assume overall responsibility and control of the Computer Automated Surveillance (CASS); and (5) establish and maintain a central records file for all underground storage tanks and associated facilities.

HANFORD TANK FARMS

Since 1944, radioactive wastes from the processing of irradiated uranium have been stored as alkaline slurries in underground tanks. Between 1943 and 1977, 156 tanks were constructed for use, ranging in capacity from 55,000 gallons to 1 million gallons. These tanks are grouped in 15 tank farms located in the 200 East and 200 West Areas. The oldest tank farms -

241-B, C, T, and U - were constructed in 1943-44 concurrently with the Bismuth Phosphate Plants. The first waste was routed to tank storage in December 1944. Additional tanks in separate tank farm locations have been constructed, incorporating various design changes and reflecting various philosophy changes to accommodate the wastes. Currently under construction are thirteen 1 million gallon tanks. Six of these tanks have been designated as the 241-AW Farm, and the remaining seven as the 241-AN Tank Farm. This will increase the total number of tanks farms to 17, and the total number of primary waste tanks to 169 (see Table 1 1).

The basic containment employed in the design of the tanks in the first twelve farms was the provision for a reinforced concrete shell with a carbon steel liner. During the history of the tank farms, leaks have been confirmed in 20 of the existing 169 tanks. Leaks have occurred in nine tanks storing aging wastes and in eleven tanks holding non-aging wastes. An improved tank design to provide more protection against possible release of radioactive materials to the environment was developed to have a double steel liner within the concrete shell, thereby providing an extra barrier against release of radioactive liquids, plus recovery facilities for any liquid which might collect in the annular space between the liners. (see Figures 1-1 through 4).

Four basic chemical processing operations were the source of radioactive waste solutions transferred to underground storage tanks since startup of the Hanford site. These were the Bismuth Phosphate ($BiPO_4$) Process, TriButyl Phosphate (TBP) Process, the Redox Process, and the Purex Process.

Three of these were chemical separations programs for recovery of plutonium from irradiated reactor fuels. The TBP process was designed for recovery of uranium metal waste generated by the $BiPO_4$ process. In all cases, the aqueous wastes were made alkaline for storage in underground steel tanks.

TABLE 1-1. Waste Storage Tanks at Hanford

Farm	Tanks/Farm	Capacity/Tank (gal)	Capacity/Farm (gal)	Year Constr.
A	6	1,000,000	6,000,000	1954-55
AN	7	1,000,000	7,000,000	1977-79
AW	6	1,000,000	6,000,000	1978-80
AX	4	1,000,000	4,000,000	1963-64
AY	2	1,000,000	2,000,000	1968-70
AZ	2	1,000,000	2,000,000	1971-77
B	12	530,000	6,360,000	1943-44
	4	55,000	220,000	
BX	12	530,000	6,360,000	1946-47
BY	12	750,000	9,000,000	1948-49
C	12	530,000	6,360,000	1943-44
	4	55,000	220,000	
S	12	750,000	9,000,000	1950-51
SX	15	1,000,000	15,000,000	1953-54
SY	3	1,000,000	3,000,000	1974-77
T	12	530,000	6,360,000	1943-44
	4	55,000	220,000	
TX	18	750,000	13,500,000	1947-48
TY	6	750,000	4,500,000	1950-52
U	12	530,000	6,360,000	1943-44
	4	55,000	220,000	

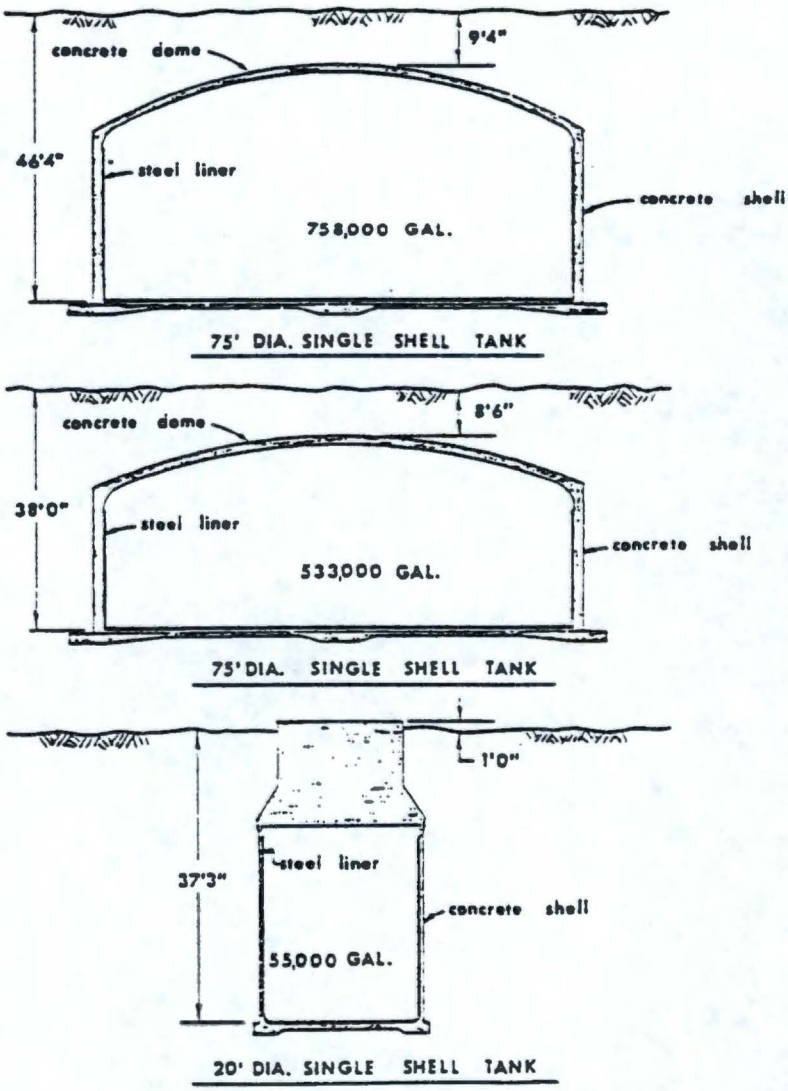
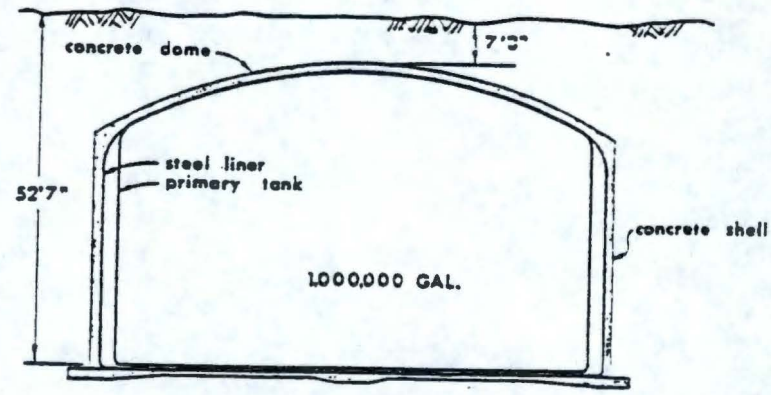
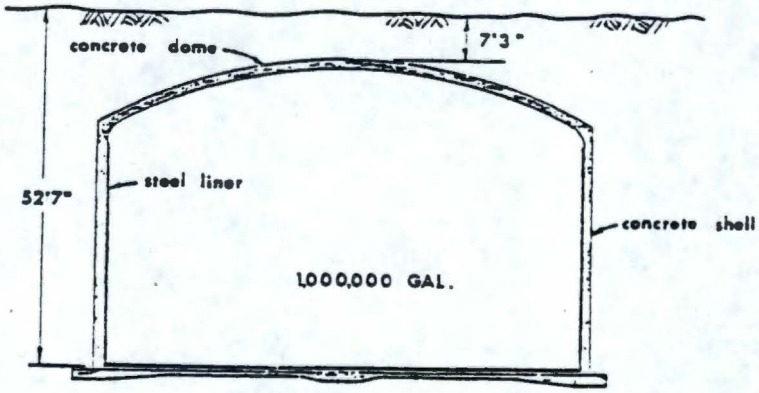


FIGURE 1-1. Typical Storage Tank Design



75' DIA. DOUBLE SHELL TANK



75' DIA. SINGLE SHELL TANK

FIGURE 1-1 (continued)

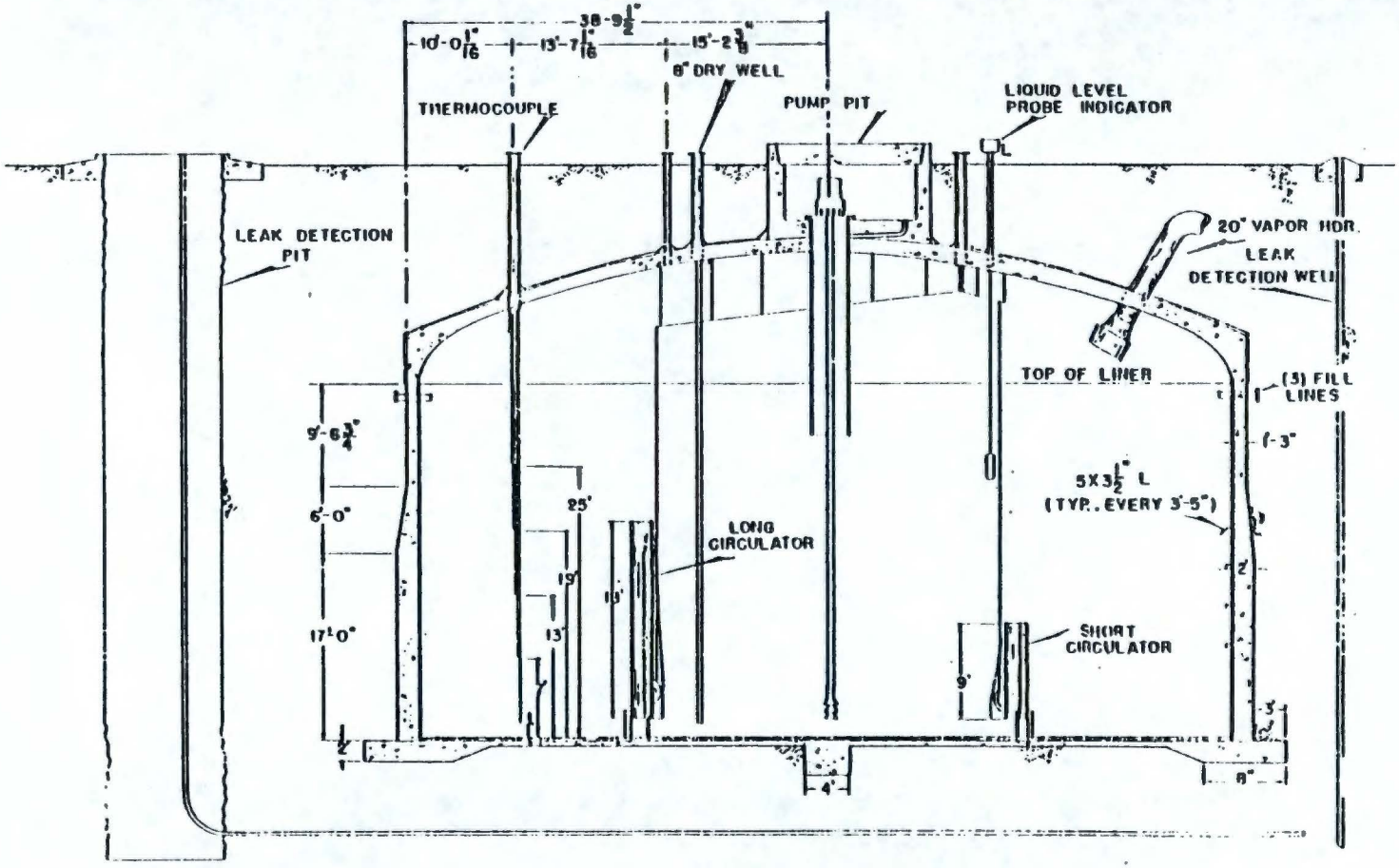


FIGURE 1-2. A Tank Farm

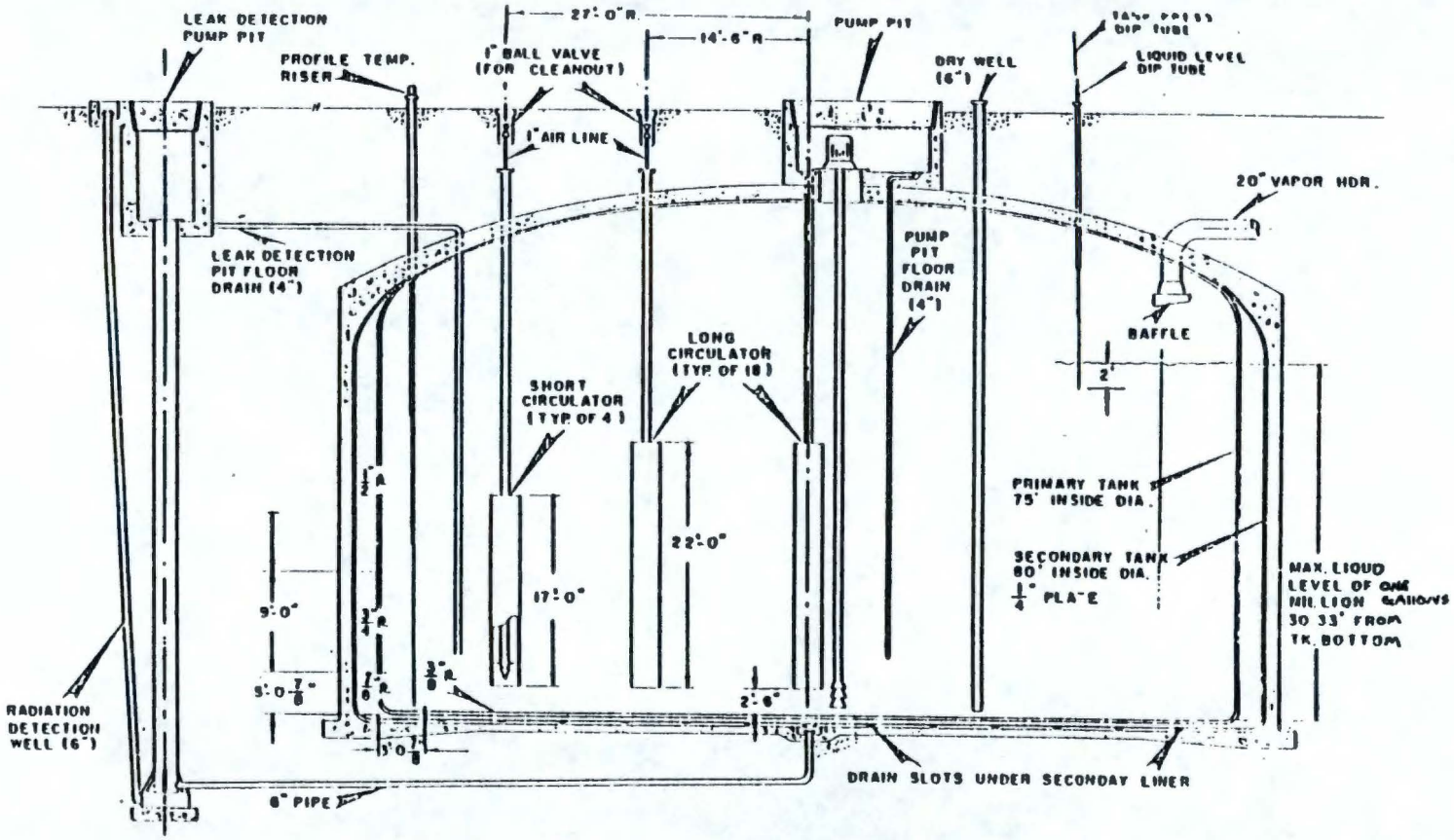


FIGURE 1-3. Double Shell Storage Tank

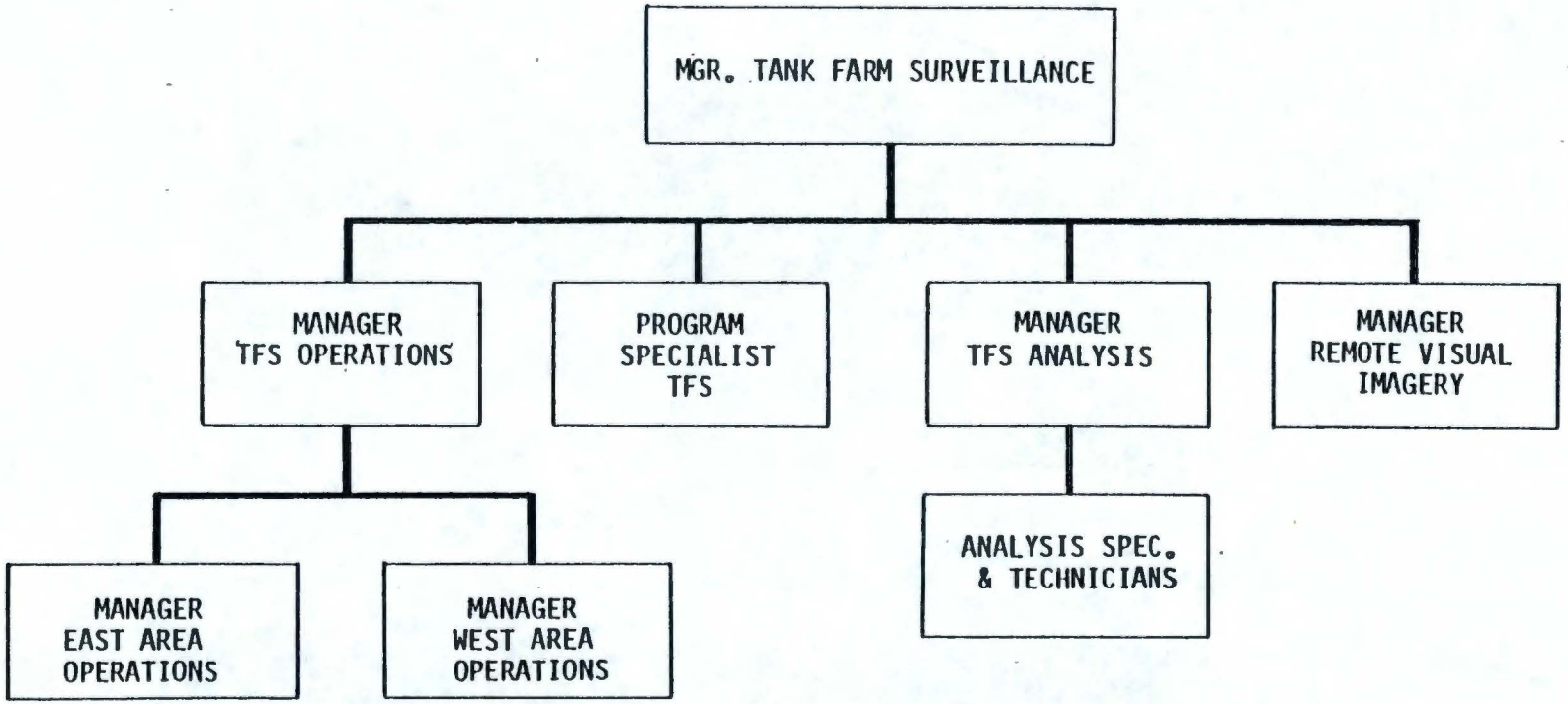


FIGURE 1-4. Tank Farm Surveillance Organization Chart

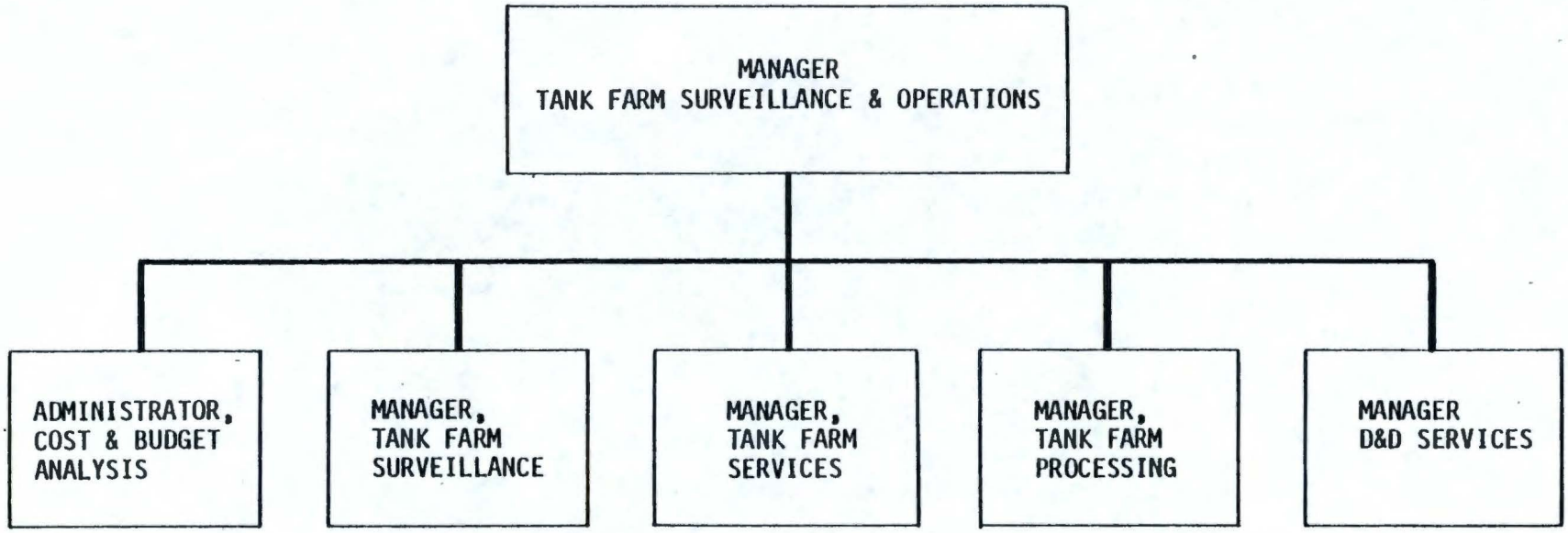


FIGURE 1-5. Organization Chart Tank Farm Surveillance and Operations Department

FIGURE 1-6. Location of Hanford Reservation

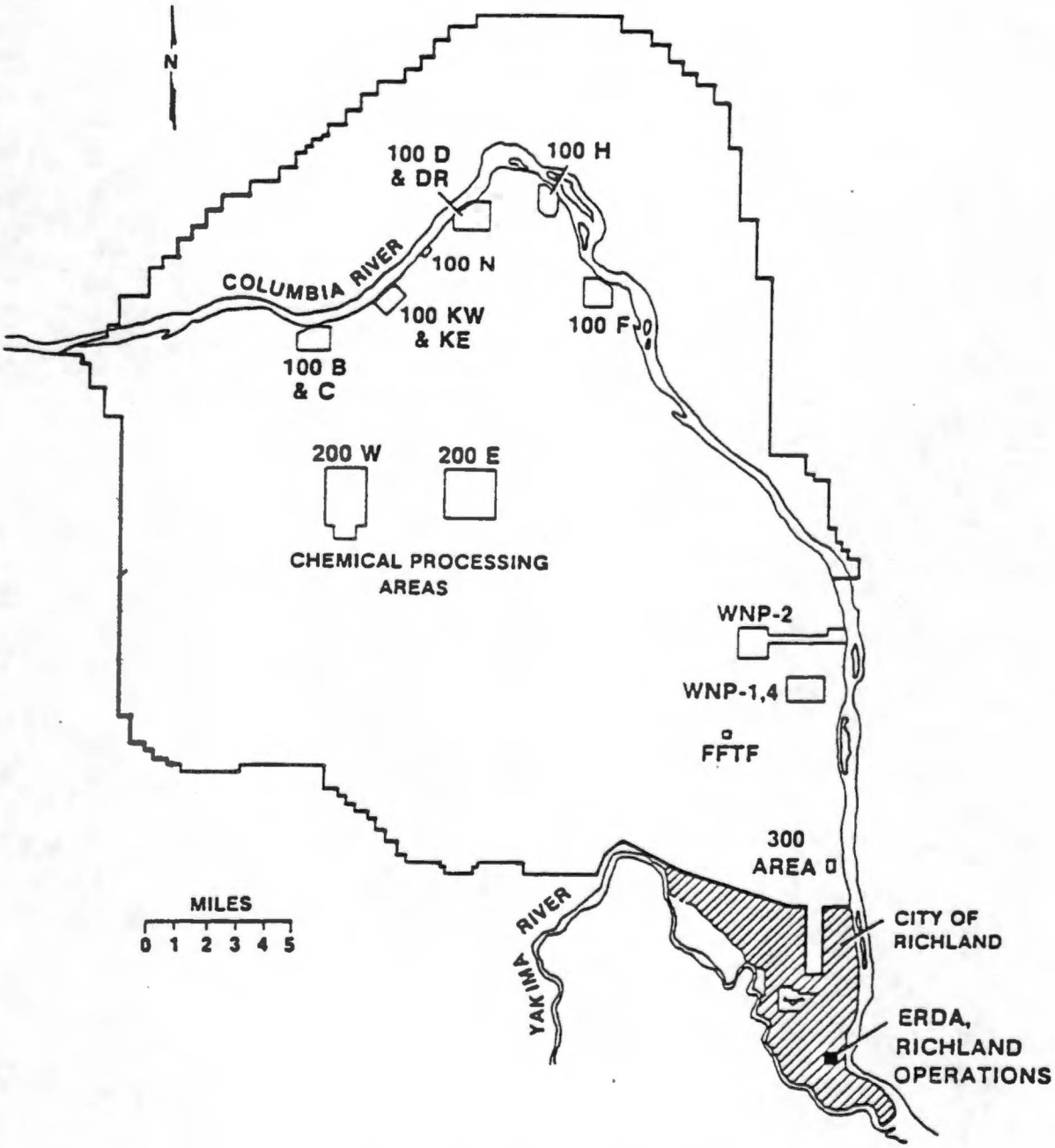


FIGURE 1-7. Map of Hanford Reservation

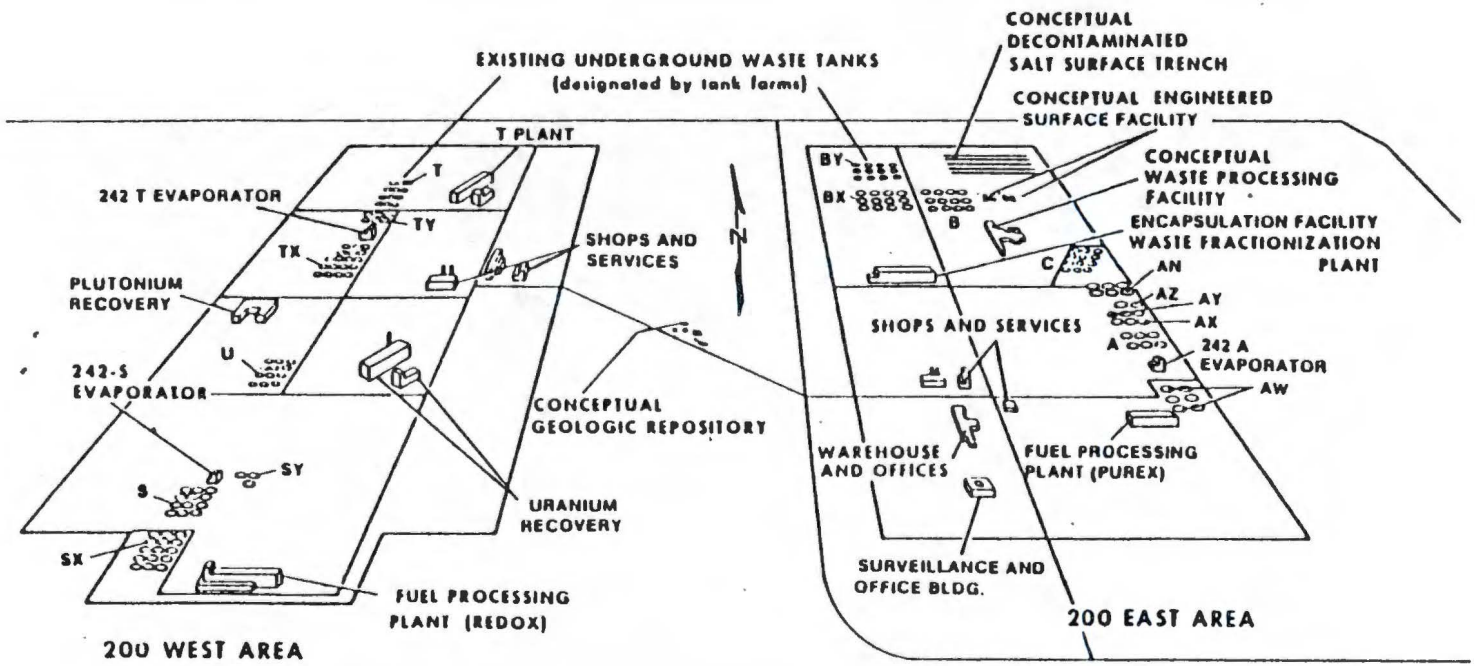


FIGURE 1-8. Chemical Processing Areas

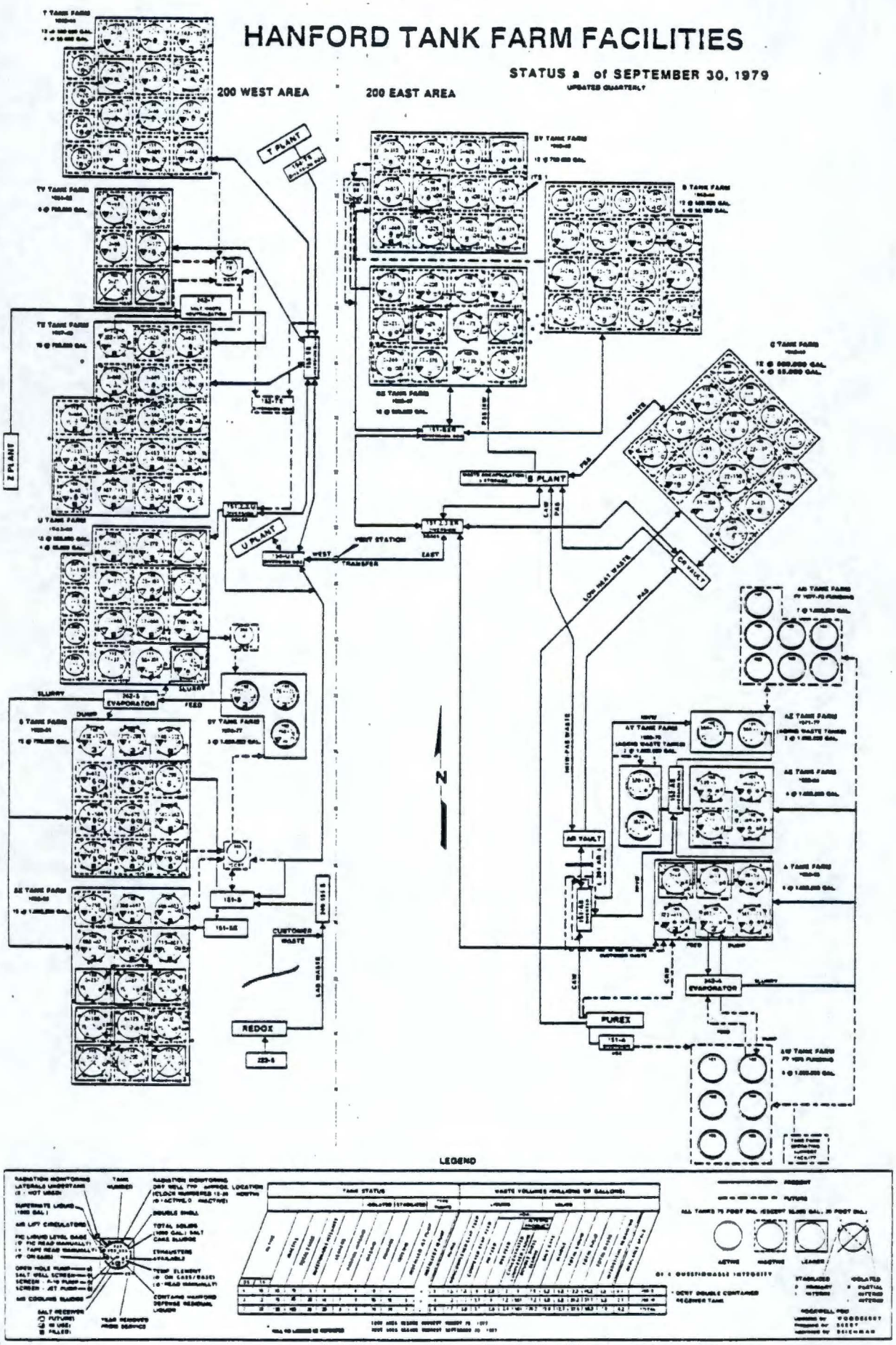


FIGURE 1-9. Hanford Tank Farm Facilities

CHARTER
TANK FARM SURVEILLANCE

Provide for the timely collection of underground waste storage tanks and associated facilities surveillance data. Perform trend analysis and reports of criteria deviations for prompt detection of possible leaks in storage tanks and associated facilities. Maintain a permanent record of all data; document evaluation conclusions, indicate and expedite initiation of corrective options should analysis indicate breach of containment.

In support of the aforementioned functions, planning, coordination and controlling of the related programmatic activities and sub-activities will be accomplished.

RESPONSIBILITIES

1. Collect surveillance data on underground waste storage tanks and associated facilities.
2. Record and anlayze underground waste storage tank and associated facilities data.
3. Investigate and report all deviations from waste tank and associated facilities monitoring criteria.
4. Indicate and expedite within the scope of the department, initiation of corrective options for containment of radioactive material should analysis indicate breach of containment.
5. Define the operating and reporting requirements for the Computerized Automated Surveillance System (CASS).
6. Maintain the "Waste Tank Status and Leak Detection Criteria Manual" in a current status.
7. Ensure that the latest investigative techniques and tools are utilized in analysis of surveillance data.
8. Establish and maintain a comprehensive master records system for underground waste storage tanks and associated facilities.

9. Coordinate the maintenance, calibration and repair of assigned equipment.

10. Perform Programmatiac and Functional special services as directed.

11. Budget resources, plan activities, and verify performance against department and programmatic milestones.

TESTING EMERGENCY SIGNALS

CRITICALITY (NUCLEAR EXCURSION)

Operations, maintenance, and radiation monitoring jointly conduct weekly operational tests of the radiation criticality instruments in processing plants and laboratories.

Instrument malfunctions are corrected by the testing crew during the test.

OUTDOOR SIRENS

Outdoor sirens are tested on the last Friday of each month between 11:30 a.m. and 11:50 a.m. in 200 East and 200 West Area, except when Friday is a Company holiday.

The 200 West Area Patrol Radio Operator initiates testing by actuating each area telephone crash alarm system, announcing a siren test is in progress, and instructing those on crash alarm phones to participate according to test plan.

Certain crash alarm phones are close to siren switches, and the person answering the phone shall switch the siren on "steady" for a period of 30 seconds. Any malfunction of the sirens shall be reported to the appropriate building superintendent immediately.

TELEPHONE CRASH ALARM SYSTEMS

The 200 Area telephone crash alarm system is tested every Friday between 11:30 a.m. and 11:50 a.m., except when Friday is a Company holiday.

The Rockwell residential telephone crash alarm and Hanford Contractor Manager's residential systems are tested on the first Monday of each month at approximately 6:00 p.m., excpet when Monday is a Company holiday.

EMERGENCY TESTS AND DRILLS

A scheule of emergency tests and drills to be conducted in Rockwell facilities will be published during January of each year indicating the month in which these practices will be conducted.

PUREX/B-PLANT RADIO COMMUNICATIONS

Two-way radio communications on a set frequency can be established between Purex and B-Plant in the event of an emergency. The radio can be used for emergency purposes where outside notifications and help are required should telephone communication from Purex malfunction or be severed.

EVACUATION BUSSES

Evacuation busses shall be provided to transport plant personnel away from work places under the following emergency conditions:

1. Local disasters such as a nuclear excursion where immediate, short transport distance is required.
2. Any disaster where movement of personnel away from the 200 Areas is required.
3. Enemy attack - take personnel to best available cover or transport to 1100 Area bus lot if time allows.

RESPONSIBILITIES - BUS DRIVERS

Bus drivers shall start and warm up their busses once each week; inspect bus for mechanical defects, complete a Monthly Inspection Report, and forward to the Building Superintendent. Mechanical trouble shall be reported immediately to the 200 West Garage, 942-2497. Busses needing cleaning shall be reported to the Building Superintendent to schedule cleaning.

Each driver shall make a practice run two times per year to maintain familiarity with bus operation. Observe all traffic rules such as signals, stop signs, rail crossings, etc., when returning from practice drills.

A log shall be kept for each bus. Note date of inspection, starting and warm up, and practice runs.

INFORMATION

Gasoline busses are limited to 75 persons including standees, and 90 persons including standees for diesel busses.

Busses are stationed throughout the 200 Areas.

TANK FARMS EMERGENCY CHAIN OF COMMAND

RESPONSIBILITY

The overall responsibility for the protection of personnel and property at the tank farms, shall rest with the Manager, Tank Farm Surveillance and Operations, work phone 2-2005.

PERSONNEL ACCOUNTING

Each manager, supervisor, and foreman shall be capable of accounting for the personnel directly under his supervision to assure that everyone has evacuated the area involved in an emergency. In addition, the possible presence of visitors, i.e., nonassigned personnel, at the time of the incident shall be ascertained and their whereabouts established. All missing (unaccounted) personnel shall be reported to the Emergency Director immediately.

Telephone Number: Emergency No. 811.

PLANNING

Emergency planning will be devised and documented by the Manager, Tank Farm Surveillance and Operations.

The CHAIN OF COMMAND during an emergency condition originating in tank farm facilities shall be as follows:

1. Action taken from the outset into at least the early recovery phase of an emergency shall be coordinated and directed by one of the "on duty" personnel in the following order:

   (a) Supervisor, Tank Farm Operations, work phone 2-2689, 2-2289, 2-2920.

   (b) Supervisor, Tank Farm Support Service, work phone 2-2820 for the 200 East Area or 2-2284 for the 200 West Area.

   (c) If the emergency is of serious nature, the supervisors shall notify the Emergency Director, Telephone Number: Emergency No. 811.

2. If the emergency is of serious nature, the Supervisor shall notify and remain in charge unless relieved by the Manager, Tank Farm Surveillance and Operations, work phone 2-2005.

TANK FARM-EVACUATION

EVACUATION

Introduction

An emergency evacuation condition is one which results from a serious plant incident, a natural disaster, or a national emergency. Notice of an evacuation will be transmitted by the Patrol via the area crash alarm system.

Emergency Signal

A steady siren of three or more minutes duration is the emergency signal for an evacuation.

Immediate Action

1. When notified by Patrol that an emergency exists requiring evacuation, the Supervisor shall inform and provide transporation for all personnel working in the tank farm areas. Operating units will be shut down as per existing emergency procedures.

2. All personnel shall respond to the steady siren by reporting to the nearest information station. Information stations in the tank farms are the crash alarm phones at 241-BY (22651), 244-AR (22593), 241-A (22890), 242-A (22289), the Shift Supervisor's office at 271-CR (22689), 224-U (22284), 242-S (22920) and 242-T (22563).

3. The Supervisor shall instruct all personnel to proceed to the evacuation bus, designate one of the crew as the bus driver, and instruct the bus driver as to the evacuation route. Unless instructed differently, the busses shall deliver the employees to the 1100 Area Bus Lot, where the busses will shuttle the employees to their neighborhoods. Those employees who use private vehicles shall proceed to their homes.

4. Supervisors must account for all personnel under their direction as outlined in "Personnel Accounting" section of Emergency Procedure, "Tank Farm Emergency Chain of Command".

5. When the evacuation results from causes other than a civil defense alert, the bus drivers and employees will be directed by ranking management as to the proper routes and destinations.

BOMB THREAT RESPONSE
TANK FARMS

INTRODUCTION

During the last few years, a number of industrial firms, schools, government agencies, and contractors have received telephone calls warning of a bomb placed in their plants or buildings. Bomb threats have been received on the Hanford project. Prompt and effective response in such a situation requires an established plan and the implementation of certain procedures.

RESPONSE AUTHORITY

The Emergency Action Coordinator (the Building Superintendent or his delegate) will be notified of a bomb threat directly from the person who receives the call, after that person has reported it to the Emergency Officer on 811 (Ref. - pp. 9-11, RHO-MA-111, Basic Emergency Plan).

WHAT TO DO UPON RECEIVING A BOMB THREAT

Get all the information possible:

1. Note exact words of caller.
2. Ask the message be repeated.
3. Try to learn exact location of bomb.
4. Note your impressions about age, sex, accent, speech impediments, intoxication, or other mannerisms of caller.
5. Use the checklist on pg. 28, RHO-MA-111.
6. Notify the Emergency Officer on 811. This automatically advises the Rockwell Emergency Director who will immediately be on his way to the threat scene.
7. Give your checklist to your supervisor as quickly as possible. If he is not the EAC, he shall notify that person immediately.

WHAT THE EAC IS TO DO

A. Obtain record of call from the recipient of the threat. a) If the call concerns another building, immediately advise the appropriate Building Superintendent. b) If the call does not threaten any

building, consult with the Emergency Director through Patrol before taking any action. c) If the call threatens this building, assess the credibility and nature of the message--then proceed with steps B or C.

B. If a specific location in this building is threatened:

1. Decide whether any, all, or a part of the threatened building is to be evacuated. If an evacuation is to occur, instruct the affected employees to do the following:

   - Secure classified and special nuclear materials.
   - Visually check their work stations for unusual conditions.
   - Take their personal effects and leave all doors open.
   - Leave the building in the most direct route.
   - Report to the pre-determined assembly point which is to be at least 200 feet from the building.
   - In the event that a handicapped person is within the evacuation area, the EAC will appoint another employee to assist in their evacuation.

2. Upon his arrival at the assembly point the EAC will perform the following duties:

   - Satisfy himself that all evacuated employees and vistors are at the assembly point and are accounted for.
   - Establish a tactical command post in a cleared area outside the building.
   - Check evacuees to determine if any of them observed anything unusual on their way out.
   - Organize the bomb search program using the building floor plans provided for search progress check-off.
   - The Emergency Action Coordinator will be the controlling authority until he is relieved by the Emergency Director.

3. If there is to be only a partial evacuation or no evacuation at all, decide extent of threat announcement and what personnel are to be advised.

4. Request all response personnel at the scene to work in a manner which will avoid panic.

5. Request area patrol to log all personnel leaving limited area (200E or 200W), and to prevent access to threatened building except for emergency response personnel.

6. If a suspicious object is located, do not move, jar, or touch it or anything attached to it. Evacuate further as necessary to remove all personnel at least 200 feet away from the object.

7. Advise the Emergency Director immediately. He will notify DOE. They will evaluate object, determine its nature and, if necessary, dispose of it.

8. If search effort reveals no suspicious object, building may be re-entered when authorized by the Emergency Director.

C. If no specific location in this building is threatened, proceed according to Section B above, except the scope of search may be less thorough but will cover a much larger portion of the building. Direct the search team to first scan the more vital areas of the building and second those areas most accessible.

MANAGEMENT RESPONSIBILITIES

A. Update the list of bomb search team members at six month intervals.

B. Provide a set of floor plans to search teams showing both the vital areas of the building and the most accessible portions for use in prioritizing and recording search efforts.

C. Provide the best available training and equipment for search team.

TANK FARMS - NUCLEAR EXCURSION
(Criticality)

NUCLEAR EXCURSION

Introduction

No possibility of a criticality exists within those facilities; therefore, a detailed procedure is not needed. Temporary assignments may take personnel into other facilities where criticality is possible. The following is a brief explanation of the basic course of action to be followed.

Emergency Signal and Immediate Action

The "AH-OO-GAH" howlers are the nuclear excursion evacuation signal devices, and each one is located in the immediate vicinity of a potential nuclear excursion site. Personnel hearing a nuclear excursion signal in a process facility shall Immediately Run, evacuating the area. They should follow the lead of assigned personnel to the designated meeting place, keeping at least 100 feet from the building at all times.

TANK FARMS-FIRE AND/OR EXPLOSION

FIRE AND/OR EXPLOSION

Introduction

Prompt reporting of all fires is essential to fire control and extinguishment. Explosions may be the cause or result of a fire, or may be totally dissassociated. In this procedure, fire and explosion are treated simultaneously.

Fire fighting and rescue of personnel is mainly work for professionals trained in techniques and use of equipment designed for that purpose. However, there are many things Tank Farm personnel should do before and after Fire Protection personnel arrive.

Fire fighting efforts are not complicated by the threat of nuclear excursion since the Tank Farms do not process fissionable material in significant quantities or concentrations.

Reporting Fires

1. The person discovering a fire shall immediately telephone 811, or Fire Protection on 2-2301, and activiate the nearest fire alarm pull box.

   After reporting the fire, the person at the scene shall notify the Tank Farm Supervisor, phone number 2-2689 or 2-2920 for shift or 2-2820 for days, 200E Area, 2-2284 for days, 200W Area.

Individual Responsibility

1. Once the fire has been reported, the person at the scene should complete emergency shutdown of equipment when practical.

2. Within the limits of good judgement, attempt to extinguish the fire using the approved equipment provided.

3. If the fire is in a Radiation Zone, the minimum respiratory protection required is a full face respirator.

4. The person at the scene should be in position to meet and direct firemen to the exact location of the fire.

Supervisor's Responsibility

1. The Supervisor shall evaluate the need for radiation monitoring assistance and arrange for help if necessary.

2. If there is a possibility of contamination release to the environs, the Supervisor may obtain meteorological information at any time by telephoning 2-2716.

3. The Supervisor shall evaluate the physical damage to structures and/or equipment.

4. At the conclusion of the emergency the Supervisor shall organize clean up, waste handling and repair service.

TANK FARM - LOSS OF ELECTRICITY

LOSS OF ELECTRICITY

"A" Farm Complex Introduction

AZ Tank Farm. The 241-AZ Tank Farm is fed by distribution line C8L6 from the 251 substation. There is no second line or standby power available on an automatic switch over basis for this farm. Power can be back-fed from line C8L8 manually if necessary.

A-AX-AY Tank Farm. The 241-A, AX and AY Tank Farms are fed by a 13.8 kV distribution line C8L5 from the 251 substation. A second 2.4 kV line E8-L216 from the Purex Facility provides standby power from certain critical equipment in the tank farms, but has a limited capacity of 300 KW. Currently, line E8-L216 is normally supplied by line C8L8 via Purex, but automatically transfers to line C8L8 via Purex switchgear in the event of a failure on C8L5.

A third source of limited power is available in the event of a total failure on both line C8L5 and C8L8. This emergency power is provided by a 96 KW diesel generator and a 300 KW diesel generator. One or both generators will start automatically and automatic switching will restore power to MCC A3, MCC A4, MCC A5, and MCC A6. Automatic switching will restore each MCC back again when "normal" power has been restored.

Emergency or standby power can be provided for the A, AX, and AZ farms as follows:

96 KW Diesel Generator

- MCC A4 Cooling water pumps
- MCC A6 DASC system
- Emergency lighting

300 KW Diesel Generator

- MCC A3 Air compressors (limited to two air compressors)
- MCC A5 Vent Filter Building (limited to one exhaust fan)
- Emergency lighting

Standby Power - 300 KW Maximum (Requires Manual Transfer)

- MCC A3 Air compressor (limited to three air compressors)
- MCC A4 Cooling water pumps
- MCC A5 Vent Filter Building (limited to one exhaust fan)
- MCC A6 Data Acquisition and Signal Conditioning System
- Emergency lighting

Immediate Action

1. The controls for emergency generators are to be set for automatic starting at all times.
2. Generators and auxiliary equipment are inspected weekly.
3. If the 96 KW generator #2 fails to operate, open the manual by-pass water valves to the surface condenser cooling coils. (These valves are identified).
4. If the 300 KW generator #1 fails to operate, start diesel-driven air compressor and valve into the system.
5. Call for shift electrician. Contact electrical supervisor.

LOSS OF ELECTRICITY - TANK FARMS

SX Farm Introduction

Normal power is supplied by the Bonneville system and is fed from the 202-S Building Substation C8S7 through line E8L115 to 241-SX. Any interruption of this flow will activate a red light and horn in the 200W Power House. Simultaneously the normal incoming 252 Substation breaker will open to prevent feedback, the emergency steam turbine will be at full speed, breaker E8X14 will close supplying emergency power through the E8L142 line to 3-15 KVA transformers feed 480 volts to the compressors in the 701 Building, and also 480 volts to the vent fans on the north end of the 401 Condenser Building.

A power loss will also trigger a klaxon horn and a red light atop the SX farm pump house and trip an alarm on the 402-SX Instrument building annunciator alarm panel. Also an audible alarm will be recieved in the 242-S operating gallery.

Immediate Action

1. Upon receipt of alarm, the 242-S operator will notify the day Supervisor if the outage occurs on days or the shift Supervisor at any other time.

2. Immediately inspect the annunciator alarm panel in the 402-SX Instrument building to isolate the alarm signal.

3. Visually check to see that the compressors and vent fan are running on emergency power.

4. Notify the 200W Power House operator that the facility is functioning properly on emergency power. Phone 2-2550.

5. Stand by until the trouble has been corrected the equipment is back on normal power and operating.

6. Push acknowledge button on the annunciator panel to silence buzzer. The klaxon and red light on the pump house will be deactivated when system is switched back to normal power.

LOSS OF ELECTRICITY - TANK FARMS

SY - Farm Introduction

Normal power is supplied by the Bonneville system from the existing 13.8 kV line C8-L4. Power is fed to the SY tank farm through the 242-S Substation. There is no second line or emergency power available on an automatic switch over basis for this farm.

Immediate Action

1. Notify TFO supervision immediately upon loss of power.

2. Lock out transfer pumps that were operating at the time of shutdown.

3. Water flush lines and pumps that were operating.

4. Notify Radiation Monitoring that the stack monitor and air sample equipment have been shutdown.

LOSS OF WATER-"A" FARM COMPLEX

A-AX-AY-AZ TANK FARMS

Introduction

There are three types of water normally used in the A-Farm complex.

1. Raw water used for cooling the Joy compressors and supplying water to the bearing water pits, pit flushing systems and to hose connections.

2. Sanitary water used in the drinking fountain and lavatory facilities.

3. Export water from 201-A tank, used for the condensor cooling water system.

A loss of export water supply will necessitate use of the emergency cooling water tower and associated equipment. The system can be operated independently of the existing raw water and electrical installations.

Major equipment consists of the following:

- A 100 gpm deep well pump located northeast of 241-AX farm.

- A 150 KW capacity motor-generator and associated switch gear and controls for the generator, pumps, and cooling tower. Equipment is located in north end of compressor building.

- An induced draft cooling tower capable of cooling 800 gpm of condensate from 150°F to 90°F.

- Warm water sump with two 1,000 gpm circulation pumps and valving for the deep well pump.

- Automatic control of all equipment, except the deep well pump, is maintained by the vapor temperature controllers.

B. Immediate Action: Loss of Raw Water

1. Sanitary water will be used for cooling the Joy compressors. A hose will be connected to the cooling water system at the compressors and the other end hooked up to the sanitary water supply in the Water Treatment Room, 2707-AX building. Notify supervision immediately.

2. All pumping using bearing water must be shut down as soon as possible.

3. Any work being done in the tanks or associated pits must come to a logical conclusion and the pits closed.

4. Notify Power operator.

C. Immediate Action: Loss of Sanitary Water

1. Notify supervision immediately.

2. Notify other personnel working in the farms that the sanitary water is off.

D. Immediate Action: Loss of Both Raw and Sanitary Water

1. Follow steps B and C of this procedure (except step B.1), notify supervision immediately.

2. Shutdown the Joy compressors and start the diesel powered Le Roi compressor and valve it into the air supply system. (Air lift circulators may have to be adjusted for changes in air capacity).

3. Notify Power operator.

E. Immediate Action: Loss of Export Water

1. When the 201 tank level drops to 18 feet an alarm will sound in the 202-A center control room. If the reason for the drop has not been established and the raw water supply to the 201 tank is insufficient to supply the tank farm demands, activate the emergency cooling tower immediately. (Notify Supervision)

2. Visually check that the following valves in the cold water sump are closed: Ejector pressure float by-pass, 3-inch makeup water,

3-inch stop valve ahead of the float valve in the cold water sump, all stop valves in pump discharge lines, valves at the cooling tower and 8-inch valve (marked #12) to 16-inch header in the condenser building.

4. Close the sluice gate in the warm water sump.

5. Start one lift pump to the cooling tower.

6. Start the cooling tower fans at low speed. Switch to high speed after two minutes.

7. Start the deep well pump. Level in cold water sump will be controlled by float valve.

8. When the cold water sump is filled, start one circulation pump.

9. Check that the butterfly valve in the 16-inch raw water header in the condenser building has closed. (This valve is controlled by a Mercoid switch in the 8-inch header.)

10. With the temperature differential recorder on manual, set the water control valves so that 200 gpm of water is flowing through each of the three operating condensers. (Total flow is 600 gpm.)

LOSS OF STEAM-A FARM COMPLEX

INTRODUCTION

Uses of steam at the A Farm complex includes:

1. Steam to AZ Farm tank coils
2. Steam to AY Farm tank coils
3. Steam to the seal loop of the 101 and 102-AY tanks
4. Steam to the heaters in the vessel ventilation building.

The use of steam in the A Farm ventilation system is critical. Loss of steam for prolonged periods of time may result in wetting of the HEPA Filters by condensate.

IMMEDIATE ACTION

1. Notify TFO supervision when steam loss occurs.

2. Close the steam valve in the 702-A building (Filter side).

3. Shut down the main vessel vent system by pushing the stop button on the vessel vent fan.

4. Switch both vessel vent fans to the off position.

5. Start the standby exhauster per SOP 200.1.16.

6. Open all by-pass valves on steam traps in the A-AX-AY and AZ steam system allowing condensate to flow to the drains.

Note: Traps are at PRV stations and at all points main line goes over head.

RESTORING TO NORMAL OPERATION

1. When all condensate has cleared the line and a full blow of steam occurs at the trap drain lines, close all by-pass valves on the steam traps in the A-AX-AY and AZ system.

2. Open the main stream valve in 702-A SLOWLY!! (One full turn per minute would be a good guide). When the pipe is warm, the valve may be fully open.

3. Start the vessel vent system as per SOP 200.2.1.1.

LOSS OF STEAM - SY FARM

INTRODUCTION

The use of steam is critical in SY tank Farm annulus and tank ventilation systems. Loss of steam for prolonged periods of time may result in damage to the HEPA filter by condensate.

IMMEDIATE ACTION

1. Notify TFO supervision when steam loss occurs.

2. Shut down tank ventilation system by placing both vessel vent fan switches in the off position.

3. Close main steam valve in line to the heater.

4. Shutdown annulus ventilation system and close steam line valves to heater.

5. Open by-pass valves on all steam traps allowing condensate to flow to the drains.

Note: Traps are at PRV stations.

6. Shutdown all transfers while ventilation systems are not operating.

7. Water flush all lines and pumps that were operating at the time of shutdown.

LOSS OF AIR - A FARM COMPLEX

A-AX-AY-AZ TANK FARMS

Introduction

Air to the A-AX-AY-AZ Tank Farms is supplied by four 50-horsepower, vertical, single cylinder, piston-type Joy compressors located in the Compressor Building, 241-A-701. Each compressor has a normal capacity of 360 cfm with a discharge pressure of 40 psig. The compressors are driven by 440 volts, 3-phase electric motors. The four units discharge into a common process air manifold which, through the air receiver tank, supplies both instrument and process air to the tank farms.

Operation of the compressors is automatically controlled by a number of pressure switches and relays. Normal header pressure is 35 psi to 40 psi. Should the pressure start falling off, the standby compressor will start up in order of sequence. A further drop in air pressure to 20 psi will close a pressure switch and sound an alarm in the 241-A-271 Building and also in the Dispatchers Office in the 202-A Building.

In the event of a power outage, a 125 KVA emergency diesel-driven generator will start automatically and provide electricity for the air compressors.

Should both a power outage and emergency generator failure occur, a portable Le Roi diesel-powered compressor parked adjacent to the east end of the Compressor Building could be used. This compressor is maintained in "ready to run" condition and is piped into the discharge air header. Its maximum capacity is 620 cfm so the pressure to the farm air lift circulators may have to be adjusted.

Immediate Action

1. Upon receipt of an alarm in 241-A-271 or 202-A Building the operator on duty shall notify the Shift Supervisor or the 200 East Day Tank Farm Supervisor.

2. Inspect the facility immediately to determine the source of trouble.

3. During a power outage, check to see that emergency diesel generator is operating properly. If not, start manually.

4. If unable to restart compressors, start the portable Le Roi compressors immediately.

5. Adjust air lift circulators for any changes in air capacity.

LOSS OF AIR - S AND SX TANK FARMS

INTRODUCTION

The 241-SX compressor house is equipped with two 5 HP DeVilbiss piston-type compressors to supply instrument air, and two 40 HP Fuller rotary-type compressors to supply process air for the S and SX Tank Farms.

Instrument air compressors serve the following:

1. Instrument sheds on: 107-SX, 108-SX, 109-SX, 110-SX, 111-SX, 112-SX, 114-SX, 115-SX storage tanks.

2. F.I.C. units on: All tanks in S Farm except 104-S

   101-SX, 102-SX, 103-SX, 104-SX, 105-SX, 106-SX

Process air compressors provide air for air lift circulators on the following storage tanks:

105-SX, 107-SX, 108-SX, 109-SX, 110-SX, 111-SX, 112-SX, 114-SX, and 115-SX.

It should be noted that while process air is provided for circulators on these tanks, not all tanks have air lift circulators in operation.

Both pairs of compressors are alternated in service and are equipped with automatic switching devices. Should a "run" compressor fail or shutdown because of overload or excessive heat, the "standby" compressor will automatically start.

When a compressor shuts down, an alarm sounds in the 242-S Building. Immediate action is necessary, as the compressor, which shuts itself off, will not automatically restart, should the running compressor shutdown for any reason.

The process air pressure operating range in 30 psi to 35 psi. Should the pressure drop below 24 psi, it will trip a relay in the 402-SX instrument building annunciator alarm panel, causing a red light to come on and a buzzer to sound. The alarm will be received in the operating gallery of 242-S Building. In addition, a red light and klaxon mounted on the roof of the 241-SX pump house will be activated and will remain so until the trouble is corrected.

IMMEDIATE ACTION

1. Upon sound of the low pressure alarm, the 242-S operator will notify TFO supervision immediately.

2. The TFO supervisor in charge is responsible for dispatching personnel to inspect the 241-SX compressor facility and attempt to determine the source of trouble.

3. Restart the compressor if possible. If unable to restart the compressor notify Maintenance Field Services supervisor; 2-2724, and request a portable air compressor to be brought to the facility.

4. If a portable air compressor is needed, hook up the unit to the process air or instrument air connections provided.

   a. The process air emergency connection is in the pit at the large air receiver tank.

   b. The instrument air connection is inside the building on the intake side of the filter.

RECOVERY

1. When the process has been restored to normal operation, restart the system.

2. Valve out and shutdown the portable compressor and notify maintenance that the portable compressor is no longer required at this facility.

LOSS OF AIR - SY TANK FARM

INTRODUCTION

The 241-SY instrument air compressor, located at the 241-SY instrument shed, supplies instrument air to the 241-SY Tank Farm. If the 241-SY farm compressor fails the instrument air will be automatically supplied from the 242-S instrument air supply system.

Note: If the 241-SY instrument air compressor shuts down it will not sound a low pressure alarm at the 242-S Building.

IMMEDIATE ACTION

1. If the 241-SY instrument air compressor is found to be shutdown, the operator will notify TFO supervision immediately.

2. The TFO supervisor is responsible for dispatching personnel to inspect the 241-SY instrument air compressor and attempt to determine the source of trouble.

3. Restart the compressor if possible. If unable to restart the compressor notify Maintenance Personnel for repairs.

4. If instrument air is lost at the SY-Farm and the 242-S instrument air system, refer to RHO-MA-115 Plant Tank Farms, Loss of Air 242-A and 242-S. Emergency Procedure.

Note: The portable compressor unit will supply air to the SY-Farm instruments.

RECOVERY

After the 241-SY instrument air compressor has been restored to normal operating condition, restart the compressor.

RADIOACTIVE GASEOUS DISCHARGES-TANK FARMS

INTRODUCTION

Gases discharged from the various Tank Farm stacks are monitored for radioactivity. Some of the emissions are measured and recorded continuously while others are monitored by periodic counts of air samples. Laboratory measurements are used for final determination and record all stack samples.

Certain actions and notification are required in the event of a significant discharge of radioactivity.

Gaseous Discharge-Radioactivity Level Determination

First indication that a release of radioactive material to the atmosphere may have occurred will come from a monitoring instrument reading on a stack air sample.

Operating surpervision is to be notified at the first indication of an abnormal reading or alarm and will proceed to determine actions as outlined in Section C, below.

ACTION REQUIRED

Supervisor's Responsibilities

1. Upon receiving an alarm, the responsible supervisor will immediately notify Radiation Monitoring, then proceed to investigate or determine whether the alarm was due to high radioactivity or an instrument malfunciton.

2. The supervisor will request replacements of the air sample and an immediate count of the sample by Radiation Monitoring.

3. The supervisor will notify the Emergency Officer (Phone 811) and his management if the alarm is found to be due to a radioactivity level that exceeds the levels described in the Section titled "Levels of Release and Action Required," found on page 2-33.

4. The supervisor will initiate an investigation to determine the source of radioactive emissions.

5. The supervisor will keep management and the Emergency Director informed throughout the progress of his investigations. He will consult with management upon the course of action to resolve the problem. He will prepare a written report of the investigation and findings.

Radiation Monitoring Responsibilities

Radiation Monitoring will provide assistance by changing air samples, counting samples and evaluating data.

Tank Farm Process Engineering

Operations Support Engineering will provide assistance as required during the investigation, isolation and resolution of problems.

Management Responsibilities

1. Tank Farm Operations (TFO) management will provide guidance as required during the investigation, isolation and resolution of problems and maintain contact with the Emergency Director.

2. TFO Management will implement activities required of personnel under emergency conditions, subject to instructions by the Emergency Director.

3. The Manager, TFO will communicate all information to Departmental Management required under emergency conditions.

Levels of Release and Action Required

The Rockwell Hanford Operations Emergency Plan, RHO-MA-111 states that a Group 2 emergency exists when an alarm is activated and then is verified as an actual release of radioactive material to the environment.

The following descriptions specify actions to be taken for various levels of release of radioactive material.

Class I

Definition. Daily environmental discharge exceeds ten percent of the release level values specified in Section 5 of Radiation Protection Standards for more than 48 hours.

Action. Notify the Emergency Officer (Phone 811), plant, department and function management. Investigate to determine the cause. Document the investigation and conclusions.

Class II

Definition. Daily environmental discharge exceeds ten percent of the release level values in Section 5 of Radiation Protection Standards for more than 48 hours.

Action. Notify the Emergency Officer (Phone 811), plant, department and function management. Investigate to determine the cause. Document the investigation and conclusions.

Class III

Definition. Environmental discharge exceeds the release level value in Section 5 of Radiation Protection Standards.

Action. Notify the Emergency Officer (Phone 811), plant, department and function management and promptly investigate to determine the cause and corrective action.

Class IV

Definition. Environmental discharge that exceeds ten times the release level values in Section 5 of Radiation Protection Standards.

Action. Notify the Emergency Officer (Phone 811), plant, department and function management immediately. Investigate promptly to determine the cause and corrective actions. If control cannot be immediately established or the discharge has exceeded 100 times the release level values, the facility shall be shutdown. Document the investigation and conclusions. Take positive action to prevent recurrence.

RADIOACTIVE LIQUID DISCHARGES - TANK FARMS

INTRODUCTION

Liquids discharged from various Tank Farm sources are monitored for radioactivity. Some of the emissions are measured by proportional samples while others are monitored by periodic samples. Laboratory measurements are used for final determination and record on all liquid effluent samples.

Certain actions and notifications are required in the event of a significant discharge of radioactivity.

LIQUID-DISCHARGE RADIOACTIVITY LEVEL DETERMINATION

First indication of a release of radioactivity may come from a monitoring instrument, from a preliminary radiation instrument reading on an effluent sample, or from a laboratory analysis.

Operating supervision is to be notified at the first indication of an abnormal reading or alarm and will proceed to determine actions as outlined in Section C, below.

ACTION REQUIRED

Supervisor's Responsibilities

1. Upon receipt of an alarm, abnormal radiation reading, or high laboratory analysis, the responsible supervisor will immediately investigate to determine validity of the observation of measurement.

2. The supervisor will notify the Emergency Officer (Phone 811) and his management if the alarm or radiation reading is found to be due to a radioactivity level that exceeds the levels described in Section D, below.

3. The supervisor will initiate an investigation to determine the source and cause of the radioactive emission.

4. The supervisor will keep management and the Emergency Director informed throughout the progress of his investigations. He will consult with management upon the course of action to resolve the problem. He will prepare a written report of the investigation and findings.

Radiation Monitoring Responsibilities

Radiation Monitoring will provide assistance where required for taking preliminary radiation readings on samples.

Operations Technical Support

Operations Technical Support will provide assistance as required during the investigation, isolation and resolution of problems.

Management Responsibilities

1. Tank Farm Operations management, Tank Farm Management Department will provide guidance as required during the investigation, isolation and resolution of the problem and maintain contact with the Emergency Director.

2. The Tank Farm Operations management will implement activities required of personnel under emergency conditions subject to instructions by the Emergency Director.

3. Tank Farm Operations management will communicate all information to departmental management required under emergency conditions.

Levels of Release and Actions Required

The Rockwell Hanford Operations Emergency Plan, RHO-MA-111 states that a Group 2 emergency exists when an alarm is activated and then is verified as an actual release of radioactive material to the environment.

The following descriptions specify actions to be taken for various levels of release of radioactive material.

Liquid Release Levels to Ponds and/or Ditches

Class I

Definition. The batch or monitored discharge reaches 50 percent of the release guide concentration values in ARH-220, Radiation Protection Standard No. 5 for two successive batches or for eight hours in any effluent stream. (Any monitored stream concentration to be checked by one laboratory analysis).

Action. Notify the Emergency Office (Phone 811), plant and department management. Investigate to determine the cause. Record the investigation and its conclusions.

Class II

Definition. Batch or monitored discharge ranges 50 to 100 percent of the release guide concentration values in ARH-220, Radiation Protection Standard No. 5 for four successive batches or for 24 hours in any effluent stream. (Any monitored stream concentration to be checked by one laboratory analysis).

Action. Notify the Emergency Officer (Phone 811), plant and department management. Investigate to determine the cause. Record the investigation and its conclusions. Since continued operation at this effluent discharge level can be cause for shutdown, make preparations for an orderly plant shutdown.

Class III

Definition. Batch or monitored discharge exceeds the release guide values in ARH-220. Radiation Protection Standard No. 5. (Any monitored stream concentration should be checked by one laboratory analysis).

Action. The facility shall be shut down immediately after another sample of the stream has been taken. Notify the Emergency Officer (Phone 811), plant, department and function management who will notify the U.S. Department of Energy (DOE) - Richland Operations Office immediately. Investigate to determine the cause and take corrective action. Positive measures to prevent recurrence shall be implemented prior to restarting the facility. The cause, corrective and preventive measures and other pertinent information resulting from the investigation shall be documented.

LIQUID RELEASE LEVELS TO CRIBS

Class I

Definition. Batch or monitored discharge reaches the plant standard concentration value for radioactivity for 12 hours on monitored stream or an equivalent number of batches. (See ARH-1601, Specification and Standards for Tank Farm Operations). (Any monitored stream concentration to be checked by one laboratory analysis).

Action. Notify the Emergency Officer (Phone 811) and plant management. Investigate to determine the cause. Report the investigation and its conclusions.

Class II

Definition. Batch or monitored discharge ranges between one and ten times the standard concentration value for 72 hours on monitored streams or an equivalent number of batches. (See ARH-1601, Specifications and Standards for Tank Farm Operations). (Any monitored stream concentration to be checked by one laboratory analysis).

Action. Notify the Emergency Officer (Phone 811), plant and department management. Investigate to determine the cause. Record the investigation and its conclusions. Since continued operations at this discharge concentration can be cause of shutdown, make preparations for recylce or orderly shutdown of the facility.

Class III

Definition. Batch or monitored discharge exceeds the specifications for the annual discharge of radioactivity to the respective crib (See ARH-1601, Specifications and Standards for Tank Farm Operation). (Any monitored stream concentration should be checked by one laboratory analysis).

Action. The facility shall be shutdown immediately after another sample of the offending stream has been taken. Notify the Emergency Officer (Phone 811), plant, department and function management who will notify DOE-RL immediately. Investigate to determine the cause and take corrective action. Positive measure to prevent recurrence shall be implemented prior to restarting the facility. The cause, corrective and preventive measures and other pertinent information resulting from the investigation shall be documented.

CRITICALITY AND RADIATION

GENERAL FISSILE LOCATIONS

Within the tank farms, concentrations of fissionable material in the wastes processed through tank farm facilities is very small and considered safe under all conditions. Nuclear criticality considerations are normally not involved in TFS plant operations.

Within Rockwell Hanford Operations, the 234-5 Plant complex is presently the only area where fissile material is handled and stored. A second area, when operations resume, will be the Purex Plant. Even though no fissile material is stored in Purex at this time, a residual amount is still present in old gloveboxes, process equipment, and vessels. Fissile material is also present at the Pacific Northwest Laboratory's (Battelle) Critical Mass Lab (E-209-E) located near the old semiworks building in 200 East Area.

GENERAL RADIATION AREAS

The radiation areas which TFS Plant personnel will be working in include:

- All designated 200 East and West Area Tank Farms
- Regulated Ponds, cribs, ditches
- Underground radiation areas designating buried piping and swab risers.

CRITICALITY SAFETY PRINCIPLES

Even though nuclear criticality considerations are not involved with TFS Plant operations, it is important to know the basic criticality Safety Policy of Rockwell Hanford Operations for fissile material handling.

The contingency philosophy of Rockwell states criticality prevention shall be based on the philosophy that at least two unlikely, independent, and concurrent changes (contingencies) in processing (and/or operating) conditions are required before a criticality is possible in shielded areas. For unshielded areas, criticality prevention shall be based on the occurrence of three such changes (contingencies) before a criticality is possible.

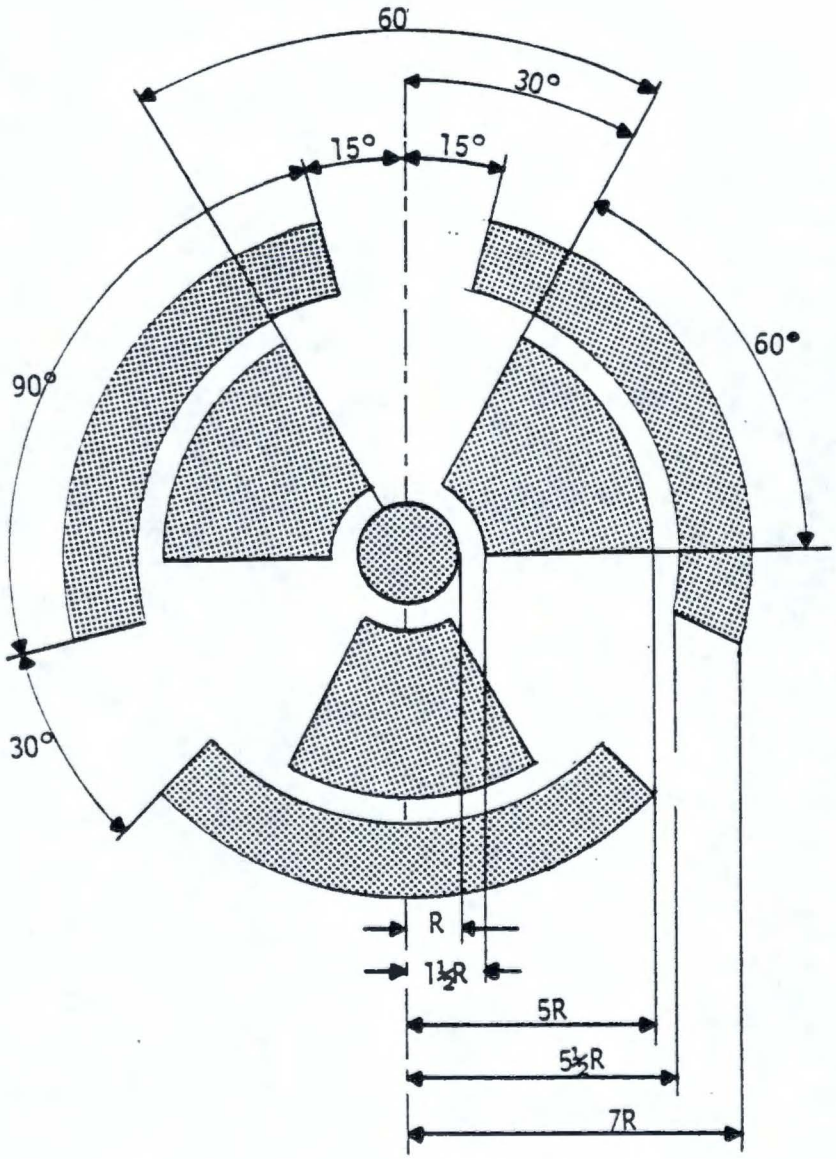
In addition to the contingency philosophy, additional criticality safety criteria apply to all phases of fissile material handling throughout Rockwell. These criteria are listed below:

- Criticality prevention provisions of RHO-CD-136 shall be applied to all handling, processing, storage, transporting, and shipment of fissile material within the responsibility of Rockwell.
- Establishment of criticality limits shall take into account neutron interaction between systems or individual units (e.g., individual fissile material batches, containers, or vessels), unless the systems are isolated to the extent ensured by one of the criteria referenced in Section 2, page 2 of RHO-MA-136.
- Where practical, all new design for moderated operations involving more than 150 grams ^{239}Pu, ^{233}U, ^{235}U, such as washing, dissolving, or use of substantial amounts of plastic shall employ equipment designed to be subcritical for the most reactive concentration of fissile material up to 450 grams per liter, including interaction of units.
- Materials with good neutron reflecting or moderating properties (for example, water, plastics, or carbon) and combustible materials shall be kept to a minimum consistent with operational requirements in areas where fissile material operations are conducted.
- Within fissile facilities, fissile material may be handled, stored, processed, or transported only in designated areas which have been analyzed and are controlled for criticality safety. The posting for fissile materials shall be identifiable from all regular personnel access points at a distance of at least equal to the spacing requirement for other fissile material and on the blind side of nonisolating walls or partitions behind which fissile materials may be regularly processed or stored.

- Fissile material must be properly identified at all times. Labeling and identification of fissile material shall be according to RHO-CD-28 Revision 1 as written by Nuclear Materials Control.
- The fissile symbol design shall conform to the requirements of American National Standards Institute (ANSI) Standard N. 12-1-1971, as displayed in Figure 3-1.

BASIC FISSILE MATERIAL SYMBOL

American National Standards Institute



NOTE 1: ALL SHADED AREAS SHALL BE PURPLE AND BACKGROUND SHALL BE YELLOW

NOTE 2: R - RADIUS OF CENTRAL DISC.

NOTE 3: THE SEGMENTS OF THE CIRCLE MAY INCLUDE THE WORD "FISSILE" AS DESCRIBED IN ANSI N12.1-1971

FIGURE 3-1. Basic Fissile Material Symbol

CRITICALITY PREVENTION GUIDE RULES

A set of guide rules for criticality prevention is listed below. The rules are for protection and the protection of your fellow workers. KNOW THEM AND USE THEM.

1. FOLLOW PROCEDURES STRICTLY.
2. NEVER TAKE SHORT CUTS.
3. NEVER OPERATE ON GUESSWORK OR "HUNCHES".
4. IF ANY UNUSUAL CONDITIONS OCCUR, STOP WORK AT ONCE AND NOTIFY SUPERVISION.
5. NEVER MAKE TRANSFERS WITHOUT KNOWING THE CONDITION AND CONTENT OF EACH VESSEL INVOLVED.
6. CAREFULLY CHECK ANALYTICAL RESULTS. COMPARE RESULTS WITH WHAT IS ANTICIPATED.
7. NEVER EXCEED OPERATING LIMITS FOR ACCUMULATION OF FISSILE MATERIAL.
8. GIVE DETAILED INFORMATION TO SUPERVISION OR TO YOUR RELIEF BEFORE TURNOVER.
9. KEEP ALL RECORDS AND LOGS UP TO DATE.
10. IF AN INCIDENT SHOULD OCCUR, YOUR BEST PROTECTION IS AN IMMEDIATE EVACUATION.

CRITICALITY PREVENTION TERMS

Chain Reaction	A series of fissions such that a fission reaction initiates a succeeding one thus causing the reaction to be self-sustaining.
Enriched Uranium	Uranium which has been processed to increase the weight fraction of the fissionable ^{235}U atoms.
Fission	A splitting or breaking up of an atomic nucleus resulting in the release of large amounts of energy.
Fission Products	Elements formed from the fragments of fissioned atomic nuclei.
Neutron	An uncharged particle present in all atomic nuclei except the hydrogen nuclei.
Nuclear Incident	An unplanned chain reaction.
Nucleus	The positively charged central portion of an atom that comprises nearly all of the mass of an atom.

CRITICALITY PREVENTION SPECIFICATION

INTRODUCTION AND UNIFORM LIMITS

Applicable Locations

This specification applies to the following Z Plant areas: 216-Z9, 232-Z, 234-5Z, 234-5ZC, 236-Z, 241-Z, 242-Z, 2736-Z, 291-Z, and 224-T with the following exceptions:

1. Rooms 225 and 131 through 157 of the 234-5 Building are covered by ARH-2002 or ARH-MA-170 when issued.
2. Rooms 179-C through 191 and the west half of 179-B are covered by ARH-16 or ARH-MA-170 when issued.

The limits in this specification apply unless superseded in specific locations by individual specifications.

Introduction

This portion contains Criticality Prevention Specifications for areas stated in the "Applicable Locations" section above. The limits are given in these specifications are based upon:

1. One gram of plutonium is treated as one gram of ^{239}Pu*.
2. One gram of ^{235}U is treated as one gram of ^{239}Pu.
3. One gram of ^{233}U is treated as 10 grams of ^{239}Pu.
4. One gram of americium is treated as one-fiftieth gram of ^{239}Pu.
5. Natural or depleted uranium (0.72 weight percent ^{235}U) may be handled in any quantity.
6. Isotopes (^{249}Cf and ^{243}Cm) with minimum critical masses less than plutonium require a special specification.

*Except in 216-Z9 where plutonium is considered to consist of 3 weight percent ^{240}Pu and 97 weight percent ^{239}Pu.

7. Isotopes (^{237}Np, ^{240}Pu, and ^{244}Cm) with minimum critical masses greater than plutonium may be handled gram for gram as ^{249}Pu.

It is to be understood that only the handling, storage, processing, and transporting of fissile material covered in a specification is allowed. Any action not provided for in a specification may not be performed.

LIMITS

General

- Discrete containers with 15 grams or less of fissile material and accumulations of such containers up to a maximum of 150 grams of fissile material are permitted with no spacing or location requirements imposed. An accumulation is said to exist if two or more 15-gram-or-less containers have edge-to-edge spacings of less than 25 cm (10 in.).
- Decontamination solution may be brought into any hood or area for the purpose of cleaning contaminations but the plutonium content in the solution shall not exceed 100 grams. Up to 10 rags with a maximum size of 6 sq. ft. per rag are allowed in any hood or area at one time.

Undetermined Quantities of Plutonium

Any item containing an undetermined quantity of plutonium, such as a waste drum shall be stored, handled, and transported with at least a 91 cm (3 ft.) spacing from any other quantity of plutonium greater than 100 grams until the plutonium content is determined.

Equipment Modifications and Replacement

All equipment changes shall be governed by ARH-MA-154 Policy E-3, Administrative Procedure No. 2 of the Scientific, Technical, and Engineering Manual.

Violations

If a criticality prevention specification violation occurs, the requirements of ARH-MA-136 Procedure XII shall be followed.

Fire Fighting

All Z Plant plutonium storage and operating areas are B or C category. Criticality drains shall be maintained free of debris and free-flowing to prevent the accumulation of liquids in hoods:

H-7A	236-Z East Cell Access Hoods
HC-7	236-Z West Cell Access Hoods
HC-6	236-Z 4th, 5th, 6th Floor Column Hoods
HC-227S	236-Z MT Hoods 3, 5, 6
HC-4	
HC-30	
HA-23S	
HC-1	
HC-5B	

Plutonium-Beryllium Systems

A plutonium-beryllium system shall be considered as moderated by hydrogen only (one beryllium atom shall be counted as one hydrogen atom). Plutonium-beryllium systems with Be/Pu atomic ratios >20 shall not be in locations that have a limiting plutonium concentration of 20 grams/liter or less (i.e., RC cans).

Inactive Glove Boxes and Hoods

The following limits apply to inactive glove boxes and hoods:

- Criticality Engineering and Analysis shall be informed when a glove box is placed in an inactive status.
- The fissile content shall be known by NDA and the location of fissile material if localized.

Exception: If an NDA of the glove box or hood is not performed, the glove box or hood shall be assumed to contain >100 grams of Pu.

- Reasonable effort shall be made to remove accessible fissile material prior to declaring the hood or glove box inactive.

- While in an inactive status, the only permitted fissile movement is that up to 3 empty containers ≤1.5 liters each may be brought into a hood or glove box with ≤2500 grams fissile material at one time for the removal of residual fissile material. An inactive hood or glove box with >2500 grams fissile material shall have a special specification written for it before fissile material movement is permitted.

Exception: No CPS controls are necessary if the hood or glove box contains ≤15 grams fissile material.

- If the inactive hood or glove box contains >100 grams fissile material, a 91 cm (3 ft.) mimimum spacing is required between the hood or glove box and any fissile material stored near it. No spacing is required if the hood or glove box contains ≤100 grams fissile material.

- If the inactive hood or glove box contains >100 grams of fissile material a 46 cm (18 in.) minimum spacing is required between the hood or glove box and any fissile material in a transportation status. No spacing is required if the hood or glove box contains ≤100 grams fissile material.

CRITICALITY ALARM AND DOSIMETRY SYSTEMS

Introduction

Criticality alarm systems (CAS) and criticality dosimeters are required by Department of Energy Manual Chapter 0530 in facilities where fissile materials are handled in quantities which could cause a nuclear criticality. The purpose of the CAS is to detect a criticality and signal immediate evacuation. Criticality dosimeters are used to provide post-incident information on the composition of the radiation field resulting from a criticality to allow determination of individual doses.

Criticality Alarm Systems

Locations Where a Criticality Alarm System is Required. A CAS is required in all fissile facilities.

Portable CAS's may only be used for temporary operations where a permanently installed system is unnecessary. Criticality Engineering and Analysis (CE&A) and Radiological Engineering approval is required for portable CAS use.

Transport of fissile material outside facilities does not require a CAS.

Design and Functional Requirements for Criticality Alarm Systems.

- Detectors shall be designed, located, and adjusted to detect radiation (gamma ray or neutron) resulting from a criticality which would cause an absorbed dose in soft tissue ≥20 rads of combined neutron and gamma radiation at an unshielded distance of two meters within one minute. Areas of a fissile facility which are shielded to protect personnel from receiving more than 20 rads from a credible criticality originating from behind the shielding do not require detector coverage meeting the requirements of items 1 through 7. However, means shall be provided to detect a criticality in such areas either directly or indirectly.
- Instrument sensitivity and response shall be such that as a result of a radiation transient producing 20 rads as in item 1, above, even if occurring over a short a time as one millisecond, an evacuation alarm shall be activated with no perceptible delay.
- The evacuation alarm signal shall be a continuous repeating AH-OO-GAH producing an overall sound pressure level which is not less than 10 decibels above the overall maximum ambient noise level, and, in any case, not less than 75 decibels at every location from which prompt evacuation is essential. A sufficient number of alarm signal units shall be installed such that these requirements are met.
- The alarm system shall be designed so that the alarm signal continues to sound after the radiation level has fallen below that required for activation.

- Coverage of all areas by two or more detectors is required with the concurrent response of two or more of them being necessary to initiate the evacuation alarm.
- Detector malfunction shall be indicated by both visual and audible signals. The status of the system shall be constantly indicated in a continuously occupied location.
- Auxiliary battery power supplies shall be utilized for the CAS so that monitoring can continue during power outages. Transfers from normal to auxiliary power shall be automatic and essentially transient free.

Criticality Dosimetry System

A system for criticality dosimetry is required in any facility in which a CAS is required to provide gamma and neutron dose information on individuals following a criticality.

Personal dosimeters, fixed station dosimeters, analysis of biological samples, and "quick sort" techniques are used at Rockwell Hanford Operations (Rockwell) to provide dose information.

Personal Dosimeters

All personnel entering facilities in which CAS's are required to wear personal dosimeters.

TRAINING AND QUALIFICATION

Employees must be trained in the prevention and control of criticality hazards. Satisfactory completion of the required criticality training is a prerequisite for employees prior to their handling fissile material within company facilities. A major factor in criticality safety is strict adherence to written limits and controls. It is essential that the personnel involved understand the bases and the details of these limits and controls as they apply to the individual's work assignments.

This standard outlines the requirements for criticality safety training, qualification, and documentation of qualifications of personnel.

Requirements for Fissile Facilities

Training and Qualification. A criticality safety training and qualification program is required for the following personnel assigned to fissile facilities:

- Fissile material handlers*.
- Personnel directing the activities of fissile material handlers.

In addition, design engineers, project engineers, process engineers, fire fighters, maintenance personnel, and all others assigned to a fissile facility or who, within their area of job responsibility could be expected to work in a facility, shall receive criticality safety training appropriate to the level of involvement and responsibility. Satisfactory completion of the criticality safety training program is required for all personnel who work within a fissile facility.

Fissile material handlers and personnel directing their activities shall receive a physical examination prior to employment or assignment. Management shall schedule periodic physical examinations for these individuals to verify the continued capability of the employee to meet the physical requirements of the job. Individuals who have had any serious injury or illness shall be cleared by medical examination prior to returning to work to attest to the fitness of the employee to perform defined tasks safely.

Information on meeting medical requirements for fissile material handling assignments is shown in Appendix III.F. Although certain prerequisites have been established as medical requirements, the physician's judgment

*See glossary for definition.

on the individual's fitness to perform assigned tasks, as described by management, is the final decision. The medical requirements for these job assignments is dictated entirely by safety.

Individuals who have not successfully completed formal training shall not be allowed to handle fissile material even under the direction of another.

Individuals who have successfully completed formal training may be allowed to handle fissile materials as a part of on-the-job training, but only when under the constant direction of a qualified individual.

Formal training is defined to be that training received in formal classroom training sessions on subject material listed in Appendix III.A.

On-the-job training, an essential part of the overall training program, is defined to be that training an individual would receive during actual performance (under constant supervision), observations of an operation, or discussions with immediate management on those points listed in Appendix III.A.

On-the-job training for those items shown in Appendix III.A shall be sufficiently detailed to provide for the proficiency and safety required to perform the complete tasks involving fissile material, i.e., the overall system function and operation, not just those plant operations controlled by the criticality prevention specification (CPS).

Only individuals fully qualified as a result of formal and on-the-job training or retaining shall be allowed to independently handle fissile material, perform any function intimately connected with fissile material, or direct the activities of those who do.

Following successful completion of the formal training and on-the-job training programs, and receipt of a satisfactory statement of medical condition from the Hanford Environmental Health Foundation (HEHF),

fissile material handlers and those who supervise them shall be approved in writing by their managers to work within the facility. This approval shall be entered in their training record.

The Manager, Criticality Engineering and Analysis (CE&A) shall provide the formal training programs suitable for the personnel identified above. Immediate manageers of these personnel shall supplement the formal training with on-the-job training as outlined in the appendix. Managers of employees to be trained may review training programs.

Table 3-1 summarizes the general subjects requiring formal and on-the-job training for the categories of personnel involved and the frequency for requalification and retraining.

Training Records. Management Development and Training shall maintain the official records of criticality safety training and qualification status.

The Manager, CE&A shall record on the employees training record the formal courses taken, subjects covered, and any examination scores. This information shall be forwarded to the employee's manager and MD&T.

The individual conducting the on-the-job training will record information concerning such training for each employee. On-the-job training shall be documented on the appropriate training record.

On-the-job training record sheets shall be used for annual on-the-job training on emergency procedures and response. Copies of these sheets shall be forwarded to MD&T.

Managers of fissile material handlers and those who supervise handlers shall maintain a summary of criticality training records for each of their employees. A new form shall be used for each two year qualification cycle.

TABLE 3-1. Training Requirements for Fissile Material Handlers and Those who Supervise Fissile Material Handlers.

Training Subjects	Fissile Material Handlers	Those Who Supervise Fissile Material Handlers*	Frequency of Requalification***
Criticality and Its Consequences	F	F	Every two years
Parameters Significant to Reactivity Changes	F	F	Every two years
Contingency Philosophy	F	F	Every two years
Criticality Prevention Methods and Responsibilities	F	F	Every two years
Labeling and Posting Requirements	F	F	Every two years
Emergency Procedures and Response	F-OJT	F-OJT	Annually
Appropriate Section of RHO-MA-136	F	F	Every two years
Normal and Abnormal/Infrequent Operating Procedures; Emergency Action, and Administrative Controls and Responsibilities	OJT	OJT	Annually
Radiological Safety and Control, as Applies to Plant Characteristics/ Specifics	OJT	OJT	Every two years

F indicates formal training, OJT indicates on-the-job training. The depth of subjects covered shall be appropriate for the duties and responsibilities of the category of employee. Where formal and on-the-job training are listed together, formal training should preceed the on-the-job training.

* Indicates qualification by satisfactory completion of the program is required. Training records shall be maintained by operating or laboratory manager.

*** In addition, retraining is required whenever performance deficiencies, such a failure to follow written operating procedures, failure to observe or respond to alarms or other instrument trends indicating the development of equipment or process problems, violation of safety limits, careless handling of radioactive or other hazardous materials, etc. Training may be OJT or formal as determined by the employee's manager. Retraining shall be documented in the employee's training record. Requalification requires completion of the same requirements as the original qualification.

Training records shall be maintained for certain other employees assigned to or providing support to fissile facilities. The employee's manager shall maintain a summary sheet for each employee listing the training received for each two year cycle.

The criticality training records shall be transferred with the employee whenever the employee is assigned to another organization within Rockwell Hanford Operations (Rockwell). The record copy of all criticality safety training shall remain with the MD&T Department.

Requirements for Isolated and Limited Control Facilities

Training. Management in these facilities is responsible for conducting initial training and annual retraining on the following subjects:

- Classification of the facility and basis for it.
- Necessary controls, if any, consistent with the facility classification.
- Inventory and labeling requirements, as appropriate.

Training Records. The subjects covered in the annual training session and a list of attendees shall be maintained by the facility manager in a central location and also transmitted to the Manager, MD&T.

Training Materials

The description of formal and on-the-job training received shall be in sufficient detail to allow auditing personnel to adequately assess the degree of training of the employee.

CRITICALITY SAFETY GLOSSARY

Array - An arrangement of containers, such as tanks, cans, etc., which are spaced a fixed minimum distance from other containers of plutonium for nuclear safety purposes.

Container - A container is a rigid, movable object used primarily for contamination control purposes, for packaging, or for containing a quantity of fissile material. The container may be made of plastic, cardboard, wood, glass, or metal such as a bottle, waste carton, jar, beaker, or drum. It must be capable of confining the contents to the shape of the container. An object which is normally considered a container may be classified as a non-container for nuclear safety purposes only if it meets one of the following criteria:

- An object with the height of the sides ≤2.5 cm (1 in.) (e.g., burning pan, lid, tray). A group of such objects are classified as containers if they are stacked to a height of >2.5 cm.

- At least 10 percent of the bottom surface area is open (holes or screen) and the bottom surface is not obstructed for solution flow. Alternately, if the bottom surface is positioned so that free passage of solution from the object cannot be asssured, each side of the object shall contain an opening(s) whose area is ≥1 sq. in. and the center of which is no more than 1 in. above the bottom. (A cylindrical object is considered to have one side.) In either case, the minimum individual hole size shall be equal to the area of a 1/2 in. diameter hole. Screen shall be 16 mesh or larger size.

- The object is watertight or covered with a watertight lid and known to contain no fissile material.

- The object is stored upside down or on its side so that it cannot retain fissile material. (Cartons in sphincters are in ths category.)

- The object is a fixed process vessel, piece of equipment or is specifically exempted by the specification.

When containers are totally contained inside outer containers, only the volume of the outer container need be considered.

No solution containing >15 grams fissile material shall be in a plastic bag unless the liquid is held in an inner container or the plastic bag is held in an outer container. Fissile liquid accumulation in glove box gloves shall be limited to no more than 15 grams Pu. Liquid detected in a glove can be dumped back into the glove box under Unique Procedure 77.16, "Prevention and Handling of Solution in Glove Box Gloves", approved by Criticality Engineering and Analysis.

Criticality Drain - An opening in a hood (glove box) to limit the depth of liquid that can accumulate in the bottom of a hood. This drain is designed to maintain a safe level of solution in a hood during the fighting of a fire with water or an accidental release of solution from process piping or equipment.

Criticality Safety Representative - An engineer in the Criticality Engineering and Analysis Section who has been assigned as a representative on criticality prevention matters for a facility. His responsibilities include: writing criticality prevention specification, performing internal audits and general liaison for criticality prevention matters.

DOE Certificate of Compliance - The license document that states shipping containers have met rigid tests by the government for transportation of fissile material.

Encasement (Pipe) - A pipe enclosed in another pipe or similar confining container (e. g., concrete mold or rigid plastic sleeve) used to doubly contain a process line containing a high level of radioactive material from its surrounding environment.

Facility - An entire building or a portion of a building which comprises an operating entity, including primary and supporting equipment, that is permanently established and physically separate from other facilities, such that separation does not depend upon administrative control.

Fixed Equipment - Equipment which is bolted, welded, or otherwise firmly fixed in a processing area or whose movement is restricted by design.

Glove Box - An enclosure having openings fitted with gas-tight gloves by means of which certain radioactive or other special materials may be handled safely. The box is usually kept under slight negative pressure and ventilation is provided through high efficiency filter (HEPA filters).

Hood - A small ventilated enclosure for performing work on process materials or equipment. Hoods permit visibility (via transparent walls or windows) and access (via glove ports and air locks) while maintaining control of contamination.

Hydrogen/Plutonium Ratio - The ratio of hydrogen atoms to plutonium atoms in a package of plutonium-bearing material. Material with $H/Pu \leq 2$ is considered unmoderated material and material with $H/Pu > 2$ is considered moderated material, although in some cases the moderated group will be subdivided.

Table 3-2. Routinely Handled Materials in Z Plant and the H/Pu Ratio Assigned to the Material.

Material	H/Pu Ratio
1. Plutonium Metal	2
2. Plutonium Oxide	2
3. Slag and Crucible Fragments	2
4. Plutonium-Aluminum Alloys	2
5. Zr Clad Fuel Element Pieces	2
6. Plutonium Fluoride	2
7. Incinerator Ash	10
8. Sludge Dried on a Hotplate	20
9. Room and Hood Waste	fully moderated
10. HEPA Filters (any size)	fully moderated
11. Plutonium Oxalate, damp or dry	fully moderated
12. Any plutonium item which is damp or has liquid moisture present	fully moderated

The Criticality Safety Representative may be consulted on any item not on the list for which there is any doubt as to its hydrogen to plutonium ratio or the item shall be handled, processed, or stored using the limits of fully moderated material.

Inactive Hood or Glove Box - A hood or glove box not covered by an individual specification. Specification coverage for such hoods or glove boxes is provided by CPS No. 80.1, Section G.

Isolation Wall - A wall which prevents neutron interaction between two arrays. An example is 30 cm (12 in.) of water or 30 cm (12 in.) of concrete or the equivalent.

Loaded Container - A container within a hood or glove box with more than 15 grams of plutonium.

Moderator - A material used to slow down neutrons. Common moderating materials are graphite (carbon), beryllium, heavy water (D_2O), water and other hydrogenous materials such as oil, wax, plastic, and concrete.

Movable Equipment - Equipment normally fixed which is being moved for maintenance, disassembly or transfer purposes.

NDA (Nondestructive Assay) - Measurement techniques used for determining quantities and isotope of plutonium (or other radioactive compounds) without physically or chemically changing the material being measured.

Pallet - A portable platform, usually made of aluminum, used for Z Plant for handling, storage, or movement of plutonium buttons or other unit mass within the RMC Fabrication Line Hoods (see drawing H-2-23860).

Powder Pan - A geometrically favorable container used for the collection and transport of plutonium compounds within a process hood.

Storage - An item is considered to be in storage when it is left unattended.

Storage Array - An arrangement of storage units.

Cubicle Storage - A type of storage arrangement which utilizes a partitioned shelf or space for storage of a unit mass with a fixed spacing between unit masses (reference drawings H-2-26286, 26317, 26370, 26422, and 26649).

Pedestal Storage - A storage arrangement which consists of a base (long pole) which supports a column of storage units with a fixed distance between units (reference drawings H-2-26286, 26317, 26370, 26422, and 26649).

Storage Location - An area used for storage of fissile material.

Storage Unit - An enclosure (box, shelf, cabinet, container, etc.) within a storage location which has specified limits as to the amount and type of fissile material stored there.

Sump - A pit, tank, or reservoir serving as a drain or receptacle for liquid, usually located at the lowest point in the system.

Transit - A unit mass is said to be in transit if it is out of storage and attended by some individual.

Transition - The movement of material from a hood or storage array into a transportation array and vice versa.

Transportation Array - An array that is being moved by some means of locomotion (e.g , individual wagon, cart, car, or truck).

Unit Mass - A specified mass of fissile material in an easily recognized location and contained in a specified volume of containers such as the contents of a single can, or a group of containers at one location. All containers in a hood shall be considered as part of the volume of a unit mass whenever unit mass limits are stated. Fixed equipment is not included in unit mass limits.

CONTAMINATION CONTROL

During TFS plant operations, the two forms of radioactive contamination which may be encountered are surface and/or airborne contamination. It should be noted that it is possible to have surface contamination without having airborne contamination. However, it is not usually possible to have airborne without the presence of some surface contamination.

AIRBORNE RADIOACTIVITY AND CONTROL

Airborne radioactivity is the presence of radioactive particles or gases in the air. Airborne radioactivity is more difficult to control than surface contamination; therefore, steps should be taken to minimize the potential for airborne prior to starting any job. The main reason for controlling airborne radioactivity is to limit the internal radiation exposure that can result from the inhalation of radioactive material. Minute radioactive particles deposited in body tissue can cause severe damage to localized tissues, and may stay lodged for years in the body until natural bodily functions or the radioactive decay process removes the hazard.

Airborne radioactivity usually results from disturbing loose contamination present on equipment or in a work area. There are several basic methods that can be used to minimize the potential airborne radioactivity. These include the use of containment, ventilation systems (portable or permanent), and decontamination of equipment or work area are the most common.

At Rockwell Hanford Operations, the following concentration guides are used when evaluating the need for respiratory protection.

Type of Radioactivity	Concentration μci/cc of Air
Alpha Emitters	2×10^{-12}
Beta-Gamma Emitters	1×10^{-9}

Respiratory protective equipment is required in the following circumstances:

- When airborne radioactivity concentrations exceed the limits stated above for alpha or beta-gamma, or when, in the judgment of Radiation Monitoring, conditions are such that airborne radioactivity concentrations may exceed the limits for alpha or beta-gamma emitters.
- When uncontained loose contamination on surfaces readily accessible to personnel exceeds 2,000 dpm/100 cm^2 alpha or 20,000 dpm/100 cm^2 beta-gamma activity.
- During operations on contaminated surfaces which may cause or have been known to cause airborne radioactivity such as grinding, welding and flame-cutting, steam-cleaning, sandblasting, or burning.
- When an individual is exposed to airborne radioactivity in concentrations which if averaged over a normal work week, would exceed 25 percent of the limits of 2×10^{-12} µci/cc (alpha) or 1×10^{-9} µci/cc (B-G) (integrated exposure of 10 MPC-hours in a 7 day period).
- In any area posted as an "AIRBORNE RADIOACTIVITY".
- When contaminated systems are opened and no containment is provided, respiratory protection is used until RM verifies by air sampling that radioactivity does not and will not exceed the guideline limits.

The full-faced respirator with tested HEPA filter(s) is the most commonly used respiratory protection at Hanford. The theoretical efficiency of this respirator for removing airborne particles is greater than 99 percent. However, the actual efficiency is based on how well the respirator fits the face. These respirators are to be used when it is anticipated that the airborne activity may exceed the limits for alpha or beta-gamma activity and/or facial contamination could occur. They are authorized for use in areas where airborne radioactivity is less than 20 times the concentrations for alpha and beta-gamma emitters. Table 3-2 contains a summary of appropriate respiratory protective devices required.

TABLE 3-3. Respiratory Protective Devices Required for Given Concentrations of Airborne Radioactivity

Type of Radioactivity	Type of Respiratory Protective Device Required	Concentration Guide Limit in μCi/cc of Air
Plutonium	a. None required	up to 2×10^{-12}
	b. Full-face respirator (filtered)	2×10^{-12} to 4×10^{-11}
	c. Supplied air respirator	above 4×10^{-11}
Fission products	a. None required	up to 1×10^{-9}
	b. Full-face respirator (filtered)	1×10^{-9} to 2×10^{-8}
	c. Supplied air respirator	above 2×10^{-8}
Iodine	a. None required	up to 8×10^{-10}
	b. Full-face respirator (charcoal filtered)	8×10^{-10} to 1×10^{-9}
	c. Supplied air respirator	above 1×10^{-9}
Noble gases	Controls to be specified by Environmental and Occupational Safety	No limit specified (controlled by external exposure)

Each individual shall check the fit of his mask to insure a proper seal with the face before entering a controlled area requiring its use. Proper seal with the face requires that the individual be clean shaven in the area of fit and only special types of glasses shall be worn, if required. When a proper seal cannot be made or maintained, the individual shall not enter the controlled area.

If airborne radioactivity concentrations exceed 20 times the stated limits, air supplied respirators shall be worn. Except during emergency conditions, personnel shall not enter areas in which airborne radioactivity concentrations exceed 1,000 times the stated limits without prior approval of the Manager, Environmental and Occupational Safety.

Certain TFS jobs may require air sampling by Radiation Monitoring while work is in progress. RHO-MA-220 (Radiological Controls) states continuous monitoring and sampling for airborne particulate radioactivity shall be used in any area where personnel have a high potential for exposure to airborne activity due to radiological conditions of the area of specific operations being conducted in the area. When personnel are working inside temporary enclosures, such as greenhouses, and using respiratory protective equipment, Radiation Monitoring shall continuously sample the air within the enclosure while the enclosure is occupied. These samples will be used to determine if workers have been exposed to concentration of radioactive material which exceed the protection factor provided by the respiratory protective equipment.

Most facility plants are equipped with constant air monitors (CAMS) for the early detection of airborne activity. While the TFS Plant Operations does not normally require the use of CAM's, TFS personnel should be aware of the requirements for response to an area air monitor alarm. The requirements are:

- All personnel who are not wearing respiratory equipment when the alarm occurs must immediately leave the area, standby in the general vicinity, and obtain a personal survey for contamination.

- Radiation Monitoring must be notified.
- Entry to the area is permitted for personnel who are wearing appropriate respiratory protection for the purpose of evaluating the source of airborne radioactivity or stabilizing it.
- Personnel who are wearing respiratory protection when an alarm occurs may remain in the area to stop operations which might be the source of the airborne radioactivity.

Personnel advertently exposed to concentrations of radioactivity in the air exceeding the limits of 2×10^{-12} µci/cc (alpha) and/or 1×10^{-9} µci/cc (B-G) without respiratory protective equipment shall receive the appropriate bioassay and in-vivo examinations. Furthermore, the same evaluations shall be conducted in cases where workers are exposed to concentrations of airborne radioactivity which exceed the protective factor provided by respiratory protective equipment being worn, times the Concentration Guide.

CONTROLLING SURFACE CONTAMINATION

Surface contamination must be controlled to minimize unnecessary external and internal exposure of personnel to radiation. The primary concern is to avoid the internal exposure resulting from the intake of loose radioactive material by inhalation, ingestion, or skin absorption. The following limits shall be applied to determine when controls are required for surface contamination:

	REMOVABLE CONTAMINATION	TOTAL CONTAMINATION
Alpha	20 dpm/100 cm^2	Nondetectable
Beta-Gamma	200 dpm/100 cm^2	Nondetectable

"Removable Contamination" is that radioactive material that can be transferred to a smear test paper by rubbing with moderate pressure.

"Total Contamination" is that radioactive material on a surface as measured by a direct survey of the surface.

"Nondetectable" is a quantity of radioactive material which cannot be measured using approved methods and instruments with a minimum detection capability of either 220 dpm/100 cm^2 alpha, or 600 dpm/100 cm^2 beta-gamma.

The operational controls for surface contamination that must be adhered to are listed below:

- An area which exceeds or may exceed the above limits shall be posted and controlled as a Surface Contamination Area.
- Any item which has surface contamination on its outermost surface in excess of the above limits, shall be located in a Surface Contamination Area.
- Entry into Surface Contamination Areas in which the removable contamination levels exceed 40,000 dpm/100 cm^2 alpha or 400,000 dpm/100 cm^2 beta-gamma will be allowed only for surveillance or decontamination unless the Manager, Environmental and Occupational Safety approves an exception.
- Smoking, eating, or placing anything in the mouth is not permitted in contaminated areas. Smoking or drinking may be permitted by Radiation Monitoring in designated areas within a Surface Contamination Area. No radioactive material may be taken into these designated areas and a complete full body survey is required for all personnel who enter.
- Survey stations (step-off pads) shall be established at each Surface Contamination Area exit point.
- Survey stations may be established by Radiation Monitoring at exits from certain regions within a Surface Contamination Area. A contamination survey is required at each established survey station for personnel or equipment moving to the non-contaminated side of the station.
- Each person entering a Surface Contamination Area shall wear protective clothing as specifed in the applicable Radiation Work Procedure.

- Protective clothing provided for radiation work shall not be worn in lunchrooms, in areas used as lunchrooms, in other areas so designated, and for non-radiation area work. Blue coveralls shall be considered the same as personal clothing.

The most important aspect of contamination control is surveying for personnel contamination. Surveying for personnel contamination is the responsibility of and shall be performed by individuals who are trained and qualified. Individuals so qualified are permitted to survey only themselves. Radiation Monitoring shall survey all other persons. The instructions for using the equipment, the acceptable limits of contamination, and the action to be taken if any individual exceeds the limits shall be posted at each survey station.

If personnel contamination is detected, Radiation Monitoring shall be notified immediately. Contaminated individuals shall limit their movements as much as possible. Each instance of skin contamination will be recorded on a "Personnel Contamination" record card. Decontamination of personnel shall be conducted by or under the direction of Radiation Monitoring in accordance with approved procedures.

ENVIRONMENTAL PROTECTION

The operation of TFS Plant results in the generation of only minute amounts of radioactive waste. What waste is generated is not in an effluent (gas or liquid) form, and normally will not pose a hazard to the environment. To insure that environmental protection measures are not violated, TFS Plant Operations will be in compliance by observing those protective measures already included in our operating SOP and RWP's.

RWP's APPLICABLE TO TFS PLANT ASSIGNMENTS

Waste Packaging	GEN-0
	F-1
	F-4
Swab Riser Monitoring	GEN-0
A Farm Laterals	F-1
105, 107, 110, 111-SX Laterals	GEN-0
	F-1
108, 109, 112, 114, 115-SX	GEN-0
Laterals	F-1
Monitoring Liquid Levels (FIC's and Manual)	GEN-0
	F-1
Dry Well Monitoring	GEN-0
	F-1
Neutron Probe	GEN-0
	F-1
	F-14
In-Tank Photography	GEN-0
	F-1
	BP-1
Pond Monitoring	GEN-0
	F-1

INDEX TO RADIATION WORK PROCEDURES (RWP)
TANK FARM SURVEILLANCE

1.	Tank Farm Operations	F-1
2.	Dry Waste Burial Operations	F-4
3.	Dry Well Readings/Leak Testing Using Neutron Source	F-14
4.	In-Tank Photography	BP-1

TANK FARMS, DIVERSION BOXES, OTHER LIQUID DISPOSAL AREAS AND PLANT ROADWAYS WITHIN 200 EAST AND 200 WEST AREAS

Radiological Conditions and Monitoring Instructions

1. The provisions of the General Regulations Radiation Work Procedure (GEN-0) shall apply to all work performed under this procedure.

2. High dose rates and alpha-beta gamma contamination may be expected in pits, vaults, diversion boxes, and risers.

3. Contamination and dose rate monitoring is required. Qualified personnel are authorized to self-survey and may self-monitor up to 100 mrads/hr. Radiation Monitoring will monitor for all others.

4. Radiation Monitoring assistance shall be required: (a) for all maintenance work, (b) for initial survey prior to transport of requlated tools and equipment between Radiation Zones, (c) when spread of contamination is detected, (d) for initial opening of diversion box or pit, and (e) for breaking of potentially contaminated lines.

5. A work area and personal survey shall be made following liquid level measurements and sampling. In 200 West Area personal survey must be made with both an alpha and a beta-gamma detection instrument.

6. Sources of radiation in excess of 100 mR/hr must be explicitly zoned to warn personnel of such conditions.

(Cont. next page)

Description of Work

1. Make inspections from ground level.

2. Perform housekeeping and decontamination.

3. Package and remove contaminated waste and used laundry.

4. Maintain and operate equipment.

5. Obtain samples, liquid levels, temperature measures, and radiation profiles.

6. Transport tools and equipment between Radiation Zones.

Protective Apparel

1. Inspections from ground (grade) levels and for routine housekeeping and operations of equipment: Cap, one pair of coveralls, canvas boots, rubbers, canvas and/or surgeons gloves.

2. Transport of equipment between Radiation Zones: Cap, one pair of coveralls, rubbers, and canvas gloves.

3. Respiratory protection shall be worn where there is a potential for airborne radioactivity as determined by Radiation Monitoring. The extent of such mask requirements will be identified as possible, at pre-job planning meetings.

(Cont. next page)

7. This procedure is void if wind velocities are excessive when weighed against the type of work to be done. As a guide, wind speed in excess of 15 miles per hour is considered excessive.

8. Open diverson boxes or pits shall be covered during prolonged job delay or at the completion of the job.

9. A properly completed Onsite Radioactive Shipment Record (Form 54-6000-079) or a Routine Onsite Radioactive Shipment Record (Form-A-6000-024) with a Data Sheet is required for transporting requlated tools and equipment.

10. A job briefing session between Operations and Radiation Monitoring will be conducted in advance of routine work to be performed. Work having a high radiological risk potential will require a formal pre-job planning meeting which will be participated in by Operations, Maintenance, and Radiation Monitoring Supervision, as well as those personnel assigned to do the work. Specific protective clothing and respiratory requirements as designated in appropriate Radiation Work Procedures will be reviewed. Any change from these minimum clothing requirements which are needed as a result of this review will be identified in writing as part of pre-job planning check list.

11. The Radiation Monitoring supervisor can and shall terminate any Radiation Zone work he believes will impair radiological safety.

(Cont. next page)

4.* For work involving potentially contaminated process pits or diversion boxes, pump moves, sampling, maintenance or decontamination: Cap, hood, two pair of coveralls, canvas gloves, canvas boots, rubbers, and respiratory protection until radiological conditions are evaluated. Hoods will be worn if respiratory protection is required.

5.** Riggers are permitted to wear full length leather gauntlet gloves in place of surgical gloves and canvas gloves. Use of any other leather gloves will require surgical gloves taped to coveralls under the leather gloves.

6. Waterproof gloves shall be worn when handling equipment or material where there is a potential for encountering moisture. Waterproof hand protection will be required for all work at risers open to a tank, and for removal of materials or equipment directly from the risers.

7.* Hard hats or bump hats may be worn in lieu of cloth caps where respiratory protection is not required. Crane operators are permitted to wear a billed hat in lieu of cloth caps or hoods.

8.** Crane operators will be permitted to wear a half mask in lieu of full face respiratory protection with the concurrence of Radiation Monitoring.

(Cont. next page)

12. There are no routinely designated smoking or drinking areas within Tank Farm perimeters because of variations in job locations and radiation background. Radiation Monitoring will designate areas where smoking is permissible during the course of a job. There may be some jobs where radiological conditions warrant no smoking and the Radiation Monitor will appropriately notify everyone connected with the work.

13. Prior to the start of work in diversion boxes, pump pits, or other radiologically high risk jobs, construction or subcontractor private vehicles and equipment must be moved from the work location or completely contained for protection from radioactivity. RM will make appropriate notification and assure compliance.

9. The respiratory protection may be removed if it is determined by Radiation Monitoring that the potential for contamination is insignificant.

10. Radiation Monitoring will prescribe additional protective clothing and respiratory protection to RWP listed minimum clothing requirements should radiological conditions change.

11. A reduction in clothing requirements for specific jobs may be initiated in the field by the Radiation Monitor with the concurrence of Monitoring supervision.

ROCKWELL HANFORD OPERATIONS RADIATION WORK PROCEDURE

ROCKWELL DRY WASTE BURIAL GROUNDS AND PLANT ROADWAYS WITHIN AND BETWEEN 200 EAST AND 200 WEST AREAS

Radiological Conditions and Monitoring Instructions

1.* The provisions of the General Regulations Radiation Work Procedure (GEN-0) shall apply to all work performed under this procedure.

2. High dose rates and alpha or beta-gamma contamination may be expected during burial operations. Contamination and dose rate monitoring is required.

3. Waste deposited in burial trenches shall be backfilled whenever:
   (a) the dose rate at the edge of the trench exceeds 100 mR/hr.
   (b) the adequacy of containment of radioactive material is in doubt, or
   (c) any unweighted, lightweight containers have been deposited in the trench.

4.* Qualified personnel are authorized to self-survey and self-monitor up to 100 mrads/hr, however, Radiation Monitoring assistance is required when:
   (a) waste is lost or dropped in transit,
   (b) burial of material requires the use of heavy mobile equipment.

5. The external surfaces of all burial containers shall be free of any loose contamination and shall smear less than 500 d/m alpha.

(Cont. next page)

Description of Work

1. Transport packaged dry radioactive waste by pickup truck from process facilities.

2. Backfilling and burial trench activities.

3. Inspection and housekeeping from ground (grade) level.

Protective Apparel

1.* For loading, unloading, and operating vehicles: one pair of coveralls, cap, gloves and rubbers.

2.* For backfilling operations: one pair of coveralls, cap, gloves, and rubbers.

3.* For inspection and normal housekeeping: one pair of coveralls, cap, gloves, and rubbers.

4. Hardhats or bump hats may be worn in lieu of cloth caps.

5. Pre-job planning meetings will be held for burials in which there is a relatively high risk for contamination spread. Requirements for additional protective apparel and respiratory protection and the location where required will be prescribed by Radiation Monitoring at the pre-job planning meeting.

6. Radiation Monitoring will prescribe additional protective apparel and respiratory protection to RWP listed minimum requirements should radiological conditions change.

Radiological Conditions and Monitoring Instructions (Cont.)

6. A vehicle used to transport dry radioactive waste must be identified as a Radiation Zone. Protective apparel shall be worn to operate the vehicle. Release of such vehicles from Radiation Zone status must be by Radiation Monitoring.

7. Shipments will not be left unattended in transit.

8. A copy of this procedure and a properly completed Onsite Radioactive Shipment Record (For 54-6000-079) or a Routine Onsite Radioactive Shipment Record (Form A-6000-024) will accompany all radioactive shipments transported under this procedure.

9. In the event of an accident or spread of contamination while transporting waste, Operations and Radiation Monitoring supervision shall be notified immediately.

200 East Area

Operations	2-2820
Radiation Monitoring	2-2526

200 West Area

Operations	2-2284
Radiation Monitoring	2-2731

10. This permit is not valid for retrieval of equipment placed in burial trenches.

*Paragraph added or changed.

ROCKWELL HANFORD OPERATIONS RADIATION WORK PROCEDURE

ALL TANK FARM RADIATION ZONES

Radiological Conditions and Monitoring Instructions

1. The provisions of RWP GEN-0, General Regulations shall apply to all work performed under this procedure.

2. High dose rates as well as alpha and beta-gamma contamination may be encountered inside any Tank Farm and at dry well locations.

3. Contamination and dose rate monitoring is required. A personal survey is required when leaving zone. In 200-W personal surveys must be made with both an alpha as well as a beta-gamma detection instrument.

4. This procedure is not valid for work involving openings or risers open directly to the waste storage tanks.

5. The Am-Be neutron source shall be enclosed within a sealed stainless steel capsule and contained in a Department of Transportation approved moderated cask for storage. After daily use, the Am-Be source (inside the cask) shall be stored in a Radiation Zone.

6. The cask shall be securely attached to or contained in the transport vehicle.

7. Be alert for gamma and neutron dose rates when using the Am-Be source. High level alpha contamination may be present in the event of damage to or deterioration of the steel capsule.

(Cont. next page)

Description of Work

1. Take dry well reading (radiation profiles) around underground radioactive storage tanks.

2. Perform leak tests by obtaining neutron measurements within Tank Farm test wells. This work requires the use of an Americium-Beryllium (Am-Be) neutron source.

Protective Apparel

1. Transport of regulated equipment between Radiation Zones: one pair of coveralls, cap, gloves, and rubbers.

2. For routine dry well readings: one pair of coveralls, cap, gloves, canvas boots, and rubbers.

3. Respiratory protection will normally not be required for dry well and test well readings.

4. Radiation Monitoring will prescribe additional protective clothing and respiratory protective requirements to RWP listed minimum clothing requirements should radiological conditions change.

5. A reduction in clothing requirements for specific jobs may be initiated in the field by the Radiation Monitor with the concurrence of Radiation Monitoring supervision.

6. Hard hats or bump hats may be worn in lieu of cloth caps.

8. Radiation Monitoring shall survey the source capsule and moderator after each daily use of the source. The survey shall include a dose rate measurement of both moderator and source and a contamination (smear) survey of the moderator and source (alpha-beta-gamma).

9. Do not handle or come into direct contact with the source. Always use the remote handling tool to remove and use the source. Radiation measurements of the source capsule and cask:

Distance	Neutron mrem/hr	Gamma mR/hr
Cask @ Contact	20	6
Cask door open, source inside	60	15
Source @ Contact	40,000	2,800
Source @ 3'	10	1

10. Perform personal and area survey for alpha and beta-gamma following each use of the Am-Be source. Report any detectable contamination of the source, cask, personnel, or equipment immediately to Radiation Monitoring and Tank Farm Surveillance supervision. If contamination is detected, do not move cask and source until released by Radiation Monitoring.

	200 East	200 West
Surveillance	2-2929	2-2151
Radiation Mon.	2-2526	2-2731

11. Radiation Monitoring assistance shall be required for: (a) all maintenance work, (b) for all release from Radiation Zone status, and (c) when any spread of contamination is detected.

(Cont. next page)

12. A copy of this procedure and a properly completed Onsite Radioactive Shipment Record (Form 54-6000-079) or a Routine Onsite Radioactive Shipment Record (Form A-6000-024) will accompany all radioactive shipments transported under this procedure.

13. Tapes and other data materials from Dry Well Trucks must be surveyed and released by Radiation Monitoring. The Radiation Release label may be substituted if the same information is stamped or written on the data materials.

ROCKWELL HANFORD OPERATIONS RADIATION WORK PROCEDURE

ROCKWELL FACILITIES

Radiological Conditions and Monitoring Instructions

1. The provisions of the General Regulations and Practices for Radiation Work (GEN-0) shall apply to all work performed under this procedure.

2. Dose rate levels of radiation must be anticipated in process buildings and in Tank Farm areas.

3. Beta-gamma and alpha contamination is present in many Radiation Areas.

4. Radiation Monitoring assistance is required for all work performed under this procedure.

5. Notify Radiation Monitoring at facility where work is to be done prior to any entry in Rockwell Radiation Areas:

Purex	2-2678
East Tank Farms	2-2526
B Plant	2-2376
Redox	2-2468
West Tank Farms	2-2731
Z Plant	2-2564
T Plant	2-2658

6. A radiological status survey by Radiation Monitoring is required for all materials and equipment removed from the Radiation Area.

7. The contamination potential in some areas may require special preparation of photography equipment to prevent its contamination.

(Cont. next page)

Description of Work

Pacific Northwest Laboratories (PNL) Photographer to take pictures in Rockwell Radiation Areas.

Protective Apparel

1. Minimum clothing requirements: one pair of coveralls, cap, gloves, canvas boots, and rubbers.

2. Respiratory protection shall be worn wherever there is a potential for airborne radioactivity as determined by Radiation Monitoring.

3. For photo mission in tank risers: no personnel outer clothing, two pair of coveralls, canvas boots, rubbers, cap, respiratory protection, hood, surgical gloves taped at wrists to inner coveralls, and canvas gloves (or extra surgical gloves).

4. Waterproof gloves shall be worn when handling equipment or material where there is a potential for encountering moisture.

5. A reduction in clothing requirements for specific jobs may be intitated in the field by the Radiation Monitoring with the concurrence of Radiation Monitoring management.

6. Radiation Monitoring will prescribe additional protective clothing and respiratory protection to RWP listed minimum clothing requirements should radiological conditions warrant.

8. Radiological controls of photographing within underground waste tanks shall be as follows:

   A. For tanks with an operating exhauster:

      1. Containment device, such as a greenhouse.
      2. Water flush or tank riser.
      3. Operating air sampler which must be continuously checked by Radiation Monitoring. If an upward trend is indicated by the air sample, the photo mission will be terminated until air concentrations can be evaluated and/or stabilized.
      4. Respiratory protection - full face mask.

   B. For unvented tanks:

      1. Containment device, such as a greenhouse.
      2. Water flush of tank riser.
      3. Operating air sampler which must be continuously checked by Radiation Monitoring. If an upward trend is indicated by the air sample, the photomission will be terminated until air concentrations can be evaluated and/or stabilized.
      4. Supplied air respiratory protection.

(Cont. next page)

C. Supplied air may be required in some cases, even though a tank is vented, if it is necessary to photograph via a grossly contaminated riser.

9. Only those photographers who have a multipurpose dosimeter routinely assigned by PNL are authorized entry into Rockwell Radiation Areas under this procedure.

INDUSTRIAL SAFETY

INTRODUCTION

Industrial safety is an essential part of our Training Course; understanding the fundamentals of accident prevention is basic to rounding out the knowledge of a radio-chemical operator. The objective of this section is to give you a better understanding of the Rockwell Hanford Operations (Rockwell) Accident Prevention Program: Who is responsible for each phase of the program, and the various ways in which accident prevention is promoted and practiced at all levels within Rockwell. We will discuss familiar safety rules and various procedures, meetings, housekeeping, and protective equipment. Also included, is a brief review of basic emergency first-aid with which everyone ought to be familiar.

POLICY AND RESPONSIBILITY

It is the policy of Rockwell that its activities be conducted in such a manner as to protect the safety and health of all employees, and to prevent loss or damage to its facilities. All operations will be conducted in compliance with applicable health and safety requirements of the U. S. Department of Energy, and will adhere to generally recognized and accepted high standards of performance in the areas of occupational health, nuclear, radiological, industrial and fire safety, and environmental protection.

Safety is considered to be an integral part of all Rockwell work at Hanford and without exception will be routinely incorporated into all activities. Management expects that all Rocwell personnel will accept and be constantly aware of their responsibilities in this area.

This is not to say, however, that Rockwell management has sole responsibility for Industrial Safety. It is necessarily a shared responsibility among a management team functioning through its various components to set policy, a safety organization occupied exclusively with safety matters in an advisory or consulting capacity, and the third or total group of

individual employees responsible for themselves and each other. Each group in the Industrial Safety program has a well defined role to play, the best measurement of which, is the record low injury incidence rate established over the years of operation as compared with the national average and performance of the chemical industry as a whole. Of course, we are seldom as good as we would desire to be in this area of industrial safety where the ultimate aims for perfection, absence of injury to any man and the avoidance of serious incident. So the effort goes on with each of the three participating parties conducting its role in the manner directed by policy.

Role of Management

The General Manager is responsible for assuring adherence to the Rockwell Hanford Operations safety policy through appropriate managerial delegation, authorization and accountability, and through personal action as required. Program and Functional Directors are responsible for the safety of all employees and for the protection from loss of all facilities under their jurisdiction. They are additionally responsible for assuring the compliance of their employees with Rockwell Hanford Operations safety policy.

Role of Health, Safety and Environment

The Director - Health, Safety and Environment is responsible for supplying technical assistance and advice to management in matters concerning the Rockwell Hanford Operations safety program and for supporting and interpreting Rockwell safety policy.

The role of Health, Safety and Environment Department is:

1. To provide counsel on safety practices and facilities with particular attention to applicable laws, codes, and standards.
2. Issue and update the Accident Prevention Standards Manual. This manual contains the accident prevention standards, accident prevention bulletins, health bulletins and chemical safety guides.

3. Conduct periodic safety surveys of facilities and operations to assist in the identification of unsafe conditions and acts and to consult with managers on the status of the facility safety program and the application of pertinent safety and health standards to facility operations.

4. Participate in safety reviews of plants and plant practices, and in the development of corrective measures when required.

5. Review reports of injuries, property damage, and occupational illness. In the measurement area, compile, analyze, and interpret accident statistics data in reports to management.

6. Arrange for third-party services by specialists, including: physicians, industrial hygienists, and psychologists.

7. Conduct fire protection surveys in accordance with DOE directives.

8. Conducts surveys as required of activities involving the removal of surplus government property with RHO-MA-100, Policy PY 4-301, "Excess Property Disposal."

9. Conducts periodic industrial hygiene surveys of facilities and operations either separately or in coordination with safety surveys.

10. As a part of the survey procedure, the manager, Industrial Hygiene and Safety, may periodically require audits of facility adherence to a selected standard (e.g., an Accident Prevention Standard in RHO-MA-221).

Role of the Employee

All employees, as a condition of employment, are responsible for performing their work safely and in compliance with Rockwell Hanford Operations procedures, and for assuming an awareness for the safety of their fellow employees. Employees will not undertake a job which they do not understand or for which they are not trained or otherwise qualified. Additionally, employees are required to:

1. Observe the DOE safety standards applicable to their work.

2. Report promptly to the manager any condition which may lead to a violation of these standards.
3. Respond to warning signals which may be activated in the event of fire, radiation, or other possible emergencies.
4. Report emergencies using established procedures.

The responsibility for supporting the safety programs rests with each one of us as employees. This participating role includes following instructions, obeying specific rules, complying with procedures, exercising ordinary care in performing work and encouraging associates to do likewise.

SAFETY PROGRAMS

It would take a considerable effort to try and list all of the safety programs that have been developed and implemented over the years at Hanford in order to reduce or eliminate personnel injuries, hazards and property loss. We will, however, attempt to familiarize you with some of the more basic ones that may have a direct impact on you.

Executive Safety Committee

The Executive Safety Committee establishes safety policies, approves goals and objectives, and measures and evaluates performance against such goals.

The meetings are usually held on the first Wednesday of every month. Subjects regularly discussed include: fire protection, emergency preparedness, radiation protection, accidental property losses, workman's compensation, employee health, and off-the-job safety as well as engineering and morale issues related to industrial safety.

Safety Review Program

The Safety Review Program establishes the Rockwell Hanford Operations Policy for independent safety reviews which satisfy U. S. Department of Energy requirements as stated in Manual Chapter 0530 and 0531 and, where

appropriate, the requirements of other Governmental agencies such as the Nuclear Regulatory Commission as stated in Title 10 of the Code of Federal Regulations. This program assures timely reviews of the functional management activities directly responsible for safety, the conduct of facilities operations, the design of new or significantly modified facilities or processes, and the safety and environmental reports covering operational activities.

Safety Review Panel is responsible to the General Manager - Rockwell Hanford Operations for providing guidance to the Safety and Environmental Engineering Analysis Department for the implementation of this program, periodically reviewing the operation of individual Safety Review Committees and making recommendations to the General Manager as necessary for changes in this policy.

The Safety Review Committee is responsible for performing a final safety overview of facility designs (including Title II designs for capital projects) and modifications to these designs, a significant modification and cumulative modifications to processes, facility operations, activities involving radioactive or other hazardous materials, and safety and environmental reports.

During the design processes for major construction projects, the Safety Review Committees review the draft, preliminary, or final Safety Analysis Report and its supporting documentation.

Safety Review Committees

The following committees have been established for implementation of the program:

1. Chemical Processing Safety Committee

   This committee reviews nuclear fuels reprocessing, uranium oxide operations, and plutonium operations exclusive of tenant activities.

2. Waste Processing Safety Committee

   This committee reviews waste fractionization and encapsulation, waste concentration operations, and associated waste management and monitoring activities surveillance.

3. Waste Technology Safety Committee

   This committee reviews the basalt programs, the long-term defense waste programs, and the operations associated with these programs.

4. Packaging and Shipping Safety Committee

   This committee reviews shipping package design and packaging and shipping operations for compliance with DOE regulations.

5. Nuclear Criticality Safety Committee

   This committee provides independent review of the Rockwell Hanford Operations Nuclear Criticality Safety Program.

6. General and Laboratory Facilities Safety Committee

   This committee reviews Research and Engineering experiments and tests. The Californium Multiplier Facility, the Analytical and Chemical Standards and Research Laboratories. In addition, this committee reviews other DOE contractor activities carried on in Rockwell facilities, and other facilities and operations not specifically to other safety committees.

Medical Program

Rockwell Hanford Operations provides comprehensive physical examinations through Hanford Environmental Health Foundation (HEHF) in compliance with Department of Energy (DOE) directives for the purposes of job placement and health protection and to encourage good health practices.

Managers, after notification by Industrial Hygiene and Safety, are responsible for scheduling their employees for medical examinations as required by Rockwell policy and procedures. Employees are responsible for their attendence at all scheduled and special medical examinations as

may be required, and will cooperate fully with medical personnel in the performance of such examinations. Pre-employment medical examinations are required for all new employees, and final examinations are also required for terminating employees. Personnel and Public Relations ensures that all terminating and new employees receive a health examination. Periodic and special medical examinations are performed at frequencies set forth in management directives.

PROGRAM OBJECTIVES

We have seen the role that each of the three participating parties is responsible for in the Rockwell Safety program. Now for the program itself and the planning of its objectives. They are eight in number and may be stated as follows:

A. To create an atomsphere of respect for the principles of safety.

B. To establish procedures and practices that minimize risk of accidents.

C. To maintain a comprehensive effort in training employees to work safely.

D. To encourage all employees to participate actively in the safety program.

E. To maintain clean, healthful and orderly working conditions.

F. To provide and maintain in good order an adequate supply of safety equipment.

G. To apply proven safety principles to design of facilities and equipment.

H. To comply with laws and standards applicable to industrial safety practices.

PRINCIPLES AND PRACTICES

Safety Rules

Safety rules provide a positive approach to accident prevention by describing ways to work safely. No individual shall endanger his or her own safety or jeopardize the safety of fellow workers by disregarding safety rules.

1. Master Safety Rules. These ten broad rules are applicable through-out Rockwell and include such instructions as reporting of injuries. They are posted prominently in every work location for ready reference and as a reminder.

2. Job Site Safety Rules. These are regulations which apply to a specific work location or portion of a plant, broad in nature but also quite specific on local hazards. These rules are posted at the work place.

3. General Plant Rules. Every employee is issued a copy of Manual RHO-MA-119, "General Plant Rules". This manual contains General Plant Rules applicable to all Rockwell employees and provides guidance and direction to work towards Rockwell's goals and objectives in a safe and effective manner.

4. Accident Prevention Standards. Manual RHO-MA-221, Volume 1 and 2, "Accident Prevention Standards" provides information to assist all levels of management at Rockwell to make safety an integral part of the daily conduct and job performance of all employees. The manual contains Accident Prevention STANDARDS, Accident Prevention BULLETINS, and Chemical Safety GUIDES. The STANDARDS set forth those practices that are mandatory throughout Rockwell Hanford Operations to assure uniform application of basic and essential safety principles. The BULLETINS and GUIDES are advisory in nature, containing information to be applied with good judgement in management's decisions regarding specific working conditions and tasks. Technical assistance in interpreting individual safety standards from the manual for application in a job situation is provided by the Manager, Industrial Hygiene and Safety.

5. Specific Job Rules. Specific job rules are rules for safe conduct brought out in the standard operating procedures or pre-job safety plans. Where work is performed on some routine frequency the procedures are in place; where a one-shot effort is involved, a pre-job safety analysis is preformed and the work is guided accordingly.

PROCEDURES

There are many procedures associated with equipment-oriented or objective-oriented functions. The former are those which require the operations of a single type of equipment, such as sampling or some mechanical devices more common to the crafts. The latter are those which have a specific end objective reached by a series of steps not involving the continual use of the same type of equipment for the major portion of work. In this category would fall all the standard operating procedures and special operating procedures, into which are marked the particular safety precautions required to avoid the associated hazards. Frequent review and revision of the procedures are made, more often than not, due to the observations and advice of the radio-chemical operators.

Because of its special nature, there is one protective device that should receive particular attention in any training program. We refer to the Lock and Tag Procedure. Actually it is considered important enough to be classified as a standard which places it in the mandatory category. Yet it is sometimes overlooked or improperly used. The purpose of lock and tag is to prevent the possibility of injury as a result of the inadvertent operation or use of equipment upon which work is being performed. The procedure is intended to provide a controlled method for rendering inactive any moving equipment, any electrical system, and any piping arrangement which carries material considered hazardous because of the nature of the material, its temperature or pressure.

Here is how it's done. The equipment is first rendered inoperable by closing supply valves, breaking electrical circuits, removing starting mechanisms, or whatever is necessary. The operating group supervisor then places the required red and white tag which says: "DANGER - Do not Operate" and then a padlock is used somewhere on the equipment in such a manner as to make operation impossible. The key to this padlock is retained by operating personnel and no one else. The tag is signed and dated by the supervisor, and a short explanation is written on the back. This tag is never to be removed except by the operating supervisor or his

designated representative. The procedure is then duplicated by the servicing group supervisor, who checks the deactivation and applies his own lock-and-tag before repair work begins. The key to this padlock is retained by the servicing supervisor. The locks and tags are not removed until the equipment is repaired and checked for safe performance.

The Lock and Tag Procedure is one example of the kind of information found in the Rockwell Accident Prevention Standards Manual.

The Standards, printed on white paper, are mandatory practices on many different subjects. The yellow pages in the manual are advisory in nature, pointing out hazards and appropriate precautions to avoid accidents. The green sheets in the manual summarize pertinent information about the health and safety aspects of chemicals. The final section of the manual, printed on pink paper, includes industrial health bulletins. The most important of these four manual sections is the standards. It is worthwhile to repeat the mandatory nature of these prescribed practices.

In addition to the standard on lock and tag, somewhat similar standards are in place; to name a few, work in confined spaces, personnel protective equipment, care and use of tools and equipment, and working with railroad cars. There are also administrative directives related to safety rules, codes, and fire protection. Altogether, there are more requirements and procedures in this first section of the manual that apply directly to your work than we could possibly cover in this presentation. This material requires periodic review in order for an operator to remain knowledgeable.

Another safety practice requires that every job with any significant hazards needs to be performed according to an approved written procedure. All such routine work is covered by the Standard Operating Procedures (SOP). It is characteristic of these SOP's that any operating hazards and the necessary precautions to prevent accidents are included.

Whenever you get out an SOP to refresh your memory on an operating sequence or to check on some other particular point, take the extra minute to review the included hazards and precautions as well. A nonroutine hazardous job, not covered by the SOP, must be done according to a specially written procedure that is discussed with the operator before starting the job. Such a procedure is known as a pre-job safety plan. This commitment to work according to written procedures is firmly established in Rockwell. It really doesn't do any good to have a written procedure though, if the operators have not had appropriate exposure to the information or do not follow it. In accepting an assignment, check out the details with your manager or working leader. Help establish the necessary understandings at the start of a job on how the work is to be performed safely. Challenge the omission of a written procedure on any assignment involving significant or unusual hazards. Additional details on this aspect of accident prevention by pre-job safety planning can be learned by studying Accident Prevention Standard Number 2.

ACCIDENT REPORTING

An industrial safety practice, stressed for many years at Hanford, has been the prompt reporting of any injured sustained on the job. There are a number of important reasons why this practice is so strongly stated. Prompt professional treatment of our injured employees has effectively limited many adverse consequences of accidents through the years. So, no matter how slight an injury, let your manager know and get to the Medical Aid Station. Similarly, if you are with another employee who becomes disabled on the job, because of injury or illness, call the emergency Medical Aid Number (2-2703). An ambulance is also available for transportation to the Medical Aid Station or to the hospital. This course of action should be followed in every "doubtful" case. Call for help promplty! Seconds could mean the difference between life or death.

EMERGENCY MEDICAL AID

Some accidents require immediate basic emergency medical aid. If an employee is splashed with a corrosive chemical, it becomes all important to get the individual under a safety shower to dilute and remove the chemical. There should be no hesitations or inhibitions about taking this action or about removing the employee's clothing while under the shower. The green light above the shower should "signal-go" to anyone doused by acids, caustics or other chemicals. The same general advice applies to the eyes as well - move to water fast and flush for at least fifteen minutes.

The use of water is also currently the immediate treatment of thermal burns. If possible, immerse the burnt portion of the body in water or cover the burn with a wet towel as soon as possible, then head for the medical aid station or call for help.

There are a few other basic emergency medical aid measures that operators should be able to perform. Mouth-to-mouth resuscitation is simple and has saved many lives even when used by amateurs. Here are the steps: First, quickly place the victim on his back and clear the throat of any foreign matter. Remove food, vomit or mucus with your finger if you have to. The air passage must be kept clear. Pull the lower jaw toward you to further open the passage. Now, making sure to pinch the victim's nose closed, seal your mouth over his and give four quick breaths until his chest rises. Then remove your mouth and let the air escape. Be sure it flows freely. Repeat this 20 times per minute, or every three seconds until the victim begins breathing for himself. If, for some reason, a person's heart has stopped, which can be determined by pressing your fingers between the neck muscle and the throat and feeling for a pulse, his life may be saved by closed heart massage. This is done by placing the victim on his back and kneeling by his side. Place the heel of one hand on the lower portion of his breastbone and the other hand on top of the first. Then press down until the breastbone is depressed from one to

FIRE PROTECTION

INTRODUCTION

In the mid-1950's, although memory would make it seem more recent than that, the General Motors Company transmission plant at Lavonia, Michigan - a 33-1/2 acre sprawling giant - was completely razed by fire. Six lives were lost and unaccounted millions of dollars in damage were suffered, to say nothing of the many jobs that were no longer available to employees. There were some interesting yet familiar facts unearthed in the investigation that followed. To being with, only the result and the vase damage wrecked made it credible. Here was a plant, a single-story structure spread over a wide acreage, built of steel and concrete; considered essentially fire proof. Yet the near impossible happened. The chain of circumstances were triggered by a spark from a welding torch that fell into a trough containing flammable liquids. Located fairly close to the ceiling, the ignited inhibitor fed intense heat to the underside of the metal deck roof. Acting much the same as a frying pan or a hot griddle it was only a matter of minutes before combustibles in the asphalt base roof cover were burning. Local attempts were made to try and contain the blaze, without success, and it wasn't until more than 15 minutes had passed before there was enough presence of mind to call the fire department. As results proved it was 15 minutes too late.

More recently and within our own industry, in May 1969 a fire occurred at a Rocky Flats plant northwest of Denver, Colorado. This plant, operated for the Department of Energy (DOE) produces plutonium part for nuclear weapons.

This complex facility has various types of machinery used in gloveboxes. They are interconnected by enclosed conveyors to facilitate the movement of material. The gloveboxes and conveyor enclosures were of a combustible transparent plastic, and the radiation shielding inside and outside the gloveboxes and conveyors, at the time of the fire, were made of a combustible plastic or cellulose laminated material.

The first indication of the fire was by an alarm received in the plant's fire station from a heat sensing system which monitors the temperature at various locations in the glovebox system. The fire department responded promptly, but the presence of dense smoke and large quantities of combustible shielding material made the fire very difficult to fight and extinguish.

The damage to the building and its equipment was extensive with an estimated financial loss of $25,000,000. If the fire had breached the building, the spread of contamination would probably have caused a very serious condition unparalled in history.

These are only two of many similar stories of industrial fires that occur each year, stories that invariably follow the same basic patterns of failure in fire prevention or fire protection. It is to these two subjects we believe the radio-chemical operator should direct his attention to the training program since the ingredients for a really disasterous fire are always present if preventives are neglected or protective devices are sorely used.

The recent fire safety record in chemical separations plants has been excellent. On the average, only 15 fires a year occur in these plants and usually from a single source, except when accompanied by an explosion. The majority of these fires are brought under control quickly. However, a small fire can become an uncontrollable blaze. This alone is justification for fire prevention and fire protection measures.

Recent fire experience is shown in the following table.

TABLE 4-1. DOE-RL Fire Experience*

Year	Number of Fires	Amount of Loss
1978	75	$248,658
1977	78	3,000
1976	47	21,033
1975	61	7,945
1974	45	10,192

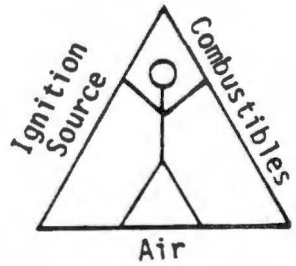
*Includes all Hanford DOE-RL contractors

FIRE PREVENTION

Our first line of defense, and the one operators have the most control over is fire prevention. Let's see what part you play in this aspect of safety.

The Fire Triangle

There are three elements that need to be present in order to have and to sustain a fire. We first need something to burn a combustible - to have fire. Secondly, have something to burn, we then need an ignition source. Thirdly, oxygen needs to be present. From our standpoint, if we can control the combustible or control the ignition source, we could control and stop fires and explosions. In reality each of us who work in this plant has a triangle as pictured below.



Full control of either combustibles or ignition sources can stop fires from occurring. Full control of either combustibles or ignition sources from a practical standpoint is not possible so we must try to control both. Saying this another way, it would be unsafe to control one and neglect the other because our control, no matter how good, cannot be 100 percent effective for either combustible or ignition sources.

The major effort in controlling combustibles involves maintenance of an orderly work place. Where an operation involves the use of flammable liquids containment of solution and vapors is obviously necessary. When a spill or leak occurs, or where inadequate ventilation is supplied in an area where paint containing a highly volatile solvent is being applied, only the lack of an ignition source prevents a fire.

What about ignition sources? Control the ignition sources properly and we can prevent fires. The ignition sources normally may be thought of as vehicles operating in hazardous plant areas or perhaps improperly maintained explosion proof electrical equipment. The most dangerous ignition source in our plant is the cutting and welding torch which is manually operated and then only by the use of a welding and cutting permit, except in a welding booth. If they are carefully prepared and followed, fires will be prevented. In monitoring this work for operations the operators may observe that conditions present are other than expected. In such a case it would be his duty to stop the work until the question is resolved.

Housekeeping

This is a familiar subject. We mentioned it briefly in the preceding section in connection with the general area of fire prevention. It bears further emphasis as an important element of fire prevention in that the terms "combustible" and "housekeeping" are so closely related as to be almost synonomous. Housekeeping is the maintenance of orderly conditions and is a basic factor in fire loss prevention.

When we get down to specifics much of the orderly arrangement to which we refer is not within the province of a chemical operator to control. What is however, should be conscientiously practiced. The remainder, although it may be a maintenance craft or power function, is always subject to audit by any of us who has stake in fire prevention. Some of these dangerous conditions may be associated with:

- Packaging Materials

  Most are combustible and readily ignitable by a spark or flame. Also, additional fuel to feed a potential fire is provided.

- Oily Waste

  Clothing, wiping rags, sawdust, lint, etc. should not be left lying around. For disposal of all such materials metal containers with self-closing lids should be used and emptied daily.

- Drip Pans

  These pans are used to collect oil drippings from mechanical equipment. The pans should be cleaned frequently and the rags or waste containing oil should be disposed in metal containers with covers.

- Clean Rags

  Clean rags are ordered in bale amounts. Only mildly hazardous they are readily flammable when allowed to become strewn around loosely. When removed from the bale they should be stored in an orderly fashion and not permitted to contact dirty rags.

Flammable and Combustible Liquids

Although not in wide use for chemical separations, the operator does have occasional contact with five hazardous liquids and should have a general knowledge of their classification.

A flammable liquid means any liquid with a flash point below 100°F. By flash point we mean the temperature at which the liquid gives off vapors sufficient to form an ignitable mixture with the air near the surface of the liquid. Some examples of flammable liquids are:

- Gasoline
- Alcohols
- Acetone
- Hexone
- Paint Thinners (Amercoat, in extensive use has a highly volatile solvent)

Combustible liquids are those having a flash point at or above 100°F. These would include:

- Tri-butyl phosphate
- Petroleum lubricants

Storage

When it is necessary to store flammable and combustible liquid within a facility approved metal cabinets are required. Not more than 60 gallons of liquids may be stored in a storage cabinet and not more than three such cabinets may be located in a single fire area, except that in an industrial occupancy, additional cabinets may be located in the same fire area if the additional cabinet, or group of no more than three cabinets is separated from other cabinets or group of cabinets by at least 100 feet.

Safety Cans

Flammable liquids, to be dispensed in small quantities for routine use, shall be kept in safety cans with flash screens intact, painted bright red, and the contents plainly marked. The cans are designed for a dual function - to release internal pressure and to arrest flame. Sketches shown below illustrate the mechanisms. If the most credible incident were to occur - the container with its flammable contents engulfed in flames - the spring mounted spout cap would open automatically to allow expanding vapors to escape. Liquid contents of the container are protected from direct contact with an ignitor at any time the cap is open by a flame arresting principle.

Two cylinders of perforated metal assembled one within the other are threaded into the pouring spouts. The proper amount of metal surface and correct air-space serve to dissipate the heat or flame on one side of the arrestor while keeping heat to a level lower than the ignition point of vapors on the opposite side.

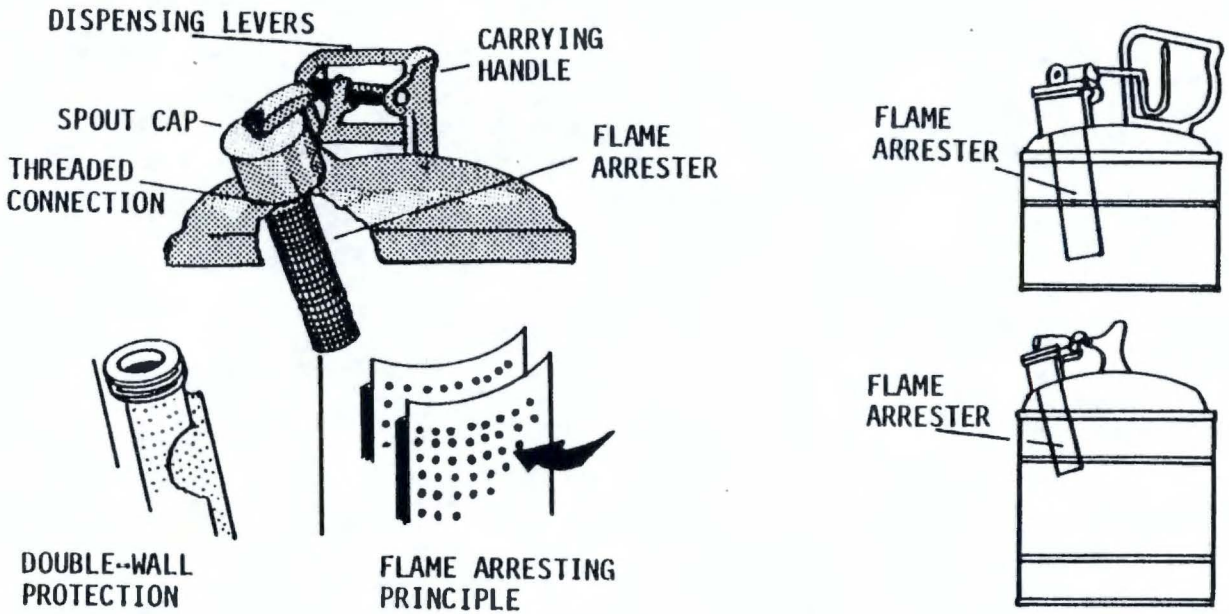


FIGURE 4-1. Safety Cans

Fire Hazards Associated with Chemicals

Many chemicals can cause fires and explosions or contribute to the severity of the fire. Chemicals are sometimes classified according to their hazardous properties, such as: ability to cause oxidation of other materials, combustibility, reactivity with water or air, instabililty, corrosiveness and explosibility. Although many chemicals possess more than one of these hazardous properties it is customery to classify them by their predominent hazard. The danger of this procedure is that the unmentioned hazardous properties may be overlooked. When evaluating a particular chemical, it is necessary to refer to chemical dictionaries and other sources of information. It should be noted that very often this information can be obtained from the container label.

Concentrated aqueous solutions of inorganic acids include nitric, sulfuric, hydrofluric and others that are not in themselves flammable. Their chief hazard lies in the danger of their coming in contact with other incompatible chemicals and/or ordinary combustible materials which in some cases will be followed by fire or explosion.

In your work place one of the most frequent causes of fires has been a common rag wetted with nitric acid. After use for decontamination and disposal to a waste container, without thoroughly flushing with water a reaction invariably occurs, heat is evolved and the rag ignites spontaneously.

The fundamental causes of spontaneous heating are few, but the conditions under which these factors may operate to create a dangerous condition are many and varied. In order for spontaneous ignition to occur two conditions are necessary: (1) oxidation of the material must take place, and (2) the heat of oxidation must be produced faster than it is dissipated.

Controlled Burning

The general precautions which should be practiced when controlled burning, particularly within the exclusion area, are very important. The primary

hazards associated with controlled burning are gusty winds and the consistently semi-arid terrain. Controlled burning during the high fire-risk season, June 1 to September 15, shall be minimized and evaluated on weather conditions. In all cases burning permits must be obtained from the Hanford Fire Protection Department.

FIRE PROTECTION ENGINEERING

The field of engineering is concerned with the safeguarding of life and property against loss from fire, explosion and related hazards. It is concerned with integrated programs involving the design and use of structures, equipment, processes and system, including the areas of prevention, detection, alarms, control and extinguishment, and gives consideration to functional, economic and operational factors. If the engineers committed no human errors and the operators were error-free, there would be no need for fire protection. In one sense, fire protection is a safeguard for human error. Reflecting for a moment, no human errors mean no fire, no explosions, no injuries, no fatalities. Enough degree of uncertainty exists, despite good performance that one unprotected hazard can nullify all the preventive measures built into a plant and possibly make the protection worthless. Hence the need for fire protection can take many and expensive forms.

Sprinkler Systems

The automatic sprinkler system is by far the most reliable and efficient fire suppression and protection system that has been invested to date. On site these systems are used at Z Plant, laboratories, warehouses, shops, and offices, etc. For those of you who are assigned where sprinklers are installed it will be to your advantage to know and understand the effect of sprinkler operation. In general, sprinkler protection is designed and installed to automatically control a postulated fire and alarm the fire department. It is important for the fire department to respond promptly and effectively in order to assure fire extinguishment.

Portable Fire Extinguishers - Hose Lines

Fire extinguishers and hose lines are the manual tools provided to fight fires. Learn where they are, what to use them on and how they are to be used. Fire extinguishers have a short life after they discharge valve is opened (13 to 60 seconds), they are naturally most efficient when used at the earliest moment upon discovery of the incipient fire.

The following information explains fire extinguisher use and limitations.

1. For Class A Fires (Wood, Rubbish, Rags, Etc.)

   Use water or multipurpose powder. The two types of water extinguishers are operated by pump handles or by squeezing the handle of the can under pressure. The effect of water, of course, is to lower the temperature of the burning material as the stream is directed at the base of the fire.

2. For Class B Fires (Flammable Liquids, Grease, Etc.)

   For Class C Fires (Electrical)

   Use CO_2, dry chemical or multipurpose powder. Both CO_2 and dry chemical extinguishers operate in the same way by squeezing a handle or turning a wheel. The material should be directed at the base of the flame in a sweeping motion. Do not blast the center section as this in effect will spread flaming liquid. Continue application after the flames appear to be extinguished to prevent flare up. When using CO_2 avoid handling the horn - it gets cold.

Multipurpose powder is used as described for Class A fires. Caution - Do not mix this powder with dry chemicals used only for B and C fires.

3. For Class D Fires (Combustible Metals)

   Isolation and confinement are required for extinguishment. The best application is one that will smother the material. It is very important to note that the extinguisher is rated for the metal fire in question. The operator who is unfamiliar with the extinguishing

techniques and agent used on metal fire should notify the fire department and not attempt extinguishment. There are as many things that can be done wrong as right and may result in personal injury.

4. Hose Lines

   Where hose lines are provided the operators capability for manual fire fighting is enhanced greatly. A hose line offers an unlimited water supply and is equipped with an adjustible nozzle which improves effectiveness and allows the operator to stand at a greater distance from the fire.

5. Fire Extinguisher and Hose Line Training

   Training in the use of this equipment is offered by the Hanford Fire Department and is strongly encouraged.

6. Fire Extinguisher and Hose Line Maintenance and Inspection

   The Hanford Fire Protection Department annually performs complete maintenance of this equipment. It is the responsibility of the component occupying the facility to perform monthly inspections and identify problems that may develop. Points covered by these inspections are: tags in place, equipment obstruction, physical damage, corrosion, seals in place and gauges reading normally where applicable.

Automatic Signaling Systems

Increasing use is being made of systems to signal presence of fire in remote locations. The systems employ different elements, but all are intended to transmit the same information -- the presence of fire. Some are responsive to heat or smoke while others detect a diffusion of light or other products of combustion. Heat sensitive devices are of two basic types: (1) fixed temperature or (2) rate-of-rise.

The fixed temperature element is set to respond to and relay an alarm signal if the temperature reaches a point 50° or 60° above normal. Rate-of-rise sensitive elements are designed to operate where temperature

increases are more rapid than normal, say 15° per minute. Some heat sensitive elements incorporate both features.

Where greater sensitivity for earlier detection is not desirable either a light source for smoke detection or an ionization element to detect by products of combustion is used.

These fire protection devices are complete with annunciator systems and provisions for read-outs to spot the exact or relative location of the source of incipient fire. Most systems also include relay through an alarm box directly to the fire station.

When you discover a fire, don't hesitate to turn in an alarm and make every effort to extinguish the fire while it is small. If extinguished in the first few seconds, only very minor damage is likely to occur. If you are successful in extinguishing a fire, the alarm will signal the fire department.

While encouraging employees to take prompt action on fires, they should not attempt extinguishment if there is danger of injury. There is little danger if the fire is still small.

A successful program in this field is dependent upon two factors: first making use of the best possible means of fire prevention and second, being prepared to handle a fire should one occur.

PRE-EMERGENCY FIRE PLANNING

Being prepared for emergencies is increasingly becoming a vital component of facility fire protection. Rockwell has realized this and published RHO-MA-111, "Rockwell Hanford Operations Emergency Plan." It is the responsibility of all operators to be familiar with this plan. Specific items of importance are as follows:

1. Have available all emergency telephone numbers.
2. Be aware of manual fire alarm box locations.

3. Be familiar with evacuation procedures.
4. Assure that local emergency response teams are formed and trained.
5. Follow facility shutdown procedures.

Class A Fires

Class A fires are those that occur in ordinary materials such as wood, paper, excelsior, rags, and rubbish. The quenching and cooling effects of water or of solutions containing large percentages of water are of first importance in extinguishing these fires. Special dry chemical agents (multipurpose dry chemical) provide rapid knockdown of the flames and the formation of a coating that tends to retard further combustion.

Class B Fires

Class B fires are those that occur in the vapor-air mixture over the surface of flammable liquids such as gasoline, oil, grease, paints, and thinners. The limiting of air (oxygen) or the combustion inhibiting effect is of primary importance on incipient fires of this class. Solid streams of water are likely to spread the fire, but under certain circumstances water fog nozzles prove effective. Generally, regular dry chemical, multipurpose dry chemical, carbon dioxide, foam, and halogenated hydrocarbon agents are used.

Class C Fires

Fires that occur in or near electrical equipment were unconducting extinquishing agents must be used are called Class C fires. Dry chemical, carbon dioxide, compressed gas and vaporizing liquid extinguishing agents are suitable. (See NFPA Standard No. 182M, Hazards of Vaporizing Liquid Extinquishing Agents.)

Foam or a stream of water should not be used because both are good conductors and can expose the operator to a severe shock hazard. Water from a very fine spray can sometimes be used on fires in electrical equipment, as in transformers, since a spray is a poorer electrical conductor than a solid stream of water.

Class D Fires

Fires that occur in combustible metals such as magnesium, titanium, zirconium, lithium, and sodium are classified under Class D. Specialized techniques, extinguishing agents and extinguishing equipment have been developed to control and extinguish fires of this type. Normal extinguishing agents generally should not be used on metal fires as there is a danger in most cases of increasing the intensity of fire because of a chemical reaction between some extinguishing agents and the burning metal.

PORTABLE FIRE EXTINGUISHERS

Principles of Use

Even though the plant may be equipped with automatic sprinklers or other means of fire protection, portable fire extinguishers should also be available and ready for emergency. "Portable" is applied to manual equipment used on small fires or in the interim between discovery of fire and the functioning of automatic equipment or arrival of professional fire fighters.

To be effective portable extinguishers must be:

1. A reliable type.
2. The right type for each class of fire that may occur in the area.
3. In sufficient quantity to protect against the exposure in the area.
4. Located where they are readily accessible for immediate use.
5. Maintained in perfect operating condition, inspected frequently, checked against tampering, and recharged as required.
6. Operable by area personnel who can find them and use them effectively and promptly.

The location of the extinguisher should be made conspicuous (Figure 4-3). For example, if it is hung on a large column or post, a distinguishing red ban can be painted around the post. Also, large signs can be posted directing attention to extinguishers. The extinguisher should be kept clean and should not be painted in any way that will camouflage it or obscure lables and markings on it.

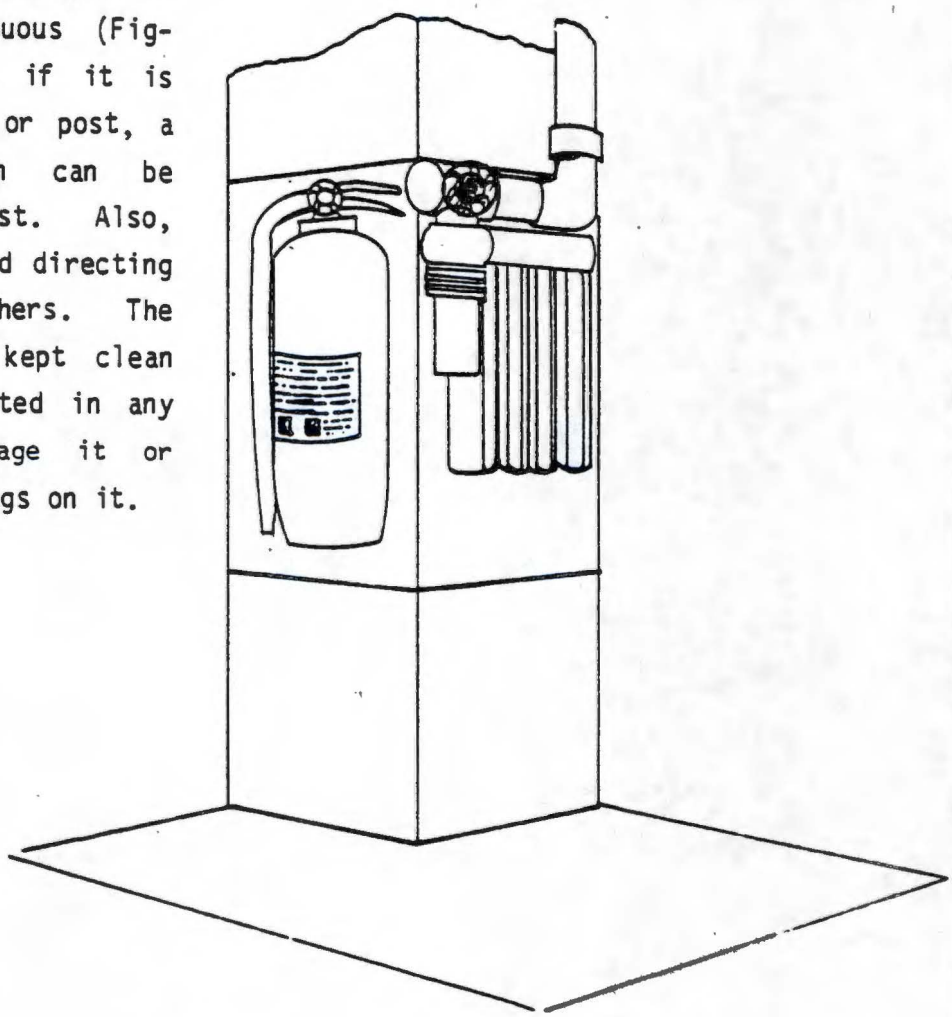


FIGURE 4-2. Locating Fire Extinguishers

TABLE 4-2.
Summary of Fire Extinguisher Characteristics

Type	Class of Fire A	B	C	D	Common Size	Total Weight (lb)	Horizontal Range (ft)	In-plant Filling Possible	Hydrostatic Test Frequency	Discharge Time (sec)	Classification
Water Solution											
Pump tank	X				2½ gal	40	30-40	yes	(none)	60[a]	2-A
Cartridge actuated	X				2½ gal	35	30-40	yes	5	60	2-A
Soda acid	X				2½ gal	35	30-40	yes	5	60	2-A
Stored pressure	X				2½ gal	40	35-40	yes	5	60	2-A
Loaded stream	X	b			2½ gal	40	30-40	yes	5	60	2-A:1-B
Foam	X	X[c]			2½ gal	35	30-40	yes	5	90	2-A:4-B
Wetting agent	X				2½ gal	40	30-40	yes	5	60	
Carbon Dioxide	b	X	X		2½ lb	12	3-4	no	5[d]	8-30[a]	1-4-B:C
	b	X	X		5 lb	20	6-8	no	5[d]	8-30[a]	1-4-B:C
	b	X	X		15 lb	48	8-10	no	5[d]	8-30[a]	12-B:C
Dry Chemical	b	X	X		2½ lb	7	8-11	yes	12[e,i]	8-20[a]	1-4-B:C
	b	X	X		5 lb	12	10-12	yes	12[i]	8-20[a]	4-B:C
	b	X	X		10 lb	22	15-20	yes	12[i]	10-25[a]	8-B:C
	b	X	X		20 lb	38	20-25	yes	12[i]	10-25[a]	16-B:C
	b	X	X		30 lb	55	20-25	yes	12[i]	10-25[a]	20-B:C
Dry Powder (Metal fires)				e	30 lb	55	6-8	yes	12	28[a]	
Liquefied Gas	b	X	X		2½ lb	6	3-5	yes	12	10[a]	4-B:C

Notes:

[a]May be operated intermittently.
[b]Limited to small fires; for best results follow up with water.
[c]Not satisfactory for fires of water-miscible solvents, such as alcohol and aetone, unless foam is of polar type.
[d]U.S. Dept. of Transportation or Board of Transport Commissioners of Canada may require testing at more frequent intervals.
[e]Models using factory-sealed disposable (nonrefillable) containers are not subject to hydrostatic testing.
[f]Models using multipurpose dry chemical are effective on Class A fires.
[g]Several different dry powders may be used; their effectiveness depends on material that is burning.
[h]Limited to small fires.
[i]Dry chemical extinguishers with stainless steel, aluminum, or soldered-brass shells should be tested at 5 year intervals.

Source: National Fire Protection Association.

FIRE EXTINGUISHMENT AND CONTROL

Ordinary

Combustibles

1. Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle shall be colored green.*

Flammable

Liquids

2. Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square shall be colored red.*

Electrical

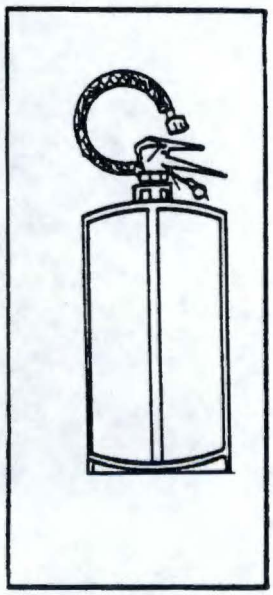
Equipment

3. Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the circle shall be colored blue.*

Combustible

Metals

4. Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star shall be colored yellow.*

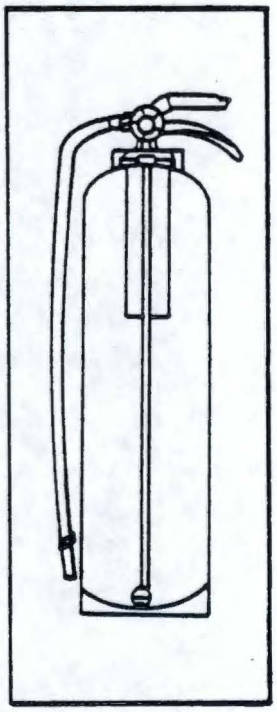


Operation. Remove locking pin, aim nozzle at base of fire, then squeeze discharge lever. Discharge is controlled by a valve released by squeezing the combination handle-operating lever.

Maintenance. Check pressure gauge frequently. When recharging, thoroughly clean valve assembly so that the valve will seal tight and give maximum protection against pressure loss. To pressurize, remove hose and attach adapter and pressurizing equipment. (Recharge equipment varies with manufacturer.) Dry nitrogen or CO_2 is usually recommended as the pressurizing gas. (Air passed through moisture traps is sometimes used, but if the trap is not 100 percent efficient, moisture can harden the chemical.)

Caution. Pressurizing gas must be dry because if moisture enters container, the chemical can harden and not flow freely from nozzle.

Figure 4-3. Dry-chemical fire extinguisher, stored pressure type, combination handle.



Operation. Can be operated intermittently be removing locking ring and squeezing combination operating lever-handle. Extinquisher is pressurized with air or inert gas through a hose line equipped with an automobile-type air chuck. Charging pressures vary from 90 to 150 psi. Direct the stream at the base of the fire, then follow up after the flames while working from side-to-side or around the fire if possible.

Maintenance. Check pressure, hose, and nozzle frequently. When charging extinguisher, fill only to water level mark so there will be sufficient room for pressurized air. Some models have an overfill tube that ensures filling to the proper level. When pressurizing, the gauge should indicate just above the full mark, then, when the pressure equalized, it will not read less than full. After charging, let it stand for 24 hours to check for leaks.

Caution. Protect from freezing. Be sure shell is the corrosive-resistant type before adding antifreeze charge. Do not refill with loaded-stream charge unless extinguisher is designated as loaded-stream type.

Figure 4-4. Stored pressure water fire extinguisher. May be labeled "loaded-stream" if charged with a special alkali-metal salt solution instead of water.

General Plant Hazards

Safety requirements and rules to be followed for TFS plant operations are found in the Master Safety Rules, General Safety Rules, Tank Farm Safety Rules, and Accident Prevention Standard Manual.

Additionally, plant hazards peculiar to TFS operations are discussed below as identified by the particular assignment where the hazard(s) primarily exists.

Lateral Monitoring

- When changing probe types, the high voltage switch must be turned "OFF". In "A" Farm the high voltage switch is on Panel B-Module 7; for 105 and 107-SX laterals the HV Switch is located on Panel D - Module 1; and for the remaining SX laterals, the high voltage switch is designated "HV" on the panel - and time allowed to permit voltage decay to below 25 volts as shown on the LED display.
- There are several head bumping conditions in all lateral buildings. Bump hats should be worn when working in these facilities.

Dry Well Van Operation and Manual Liquid Level Monitoring

- Observe safe driving practices when operating vehicles, especially when backing up.
- Caution must be used to avoid carbon monoxide poisoning when working inside the vans while vehicle motor is running.
- Avoid coming into contact with exhaust pipe running up to the back of the van, as serious burn may result.

Neutron Source Handling

- When handling the neutron probe source, the special handling device must be used at all times. (This is primarily a radiation safety consideration; however, the importance of proper neutron source handling cannot be over-emphasized).

In-Tank Photography

- The Speed-O-Tron power supply package that supplies power to the camera package strobe light can generate peak power loads of high voltage electricity. When connecting leads to this equipment, follow established safety rules for hooking up electrical equipment.
- The overall weight of the camera package varies with the amount of steam hose hand down. When handling the package, use proper lifting techniques (lift with legs, not the back) and seek assistance if the package becomes too heavy.

Automatic Liquid Monitoring (FIC's) and Manual Liquid Level Monitoring

- Beware of potential electrical hazard, both to equipment and to the operator, if you manually contact the electronic circuitry within the gauge control boxes.

MASTER SAFETY RULES

1. Follow instructions or established procedures. If you don't know, ask.
2. Correct or report unsafe conditions.
3. Keep work place and equipment clean and orderly.
4. Use the right tools and equipment for the job.
5. Report every injury. Get first aid immediately.
6. Use, adjust and repair equipment only if authorized to do so.
7. Use prescribed protective clothing and equipment. Maintain them in good condition.
8. Do not indulge in horseplay. Avoid distracting others.
9. Bend knees and keep back straight when lifting. Get help with awkward loads.
10. Comply with all safety rules and signs.

GENERAL SAFETY RULES TANK FARM OPERATIONS

1. Immediately report all injuries, no matter how slight, to supervision. Report to First Aid, as directed, for treatment. Injuries occurring in a radiation zone must be surveyed by radiation monitoring before treatment.

2. Follow safety rules, RWP's and other applicable procedures.

3. Protective clothing shall be worn as required by the specific procedures, safety rules or RWP's for each work area.

4. Safety shoes or toe guards must be worn when handling heavy loads.

5. Wear face, eye and hand protection as specified by specific safety rules and signs and as safe practice demands.

6. Observe contamination control and housekeeping procedures.

7. Follow lock-and-tag procedures.

8. Do not obstruct access to safety showers, fire extinguishers or fire blankets.

9. Do not obstruct walkways, doorways, driveways or yard fire hydrants, except as temporarily required for increased safety.

10. Maintain good housekeeping. If unable to clean up spills immediately or eliminate safety hazards, report matter to supervision for further attention.

11. Report all defective equipment to supervision immediately.

12. Walk up and down stairways. Use hand rail provided.

13. Operation, maintenance or repair of equipment is to be performed only by authorized personnel. In the event of an accident or significant unusual occurrence preserve the scene of the incident.

14. Be familiar with operation of fire extinguishers.

15. Obtain fire permit from supervision before welding or burning in any underground storage tank pump pit or sluice pit.

TANK FARM FIRE PLAN

The tank farms do not process fissionable material in sufficient quantity or concentration to provide the source for a nuclear excursion. We are susceptible to fire or explosion. Fire-fighting and rescue of personnel is mainly work for professionals trained in techniques and use of equipment designed for that purpose. There are, however, many things tank farm personnel shall do before and after the Fire Protection personnel arrive. Among these are:

1. Activate the fire alarm box if one is near, or phone the Fire Department, phone number 811.

2. Then call, or have called, the tank farm supervisor, phone number 2-2689 for shift or 2-2820 for days - East Area or 2-2284 for days - West Area.

3. Complete emergency shutdown of equipment.

4. With help on the way, do what you can to control or extinguish the fire safely. Make use of respiratory protection when fire is in a radiation zone.

5. Be in position to meet and direct firemen to exact location of fire.

6. Alert firemen to any hazards pertinent to the particular situation.

7. Assist with dress and undress if required.

8. Supervisor will evaluate need for Radiation Monitoring assistance. He will organize clean-up, waste handling, and repair service.

SAFETY RULES DRY WELL MONITORING

1. Follow tank farm safety rules, RWP's and other safe practices associated with dry well monitoring in the tank farms.

2. Report all injuries to supervision, report to first aid, as directed, for treatment.

3. Protective clothing shall be worn as required by RWP's and placed in designated receptacle after use.

4. Observe no-smoking and eating rules in SWP controlled zones to prevent health hazards.

5. Maintain good contamination control and a high standard of housekeeping.

6. Be alert to fire hazards with gas driven engines and cleaning solvents. Watch for leaks and spillings and take immediate action to wipe up spills and prevent leakage. Know the location and operation of the fire extinguisher mounted in the dry well vehicle.

7. Be alert to possibility of electrical shock in working with probes and instruments. Follow instructions when operating equipment. Report faulty wiring and loose connections to supervision.

8. Secure brooms to prevent their swinging out from vehicle while vehicle is in motion.

9. Use caution when entering and exiting dry well vehicles to prevent sprains and/or strains.

10. Be constantly alert to other tank farm operations and check with supervision before entering an area where activities such as, above ground transfers, pump removal, jumper changes, etc., are in progress.

11. Use extreme caution when operating vechicles in congested tank farms, expecially when backing. Close gates, chains or barricades when leaving zoned areas.

12. Be alert to potential neutron exposure when handling neutron probe. Use extension handles and reduce close contact with neutron sources to a minimum.

13. Be constantly aware of need for self monitoring of clothing, hands, and equipment when operating dry well monitoring equipment.

    Report unsafe conditions and unusual readings to supervision.

241-BX, 241-BY TANK FARM SAFETY RULES

1. Heavy equipment in excess of 46 tons is prohibited in this tank farm.
2. Unauthorized sprinkling or backfilling in this farm is prohibited.
3. Protective clothing for entry to the tank farm will be provided at the tank farm control house.
4. Used SWP clothing is to be handled according to approved procedures.

241-C TANK FARM SAFETY RULES

1. Live load in excess of 46 tons is prohibited in this tank farm.
2. Unauthorized sprinkling or backfilling in this farm is prohibited.
3. Laundry for entry to the tank farm will be provided at the tank farm control house.
4. Used SWP clothing is to be placed in designated receptacles only.

241-SY FARM SAFETY RULES

1. Gates are to be kept locked at all times when area is unattended.
2. Live load in excess of 40 tons is prohibited in this tank farm.
3. Unauthorized sprinkling or backfilling in this farm is prohibited.
4. Laundry for entry to the tank farm will be provided by Tank Farm Operations.
5. Used SWP clothing is to be placed in designated receptacles only.

LUNCHROOM SAFETY RULES 224-U

1. Surveys are required prior to entering the lunchroom. SWP clothing will not be permitted at any time in the lunchroom.

2. Foods must not be left unattended on the stoves, or in the ovens, while the burners are on.

3. Good sanitary conditions must be maintained in the refrigerators.

4. Oily rags, waste, and other readily combustible materials shall be kept in approved metal containers.

5. Accumulated grease, lint, dust, etc., shall be regularly removed from the stove vent system.

2707-C (CHANGE HOUSE) SAFETY RULES

1. Immediately report all injuries, no matter how slight, to supervision. Report to First Aid, as directed, for treatment.

2. No food shall be taken into the change house.

3. Water on floors shall be squeegeed immediately.

4. SWP clothing shall be removed and a body survey performed before entering the shower room or cold locker room.

5. All skin contamination shall be reported to a radiation monitor.

6. Contaminated SWP clothing will be handled according to approved procedures.

7. Extreme care shall be used when using all survey instruments. Contaminated instruments shall be cleaned before being returned to the shelf.

8. Do not block fire extinguishers.

ELEVATOR SAFETY RULES 224-U

1. Exercise extreme care while closing the gate and door. Do not close door unless all parts of the body are clear. The doors shall always be closed by means of the strap or hook provided.

2. Dollies, trucks, and other rolling equipment hauled in the elevator must be chocked.

3. Do not load the elevator over the limit of 8,000 pounds.

4. Do not use the alarm unless the elevator becomes stuck between floors.

5. While repairs are made to the elevator, the main electrical control switch must be locked and tagged "off."

6. While work is being done in the elevator pit, the elevator must be blocked up by two 4-inch pipe stifflegs."

7. After the material on hydraulic lifts is moved into the elevator, the hydraulic mechanism shall be released so that the load is resting on the floor of the elevator.

LADDERS

1. Employees shall personally inspect a ladder before putting it to use.

2. Any straight ladder must be tied off, if possible. It must be held while being tied off, and, if not possible to secure by tying off, it must be held while in use.

3. Extension ladders are not to be taken apart and parts used separately.

4. Ladders in need of repair are not to be used. They shall be tagged with "Unsafe Equipment" tags, and reported to the supervisor in charge.

5. Do not carry tools that protrude from pockets or equipment in the hands when ascending or descending a ladder; use a hand line.

6. No more than one person is allowed on a ladder at one time.

7. All portable, straight or extension ladders shall be equipped with feet and with a 6-foot safety rope. Minimum size of rope is to be 3/8 inch.

8. In erecting a ladder, the feet should be kept on-quarter of the ladder length from the base of the object on which it is resting.

9. When not in use, all ladders should be kept on racks provided for ladder storage.

10. Do not use a ladder that is too long or too short. Get the proper length ladder.

11. Never leave equipment on top of step-ladders or handling from straight or extension ladders.

12. Do not use make-shift devices to stand on; get a ladder.

13. While ascending or descending a ladder, keep hands on ladder.

14. Never lean far to one side while working from a ladder. Move the ladder to the right position.

15. Step-ladders must be fully open with locking device set before ascending. Never use a step-ladder as straight ladder, or stand above the second step from top.

16. Do not place a ladder in front of an unlocked door or window sash.

17. Aluminum and magnesium ladders are conductors of electricity and shall bear the following sign in red letters: "Caution - Do not use Around Electrical Equipment." Their use around exposed electrical circuits is prohibited.

201-C (HOT SHOP) SAFETY RULES

1. Comply with general safety rules and RWP's applicable to the work being performed.
2. No food, smoking materials or matches shall be taken into the hot shop.
3. Contamination and radiation control procedures shall be followed.
4. All unsafe equipment and tools shall be tagged "DO NOT OPERATE."
5. Stairways and doorways shall be kept clear at all times.
6. Operation of the monorail hoist shall be done only by qualified personnel. Do not walk under loaded hoist.
7. Radiation Work Procedures shall be followed for all work performed in the hot shop.
8. Fire permits are required for open flames or arcs.
9. Know the location of the safety showers and fire extinguishers.
10. Eye protection is required in the hot shop.

SECURITY

INTRODUCTION

The word "security" means the freedom from exposure to danger. From this then, we can imply that national security would be the safeguarding of those items whose misuse could be dangerous to the country. Since Hanford is the original and still one of the largest atomic installations, safeguarding the information and equipment in use here is an important part of each employee's job. The basis for security authority stems mainly from congressional action which resulted in the Atomic Energy Act of 1954. This has been supplemented by other federal laws and statutes, executive orders issued by the President, Department of Energy and Department of Defense regulations, and contractual obligations. For the chemical operator, compliance with the above boils down to a firm habit of leaving the details of the job on the job and keeping alert to any security infractions so they may be reported.

Access Authorization

The best method of protecting the information is to control the people, and one way is by restricting travel within the area by means of fences and barricades. The extreme outside edge of the area is designated as the perimeter boundary. Within this space are certain fenced areas called Limited Areas. Examples of Limited Areas are 200 East and 200 West. Then within a Limited Area there can be one or more Protected Areas (234-5).

CONCEPT OF SECURITY AT HANFORD

Controlled Access Area. Any area whereby entry is controlled by Hanford Patrol, access control devices or administrative procedures. See diagram, page 5-3.

Security Area. A physically defined space subject to physical protection and personnel access controls. A Security Area may enclose a Limited Area. The area inside the Yakima and Wye Barricades are Security Areas. See diagram, page 5-3.

Limited Area. A physically defined space subject to physical protection and personnel controls, and may enclose a Protected and/or Material Access Area. See diagram, page 5-3.

Protected Area. An area within a limited area that is encompassed by physical barriers to which access is controlled. Z Plant is a Protected Area. See diagram, page 5-3.

Material Access Area. An area containing special nuclear material in threshold or greater quantities specifically defined by physical barriers and located within a Protected Area. See diagram, page 5-3

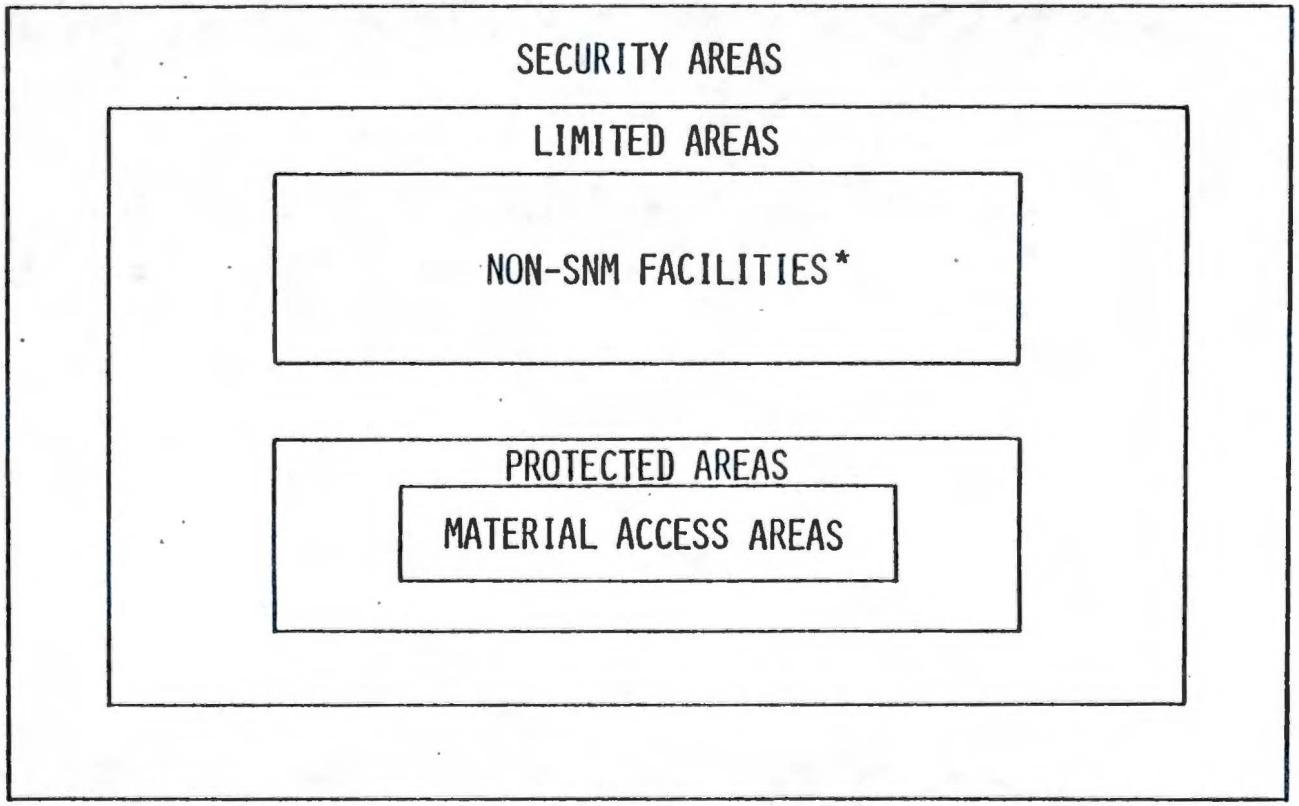
For travel within these areas then, some form of recognition by the guards is necessary. The device used on this plant is a photo badge with appropriate markings to designate accessible areas. The badge also has a color-coded background to indicate the type of security clearance.

ACCESS AUTHORIZATION AND SECURITY BADGES

"Q" Access Authorization

Access authorization (Security Clearance) is an administrative determination made by DOE that an employee or applicant for employment with DOE Contractors, subcontractors, agents, or access permittees is eligible to have access to and control of Restricted Data or other National Security information under control of the Department of Energy.

Rockwell employees requiring DOE access authorization are required to complete a Personnel Security Questionnaire Form DOE-RL (Part I), Personnel Security Questionnaire Form DOE-II (Part II), Security Acknowledgement Form DOE-15, Authority for Release of Information Form CSC 329-A, and be finger printed. These forms are processed to DOE-RL with a request for the level of clearance, Class "Q" or "L" required for the employee's job assignment.



*LOCATED THROUGHOUT LIMITED AREAS

FIGURE 5-1. Hanford Controlled Access Areas

Employees who require access to Restricted data or National Security information classified as SECRET or TOP SECRET (see S.O.M. No. 7) or who will be assigned to work within a Protected Area or who has access to Special Nuclear Material will require "Q" access authorization.

The "Q" type security badge is a 3-inch x 1 5/8-inch laminated card with a blue design at the top and bottom. It contains the badge number, employee's photograph, name, year photograph taken, company name and code symbols designating the Security Areas to which the employee is authorized access. The employee's payroll number and signature of the Manager - Security appear on the reverse side of the badge. The coded symbols are:

LIMITED AREAS	PROTECTED AREAS
1 - 100 Areas	Z - 234-5 Area
2 - 200 Areas	Orange or Blue Strip - 308 Area
3 - 300 Area	E-209-E-Area
4 - 400 Area	

Patrol and Fire

Badges of Patrol and Fire Protection personnel with "Q" Access Authorization will have no area access symbol. Instead the word PATROL or FIRE will appear on their badges. This identification will imply that all area access symbols applicable to their clearance are active.

"L" Access Authorization

The "L" type security badge is identical to the "Q" badge except that it has a tan background design. "L" Access Authorization, as a minimum, is required for all employees; and it allows access to Restricted Data or National Security information classified as CONFIDENTIAL. Individuals who hold an "L" clearance are not authorized to hand carry classified documents.

"Work Approval"

The "WA" type security badge is identical to the "L" badge except that it has a red background design and contains only limited area access symbols. A work approval is granted after a pre-employment investigation has been conducted by security. It is an interim authorization until a permanent "L" or "Q" clearance is granted. Personnel who have the "WA" badge are not authorized access to classified information or material. In addition, WA badged employees are not allowed access to 234-5, 224-T, 209-E or 308 protected areas without an escort and prior to approval by Rockwell Security.

Proper Care and Wearing of the Security Badge

The possession of a security badge then actually becomes a condition for employment, so effort must be made for its proper care. Although there are provisions for temporary replacement of lost or forgotten badges, extra work and cost are involved. If a badge should be forgotten or lost, patrol at the Area Badge House should be notified. The employee's supervisor will then be required to come to the badge house to certify the employee's clearance.

Temporary Badges

Temporary security badges may be issued by Security when a employee (1) has lost or forgotten his badge, (2) is awaiting a permanent badge, or (3) requires entry to a Controlled Access Area which is not authorized on his permanent security badge.

Lost and Forgotten Badges

Employees who have lost or forgotten their security badge must report the incident to Patrol at a Limited Area Badge House or to the receptionist at the Federal Building. The employee's supervisor or manager will be contacted and requested to come to the badge house or reception desk to identify the employee. If the supervisor or manager cannot be reached, the employee may be certified by an exempt employee in the same component.

In case of a forgotten badge, a temporary badge will be issued for a period of one day. In case of a lost badge, it will be issued for the period of time required to obtain a replacement.

Since most people utilize the dosimeter as a holder for the badge, it becomes necessary to exercise additional care when Radiation Zone work is involved.

There are many times when it would be highly desirable to remove the security badge and protect it from contamination in a pocket. The badge is issued for your identification on the project only; and, as such, wearing it in public places should be minimized. This is especially true if it is worn on an outer garmet which may later be removed. The development of a daily fixed habit for storing the badge at home (usually in the same place) will result in having the badge available when needed. Badges are to be worn in full view at all times within a security area.

Improper Use of Security Badge

Any employee who presents a counterfeit badge or a badge of another will be promptly taken into custody by Patrol, and be subject to severe disciplinary action and/or Federal prosecution. An employee who willfully damages or defaces his badge or permits another individual to use his badge for any purpose is also subject to such action.

Damaged or Defaced Badges

To arrange for replacement, the employee will report to Patrol at a Limited Area Badgehouse or directly to Security. The new badge will be forwarded to the employee's manager for issuance.

Badge Photographs

Each employee is responsible for ensuring that the photograph on his security bades is a reasonable likeness. When facial changes occur, such as addition of a beard or mustache, a new badge photograph is required. Patrol has the authority to refuse admittance to Controlled Access Areas

if the image on the badge photograph does not resemble the individual wearing the badge. At a minimum, all employees must be rephotographed at five-year intervals.

Challenge System

The challenge system is a procedure designed to prevent unauthorized persons from obtaining access to classified information and Special Nuclear Material. The unexpected presence of a person who does not normally perform work in a particular area should be questioned.

This can be most easily accomplished by offering to assist the person. If his badge is not in view, a question should be directed toward producing some evidence of security clearance. So that persons may not be unnecessarily challenged, they should clear with the supervisor or manager before entering any area where classified information is available.

In the event that the individual is acting in a suspicious manner, notify patrol, and maintain surveillance until patrol arrives.

Prohibited Articles

There are certain items which are restricted from being in one's possession. The term "prohibited articles" refers to :

- Firearms, explosives and incendiary devices.
- Narcotics and dangerous drugs.
- Potable alcohol and alcoholic beverages.
- Cameras and film.
- Copying and reproducing devices, recording devices and portable transmitting devices.

Other items similar in effect or purpose to any of the above.

Control of Prohibited Articles

Employees, visitors and vendors who transport, possess or use prohibited articles within the perimeter barricades, security areas or the secured portion of the Federal Building shall have in their possession a valid

Prohibited Articles Property Pass (Form 54-3000-606); except that this requirement shall not apply to cameras and camera equipment used outside of security areas (100, 200, 300, 400 Areas).

All persons and vehicles, and packages, lunch boxes and similar containers shall be subject to search for prohibited articles when entering and leaving the perimeter barricades, security areas, protected areas and the secured portion of the Federal Building. If prohibited articles are discovered in the possession of unauthorized persons, they will be confiscated by Patrol; and the bearer will be issued a Prohibited Articles Receipt (Form BT-6200-070). Arrangements for recovery of confiscated materials must be made through Security. Confiscated materials not claimed within thirty (30) days will be destroyed.

Control of Classified Information

The term "Classified Information" as used herein means all National Security Information (including Restricted Data and Formerly Restricted Data) which is contained in documents; embodied in materials; artifacts and processes; or known to Rockwell Hanford Operations/Rockwell Hanford Operations subcontractor employees.

Each individual who may have access to classified information, no matter how acquired, is responsible for safeguarding such information and for property limiting its dissemination. Employees, consultants, contractors or vendors who are engaged in classified work for Rockwell Hanford Operations are responsible for following security procedures.

Each custodian of a classified document, either as a recipient or originator, is responsible for its physical security and for the security of its contents until relieved of this responsibility by transfer of custody of the document to Rockwell Document Control.

In addition to their personal responsibility, each manager or supervisor is responsible for their security performance of personnel under their supervision. They are responsible for ensuring that the employees have

been properly instructed in the care and protection of classified information, and that each employee has the proper level of access authorization for the classified information entrusted to them.

Access to classified information under control of Rockwell shall be granted only to authorized and properly cleared employees and then only if the information is required in the performance of official duties.

The public media (e.g., publications, radio, or television) may on occasion report information relating to various aspects of the Rockwell program. There shall be no confinement or denial by Rockwell or contractor employees if such action would tend to reveal classified information.

Infractions of Security Regulations

Security infractions are acts or omissions involving failure to comply with established regulations or to protect classified information and material.

Infractions shall include, but not be limited to, the following examples:

1. Leaving classified documents or material exposed and unattended at the close of business or whenever a room is unattended.
2. Improper storage of classified documents or material.
3. Failure to safeguard or account for classified documents or material resulting in such matter being unaccounted for.
4. Failure to maintain prescribed records for TOP SECRET or SECRET documents.
5. Removal of classified documents or material from a security area without proper authority.
6. Failure to mark a document properly after a classification determination has been made.
7. Failure to obtain classified guidance thereby causing a compromise of classified information.
8. Change of classification of documents without proper authorization.

9. Failure to properly safequard combinations of repositories or keys to sensitive locations.
10. Destruction of classified documents in other than the prescribed manner.
11. Improper transmission of classified documents or material.
12. Discussion of classified information in the presence of hearing of unauthorized persons.
13. Discussion of classified information over the telephone system.
14. Failure to escort uncleared visitors in security areas.
15. Permitting an unauthorized person to hear, obtain visual access to, or otherwise obtain classified information.
16. Disregard for security alarm systems, i.e., alarmed doors, etc.

Responsibilty

All actual or suspected infractions shall be reported immediately to Security. Oral reports shall be confirmed in writing.

When an infraction is indicated, Security is responsible for conducting an immediate investigation to determine whether an infraction has occurred, and informing designated individuals of the department concerned.

Disciplinary Action

Disciplinary action shall be taken in any case in which a person is responsible for an infraction, except in the case of a minor infraction which does not actually jeopardize the security of classified information, such as failure to place the name of the addressee on a receipt when signed by his authorized representative, or an insignificant delay in changing a respository combination beyond the prescribed period.

TFS PLANT OPERATIONS AND EQUIPMENT

INTRODUCTION

The TFS Plant Operations & Equipment Section will be presented in two parts. The first part will be a general narrative describing the overall tank farm system, of which the TFS plant is a part. This narrative will include information regarding storage facilities, operating practices, tank auxiliaries, and monitoring systems.

The second part will be a somewhat detailed descriptive presentation of the Leak Detection Program conducted by TFS. The major topical areas discussed in this section are:

1. Waste Volume Monitoring
    - Automatic liquid level monitoring
    - Manual liquid level monitoring
    - Leak detection pits and annulus leak detection
    - Swab risers
    - Pond monitoring
2. Subsurface Monitoring
    - Dry Well monitoring
    - Neutron probe monitoring
    - Internal dry well monitoring
    - Lateral monitoring
3. Computer Automated Surveillance System
4. Remote Visual Imagery and Waste Package and Handling

TANK FARM SYSTEM

STORAGE FACILITIES

Since 1944, a total of 169 underground tanks have been, or are presently being constructed for the retention of radioactive wastes at Hanford. These tanks are strategically located in groups called Farms, containing two to eighteen tanks each. Each of the tanks is constructed of reinforced concrete with a mild carbon steel liner covering the bottom and sidewalls. Most of the tanks are 75 feet in diameter and are constructed to hold from 15 feet to 30 feet of liquid for a nominal capacity of 530,000 to 1,000,000 gallons; sixteen of the tanks are smaller units of the same basic design built to contain 55,000 gallons each. All of the tanks have a minimum of 7 feet of earth cover for shielding purposes. (See Figure 6-1).

Many of the tanks built since 1954 have been equipped with condensers and condensate disposal systems to permit the wastes to self-concentrate. These tanks are equipped with airlift circulators to avoid the fluctuating rate of boiling and resultant tank pressurization that could result from a stagnant self-heating system. Self-boiling has been observed at rates of up to 10 gallons per minute in the SX Farm, and up to 30 gallons per minute in the A Farm.

The original tank farms (T, U, B and C) featured tanks with dished bottoms and a 17-foot operating depth. The BX Farm tanks were built to the original tank design.

Second generation tank design is embodied in the S, BY, TX, and TY Tank Farms and is essentially the same as the original tanks except for increased capacity and a 23-foot operating depth.

The third and fourth generation tanks are represented by the SX and A design with the operating depth increasing to 31-feet and the A tanks going to a flat (instead of a dished) bottom.

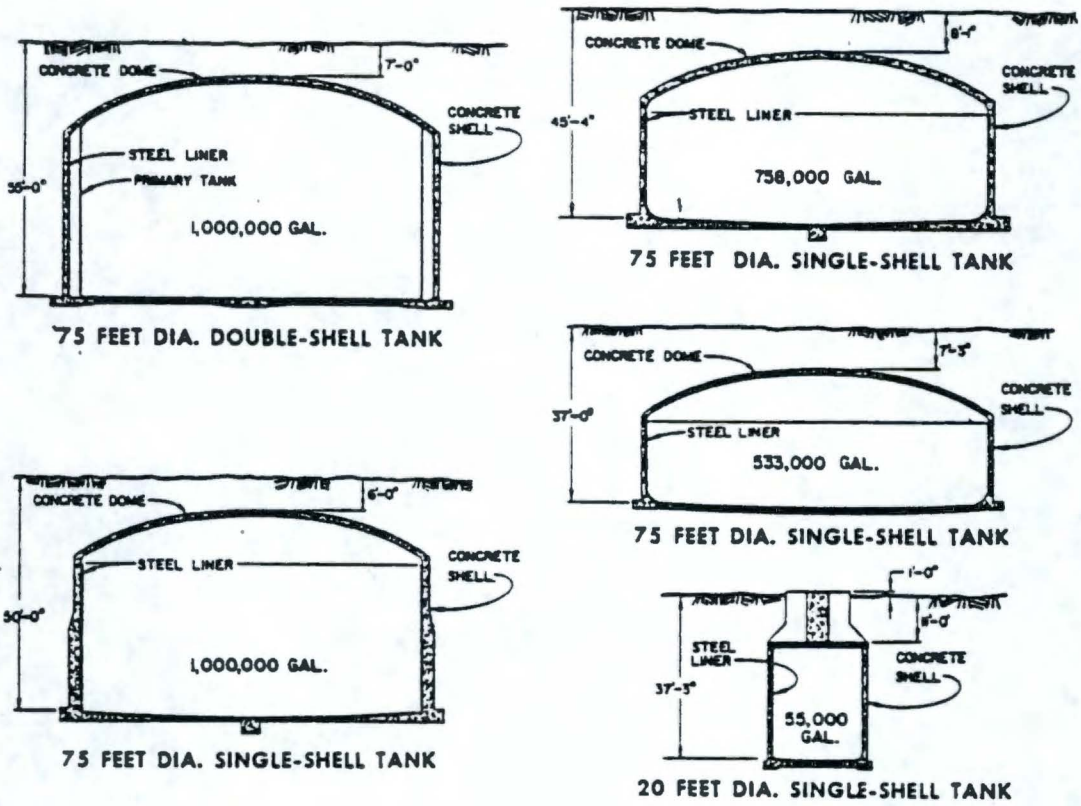


FIGURE 6-1

Waste Storage Tank Designs

The fifth generation tanks in the AX Farm were essentially the same as the A Tank design with the addition of a grid of drain slots beneath the steel liner bottom.

The grids function to collect potential tank leakage. This is then diverted to a leak detection well. The grids also serve as an escape route for free water formed as it is released from the concrete grout during initial heating of the tank.

The latest tank design represented by AN, AW, AY, AZ, and SY Farms represents a departure from the basic design reflected in all previous tanks. This design features a heat-treated, stress-relieved primary steel liner and a non-stress-relieved outer steel liner, both inside the reinforced concrete shell (See Figure 6-2).

OPERATING PRACTICES

The nine single-shell non-boiling tanks in the tank farms are of three sizes: 55,000 gallons; 530,000 gallons, and 750,000 gallons. The 530,000 gallon and 750,000 gallon tanks were originally arranged in cascades of three, four or six tanks; i.e., the tanks were arranged in such a manner that when the first tank in a cascade was filled, it overflowed to the second tanks, then to the third tank, etc. As various programs have been initiated through the years, many of the overflows between tanks in the various cascades have been removed, or blanked. A number of the tanks are equipped with air-cooled reflex condensers. Dry wells located within the tank farms are used to monitor the soil for radioactivity, thus serving as a leak detection system. These dry wells extend to a depth of approximately 40-150 feet, which is several feet below the bottom of the tanks.

The routing of non-boiling liquid waste from the operating building to the tank farms is done by means of underground lines and diversion boxes where selected underground piping is interconnected by jumpers. Leaks

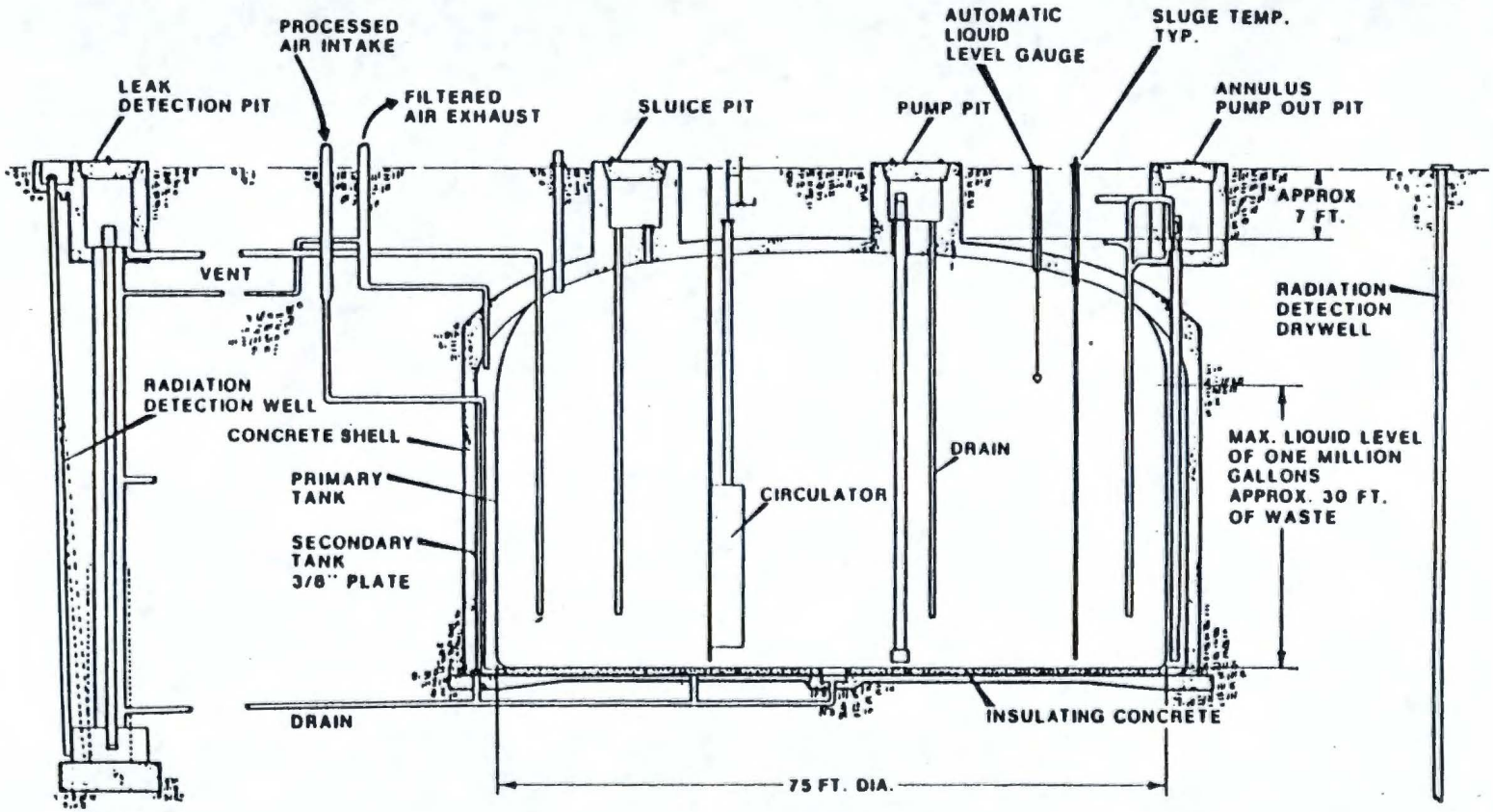


FIGURE 6-2 Double-Shell Storage Tank

occurring in the diversion boxes or into the surrounding line encasement drain to catch tanks which are then pumped to the large underground storage tanks. Catch tanks and waste storage tanks are inventoried by taking electrode readings of the liquid levels.

Upon notification from the operating building to the tank farm that a batch of waste is ready to be pumped to underground storage, Tank Farm Process Control and Tank Farm Process Operations determines:

1. That a satisfactory routing is in place from the operating building to the designated receiving tank, and
2. That the receiving tank has sufficient space to accomodate the transfer.

If all conditions are satisfactory for the transfer, Tank Farm Process Operations notifies the operating building, and the transfer is started. During the period of the transfer, the material balance is constantly monitored for possible leaks. After completing the transfer, the volume (obtained by difference from electrode measurements of the liquid level of the receiving tank) is logged for future reference.

There are five aging waste tank farms: A, AX, AY, AZ, and SX, containing 29 waste storage tanks. The SX Tank Farm, used for storing Redox salt wastes, was the first to be equipped for handling boiling waste solutions, although not all of the SX tanks could accomodate self-boiling wastes. Of the 15 tanks in the farm, only tanks 105 and 107 through 115 were equipped to handle self-boiling wastes.

The A, AX, AY and AZ tank farms were built to store Purex and B-Plant aging wastes. The capacity of these tanks, as well as SX tanks, is 1,000,000 gallons. Vapors from the boiling action (or self-concentration) are routed through headers to condensers which are vented to the atmosphere through filters. Condensate is either discarded to cribs or returned to the waste tank where it is used to maintain the desired liquid level.

In the aging waste tanks, heat is generated when the fission products decay radioactively. Most of the heat generated is dissipated by boiling the supernatant, although a small amount of heat is conducted to the ground. The rate of heat generation in a tank is dependent upon the quantity of fission products present which, in turn, is dependent upon the characteristics of the fuel being processed in terms of:

- Reactor power level (MW/T)
- Integrated exposure (MWd/T)
- Cooling time since reactor discharge
- Rate of tank filling in terms of associated tons of uranium production per day
- The period of time during which a tank receives waste
- Integrated age of the waste in the tank

The SY double-shell tank farm has been placed into service for the storage of concentrated supernatant and two tank farms are under construction (AW and AN Farms) to also store this type of waste. Current plans call for the storage of all tank farm liquid waste to be in double-shell tanks.

After constructing a new waste storage tank, a minimum of 7 inches of water is added to the tank to prevent the bottom liner from buckling under conditions of negative pressure maintained on the tank. A tank vacuum in excess of 6 inches of water is impossible because of a water seal located in the tank farm vent header.

TANK AUXILIARIES

Tank auxiliaries are provided to prevent or minimize the escape of radioactive material to the environment. The more significant auxiliary systems are briefly discussed below.

Airlift Circulators

Airlift circulators are installed in aging tanks to promote mixing of the supernatant. By maintaining motion within the body of liquid, the circulators minimize superheat buildup and, consequently, prevent bumping. (Bumping is a violent emission of vapor (steam) from boiling liquid which has been superheated).

The circulators are long, open cylinders of varying lengths immersed in the tank's contents. An air line discharging at the base of the cylinder causes a flow of solution from the bottom to the top of the cylinder. This moves fresh solution from the bottom of the tank to the supernatant layer above.

Ventilation Systems

The waste storage tanks in the T, U, B, C, S, TX and TY (first and second generation) tank farms were equipped with air-cooled condensers of the multi-tube air-fin type vented directly to the atmosphere. These condensers were adequate for the waste temperatures and vapor loads encountered in the original operations (approximately 180°F for sludge and supernatants).

The SX tanks were the first tanks designed for boiling service and were expected to boil from 1 to 5 years. The heat load on the SX system increased as wastes self-concentrated and it was necessary to install airlift circulators to prevent bumping. This increased the vapor load on the ventilation system. From a practical standpoint, the atmosphere in the tanks was considered as saturated at the ambient temperature (180°F), and condensibles were removed before non-condensibles were filtered and discharged to the atmosphere. Dependent upon the status of the tank contents, condensate was either discharged to a crib or returned to the tank to maintain the liquid level.

The A, AX, AY and AZ tank farms have a common ventilation system. Backup facilities are provided by portable exhausters which can be installed on the tanks. The SY, AW, and AN farms have their own ventilation system.

Monitoring Systems

Monitoring devices and systems are used to determine the status of the stored wastes, to measure the potential effects of the stored wastes upon the tank structures, and to indicate real or potential operating problems involving tank failure.

In relating to the waste tank structures themselves, the AX and AY tank designs provided for the installation of thermocouples in various locations within the concrete shell, within the sludge and under the tanks. Using these thermocouples, temperature profiles may be taken as a means of determining thermal stresses within the shell and sludge, and to indicate the need for changes in the mode of operations of the tanks.

The detection and measurement of radiation gives direct information relating to tank integrity, and in the event of tank failure, is used to locate the region (or regions) of failure. Monitoring wells located in the older tank farms are specifically designed for this purpose.

Radiation profiles (also temperature patterns) as a measure of tank condition, are determined by passing detection devices through piping laterals located in the soil beneath the A and SX tanks.

Monitoring non-boiling tank supernatant and sludge levels indicates possible changes of conditions with the tank. Electrode tapes are used to determine liquid levels; sludge weights (3 to 6 inches in diameter) which will sink until they contact the sludge, are used to determine sludge levels.

Stress gauges have been installed on the AY tank farm tanks to provide a measure of any stress change occurring while the tanks are in service. The stress gauges are welded directly to the inner tank liner.

Equipment provided for the prompt detection and confirmation of leaks in underground waste storage tanks consists primarily of different types of access channels beside and underneath the tanks through which instruments may travel to monitor radiation level and temperature. A brief description of the major leak detection devices follows:

Buried Horizontal Laterals

The buried horizontal lateral system for radiation detection and temperature measurement in the 241-A and SX tank farms consist of 12-foot diameter caissons sunk approximately 70 feet below grade. From each caisson three laterals are bored horizontally under each tank bottom approximately 10 feet below the base pad elevation.

The insertion of temperature and radiation probes into each lateral for a given tank provides profiles which are used in the evaluation of tank integrity and for the determination of changing conditions in the tank contents.

Wells:

The wells used are of two types:

1. Open end dry wells sunk in groups in a tank farm, and
2. Wells extending into the water table below a tank farm site.

Each tank (except double-shell tanks) is ringed with a series of dry wells which are six inches in diameter, bottom open ended, and approximately 40-125 feet below grade. The opening of the casing is approximately 23 feet below the elevation of the base slab of the tanks.

Each dry well is located approximately 10 feet from a tank. The dry wells can accomodate portable gamma and neutron detection devices.

Some wells are customarily sunk to levels below the surface of the water table table underlying the tank farm site. Routine monitoring of these wells should spot radionuclides released to the soil in sufficient quantity to reach the water table.

Leak Collection

The AX Tank Farm provides a system of drain channels in the concrete base slab immediately below the carbon steel tank liner. They drain to a 24-inch 60-foot deep well from which leakage can be pumped. A radiation detection well is located adjacent to this sump-type system.

The double-shell tanks AN, AW, AY, AZ, and SY tank farms) also have drain channels in the insulating material installed between the steel and concrete prior to the thermal stress-relieving operation. These channels could carry leakage to the annular space between the inner and outer liners. Detection during operation is provided by conductivity probes in the annulus and by radiation alarms in the exhaust system.

WASTE VOLUME MONITORING

Liquid levels in all waste storage tanks are monitored and recorded. Two general characteristics associated with the waste tank farms simplify the job of monitoring the liquid volumes. First the primary waste tanks are all of the same nominal diameter (75 feet) so that material balance (liquid volume) comparisions can generally be made directly between different tanks by liquid level changes. Secondly, the waste liquid has a high concentration of chemical salts and is electrically conductive. This permits the use of low voltage electrodes for locating the liquid surface in both manually operated and automatic measuring devices.

Leak detection criteria based on liquid level measurements have been established for all tanks with free liquid which can be reliably measured. These criteria are listed in RHO-CD-253, "Waste Storage Tank Status and Leak Detection Criteria."

Some of the tanks are listed as "no decrease criteria." These tanks are those with conditions which make liquid level measurement difficult or unreliable. Such conditions are encountered in tanks containing sludge or salt with little or no free liquid and tanks where a salt well system is in operation. Such tanks are measured for level of contents, and a special evaluation is required to define the tank's status based on this type of data.

Current levels are compared with the previously reported reading and differences are compared with an established baseline. Variances exceeding those stated in the leak detection criteria must be made known to supervision. (This is usually done by the Analysis Technicians). The Analysis Unit will ask for a recheck on those readings where a deviation from criteria is indicated. If the recheck exceeds criteria limits, then Tank Farm Surveillance Management and Tank Farm Process Control (Engineering) is notified.

Completed liquid level data sheets are delivered to Tank Farm Supervision for review and sign off.

The original data sheets are kept by TFS Analysis for follow-up evaluation and entering the data into the liquid level books. Copies are distributed to Tank Farm Process Control, 271-CR, MO-327 and 242-S.

AUTOMATIC LIQUID LEVEL MONITORING

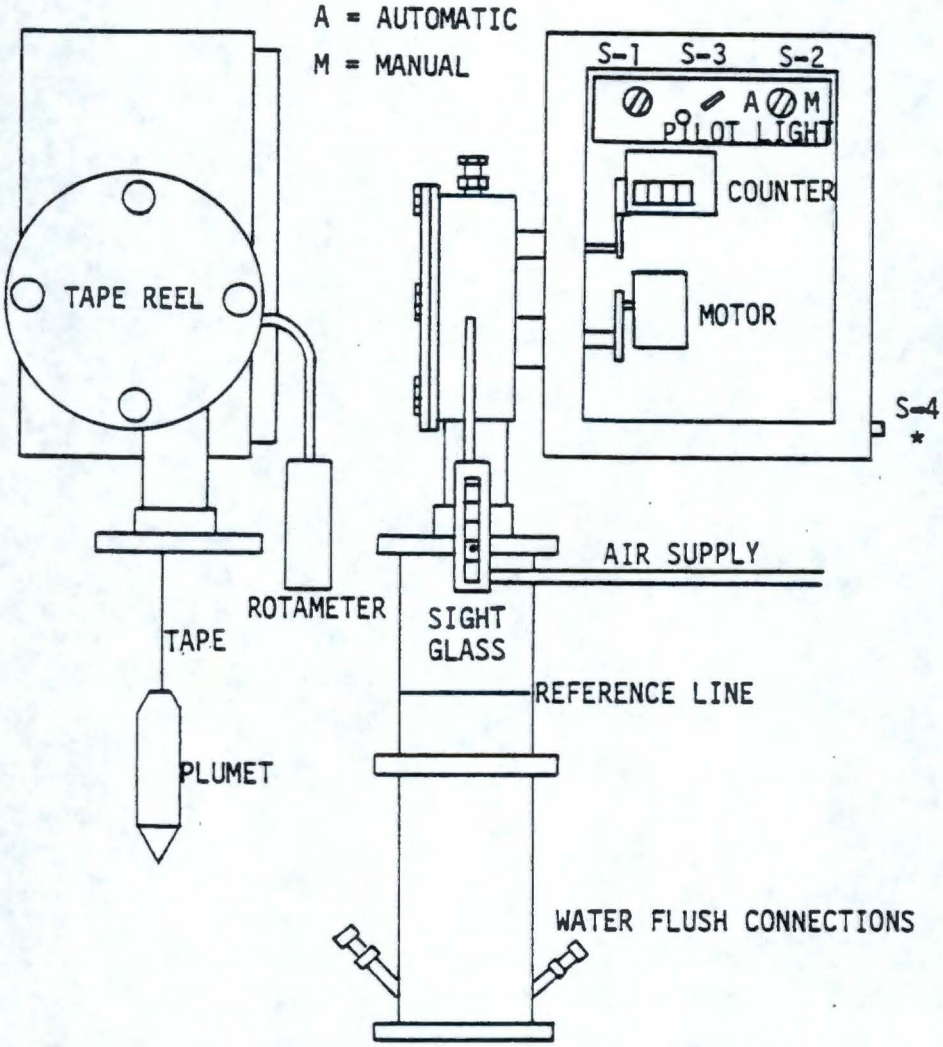
Approximately 77 of the 169 primary waste tanks in the East and West Area tank farms are equipped with automatic liquid level gauges. In local use, these are known as FIC's, a term which stems from the initials of the manufacturer. The FIC gauges consist of a plummet suspended on a

tape, tape reel, sight glass, control box, air purge, and flush sprays. The gauges are mounted on selected risers. In operation, the controls periodically automatically adjust the plummet position at the air-liquid interface at one-hour intervals.

The plummet reference position is in the sight glass; the counter is set when the plummet is at the reference position. The air purge is to minimize vapor condensation on the components of the tape take-up and sprocket wheels. (These features are shown on Figure 6-3).

The FIC's are also connected to the Computer Automated Surveillance System (CASS), which is comprised of six field microprocessors and a central microprocessor and mini computer located in Room B-105 of Bldg. 2750-East. In addition to the central printer & CRT, reports may be received and requested at remote printer terminals located in Buildings 271-CR, 242-A, and 242-S.

FIC field readings are obtained and recorded by Surveillance Operations on the day shift (0800-1600 hours). CASS computer printouts will be used for swing (1600-2400 hours) and graveyard (2400-0800) shift readings. Actual field liquid level readings shall be taken at the frequency designated in RHO-CD-213, "Waste Storage Tank Status and Leak Detection Criteria" during periods of CASS outage. The readings are obtained by activating a switch on the side of the terminal box which causes the plummet to rise and return to the liquid surface. This tells the operator the instrument is operating properly. If for some reason activating the switch does not cause the tape to move, a malfunction is indicated, and must be promptly reported to TFS supervision. Once it has been verified the instrument is working properly, two consecutive gauges counter readings are taken. Operating practice requires interpolation of the measurement to the nearest five one hundredths of an inch (0.05 inch). This value is then recorded on the data sheet.



*Denotes Revision

FIGURE 6-3.

Liquid Level Gauge - Diagram of Major Components

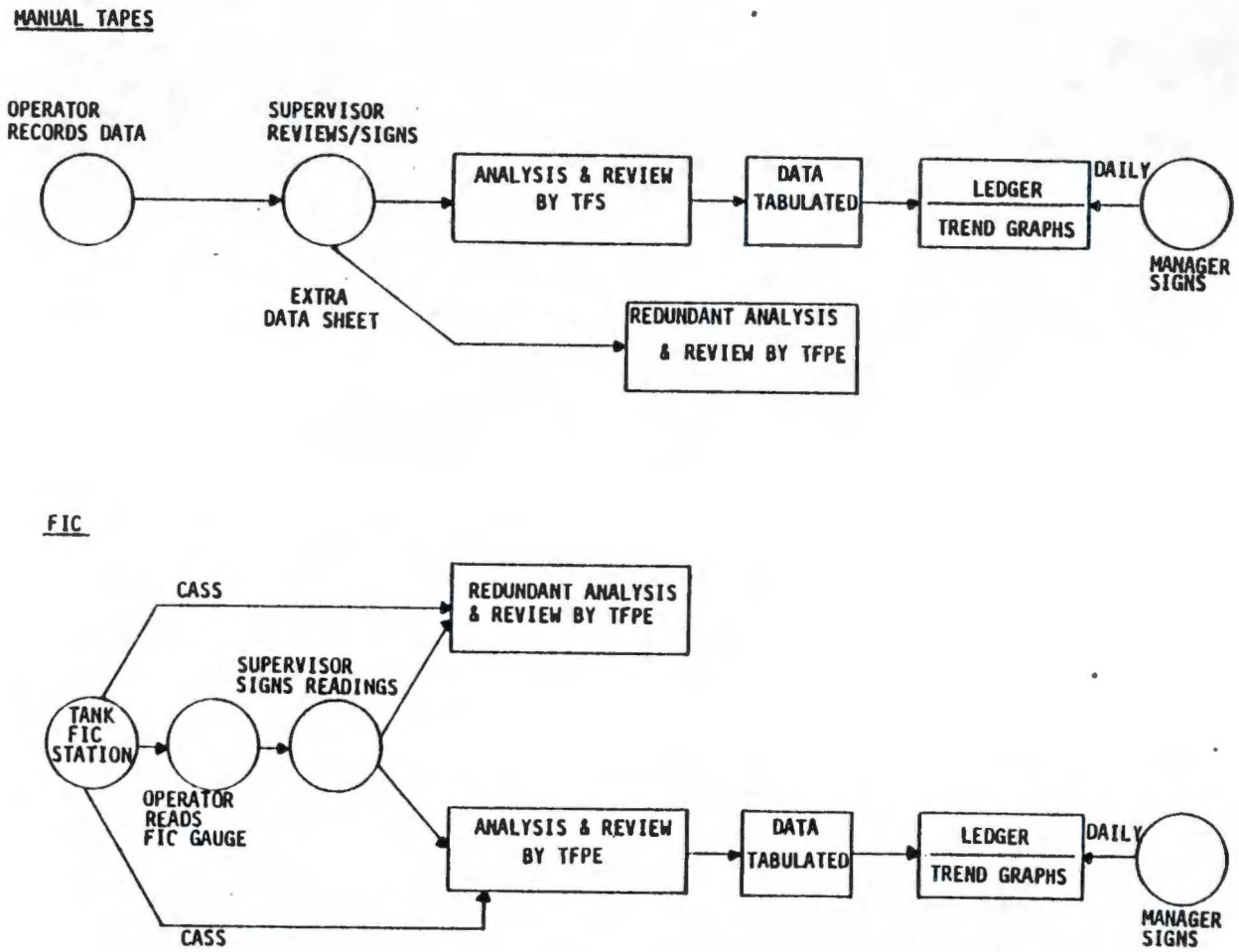


FIGURE 6-4. Liquid Level Measurements (Flow Diagram)

87685-31CN

PHOTO 6-1

Automatic Liquid Level Gauge

FIC data sheets are designed for individual tank farms to provide specific data input. For those forms designed for use in several tank farms, check off the appropriate farm at the top of the form. Data sheet forms are not to be taken into the farms. Examples of the various data sheets are on pages 12-19 of SOP TO-040-180. Automatic liquid level monitoring is covered in SOP TO-040-180.

MANUAL LIQUID LEVEL MEASUREMENT

Those tanks not on automatic liquid level measurement are equipped with manual liquid level devices. The above ground equipment for liquid level measurement consist of either reel mounted tapes or calibrated, insulated wire to which electrodes have been attached. The reels are permanently attached to the tank riser flanges (see Photo 6-2 and 6-3) and the insulated flange cover plate. In each case, the readings are obtained by use of a portable d. c. meter.

Manual liquid level readings pose a greater degree of contamination spread and/or excessive radiation exposure to personnel than do FIC readings. Therefore, frequent self monitoring and compliance with existing RWP's, Tank Farm Safety Rules, and General Safety Rules shall be maintained at all times.

Tank liquid level readings are taken at the frequency stated in the Criteria Document (RHO-CD-213). Readings are obtained by attaching the portable d.c. meter to the terminals provided at the riser, and lowering the electrodes until contact with the liquid surface is indicated by initial positive deflection of the d.c. meter. The liquid level in the tank (height in feet from the bottom of the tank or sump) is determined from graduations on the electrode lead as measured relative to the tank riser flange, the cross bar or fixed index point on those reels with plexiglass housings, or the edge of the access hole. The zero position on the electrode lead represents the bottom of the tank or sump.

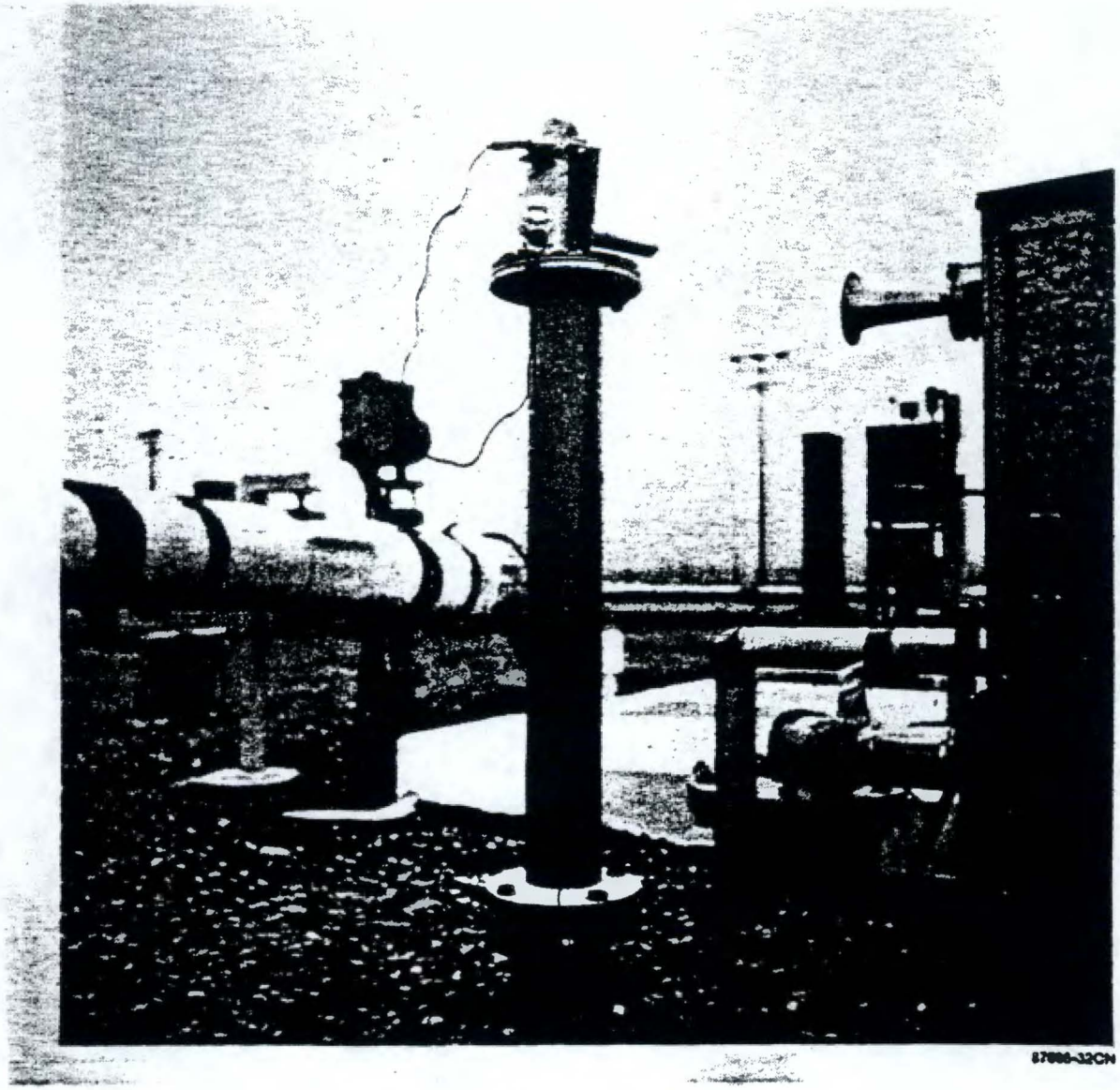


PHOTO 6-2

Manual Liquid Level Tape and D.C. Meter

PHOTO 6-3

Close-up of Manual Tape and D.C. Meter

In the real life world of waste tank measurements, complications arise. If a tank has surface agitation from air circulator operation or in-tank transfers, the precision of the electrode measurement is lessened because of liquid surface movement. The operator must be able to distinguish between intermittent contact with the liquid and steady contact at "just" the liquid surface. This motion of the liquid surface also makes the use of FIC's impractical.

Electrode measurements can be affected by salt crystallizing on the electrode which may appear to indicate a rising liquid level as the salt deposit increases. Eventually, the salt "icicle" will drop off appearing to indicate a sudden lowering of the liquid level. When indicated, the electrodes are flushed with water to remove salt formations, but flushing is done only as scheduled by TRS supervision.

Many of the stored wastes eventually reach the point where sludge extends above the surface of the liquid or a salt crust forms on top of the liquid. Either of these conditions affects the precision of the liquid level monitoring activities. A floating crust may be an irregular formation which may shift position to a point directly below the liquid level gauge, giving rise to a measurement entirely different from the actual liquid surface.

Where sludge extends above the liquid surface, liquid level measurements may be widely different from the actual liquid surface. Sludge approaching dryness may not have enough electrical conductivity to activate the liquid level meter. In such cases, the operator must arrive at a "liquid level" measurement by the "feel" of the electrode lead as it contacts the sludge. Repeated contacts with the electrode may penetrate the sludge surface and eventually indicate a lowering of the surface of the waste when, in fact, the only change is at the point of contact with the electrode. A small quantity of water, where allowed, flushed down

the lead may restore conductivity and fill the hole, restoring the "true" measurement, when not in use, the electrode is withdrawn to a point about one foot above the waste surface.

Liquid level measurements are recorded on pre-printed data sheets. The detailed operations associated with this assignment and examples of the data sheets used will be found in SOP TO-040-200.

Swab Risers

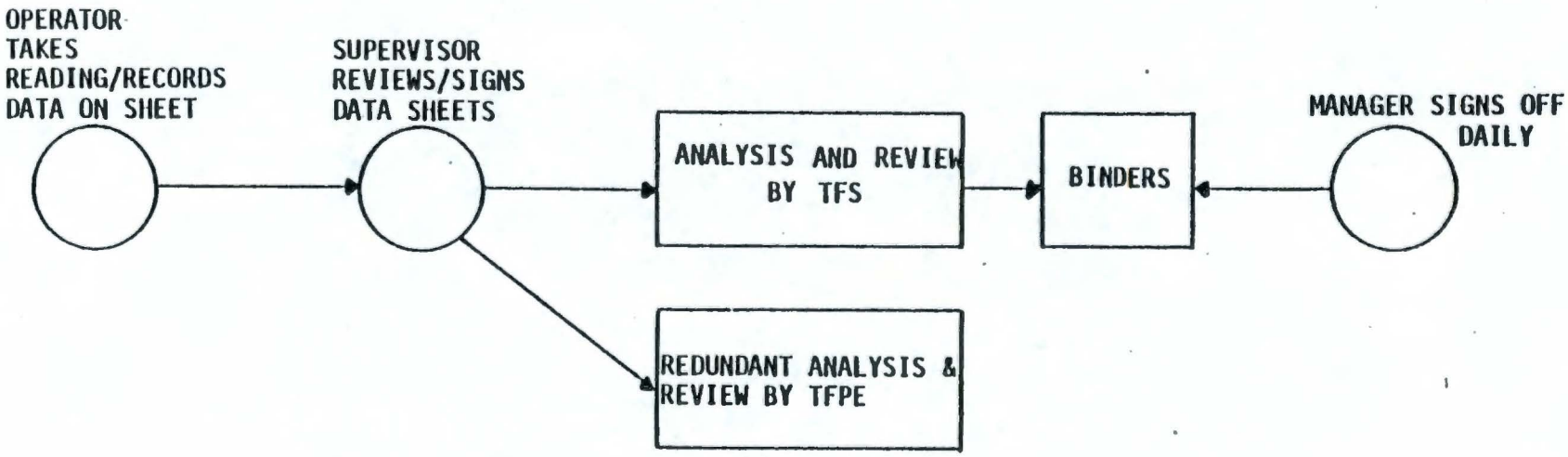
Swab riser monitoring is performed every 3 months unless otherwise specified by Tank Farm Process Control. The purpose of swab riser monitoring is to detect possible leaks that might have occurred during a transfer of material from tank to tank. The readings are taken in 2-inch swab test risers which are at various locations along the pipe-line encasement.

Swab riser monitoring requires the presence of a radiation monitor as the potential exists for contamination spread and/or excessive radiation exposure to personnel.

Standard operating procedure TO-020-70 details the requirements to do this job. RM personnel will monitor the swab for activity. The operator should note if moisture is present on the swab. Extreme care is required when handling swabs removed from the riser.

The operator performing this job must be aware of changes in data from previous readings. An immediate repeat of the sampling procedure is required if:

- The new CP reading is greater than twice the previous CP reading.
- The new swab reading is high enough to require changing from a G-M to CP probe.
- The swab comes up wet, and the previous reading was dry.
- Any new swab reading greater than 200 C/M above background.



LIQUID LEVELS MONITORED AT:

CATCH TANKS
VAULT SUMPS
AUXILIARY TANKS
CRIBS
SWAMPS & PONDS

FIGURE 6-5. Transport Line Surveillance (Data Flow Diagram).

The above deviations require notification of TFS supervision, who will then initiate an investigation as to the probable cause.

LEAK DETECTION PITS AND ANNULUS LEAK DETECTION

Two other means available for the detection of possible leaks from waste storage tanks are leak detection pits and annulus leak detection systems. It must be noted that the monitoring of these systems is not the responsibility of Tank Farm Surveillance. This work is done by Tank Farm Process Operations; however, it is important to know how these systems operate and how they are a part of the overall leak detection monitoring effort.

Leak Detection Pits

The AN, AW, AX, AY, AZ, and SY Tanks have special facilities in the form of leak detection pits that are designed to detect and recover solution leakage through the tank's steel liner (secondary liner in AN, AW, AY, AZ, and SY Tanks).

Such leakage is received into a waffle pattern originating at the tank's center. Two 4-inch tie-ins from intermediate locations connect these slots to a 60-foot deep leak detection well located adjacent to the tank. The well consists of a vertical section of 24-inch diameter pipe surmounting a base section 3 feet high by 4 feet in diameter. The 24-inch section is a pumpout riser that extends to a pump pit in which a ten gallon per minute (GPM) deep well pump is installed and connected to a 2-inch line to the 152-AX B Diverter. From here the solution can be routed to any designated tank within the A, AX, and AY Farm complex. A similar system also exists for the SY Farm.

There are three basic instrument systems installed on each leak detection pit. One is a radiation detection well installed adjacent to and extending to the base of the 4-foot diameter section. A second is instrument dip tubes for weight factor and specific gravity measurement.

Readout is provided at the panelboards in the associated instrument buildings. (See Photo 6-4). The third is a thermocouple installed in a well that extends to within three inches of the bottom of the pit. This thermocouple is connected to CASS.

Annulus Leak Detection

The AN, AW, AY, AZ, and SY Farm Tanks have a leak detection feature which is unique to the double liner concept, and which is designed to detect leakage through the primary liner. Drain channels in the insulating concrete are designed to carry any leakage to the annulus space where leak detection facilities, in the form of conductivity probes that extend into each tank annulus, are installed 120° apart in instrument risers 1, 3, and 5. There are 17 of these probes at each location, with readout at the associated farm instrument buildings. (See Photo 6-5). A determination of annulus liquid level is obtained by rotating each of the three probe selector switches through the first 17 positions. Each position coincides with a different probe elevation, and turning the selector to a probe in contact with liquid will activate both an indicator light at the panelboard and an alarm at the control building annunciators. (See Photo 6-6).

Alarms from the AN, AW, AY, AZ and SY annulus alarm annunciators are received by CASS. The probe elevations are as follows:

Position	Distance From Bottom	Position	Distance From Bottom
1	6'	10	1' 2"
2	5'	11	1'
3	4'	12	10"
4	3'	13	8"
5	2'	14	6"
6	1' 10"	15	4"
7	1' 8"	16	2"
8	1' 6"	17	1/8"
9	1' 4"		

NOTES: (1) The probe selector switches are normally left in the #17 position.

(2) A-1 annuli are also scheduled to be equipped with a reel mounted and replaceable probe.

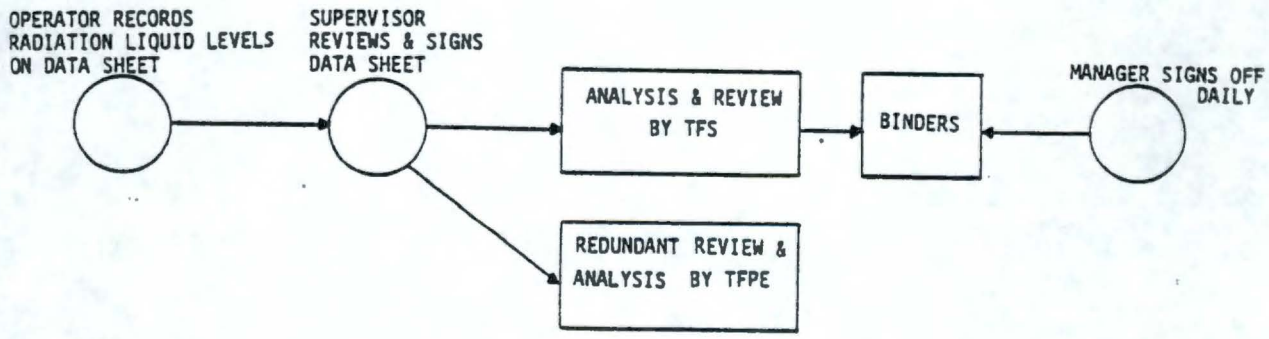


FIGURE 6-6

Leak Detection Pits and Tank Annulus

(Data Flow Diagram)

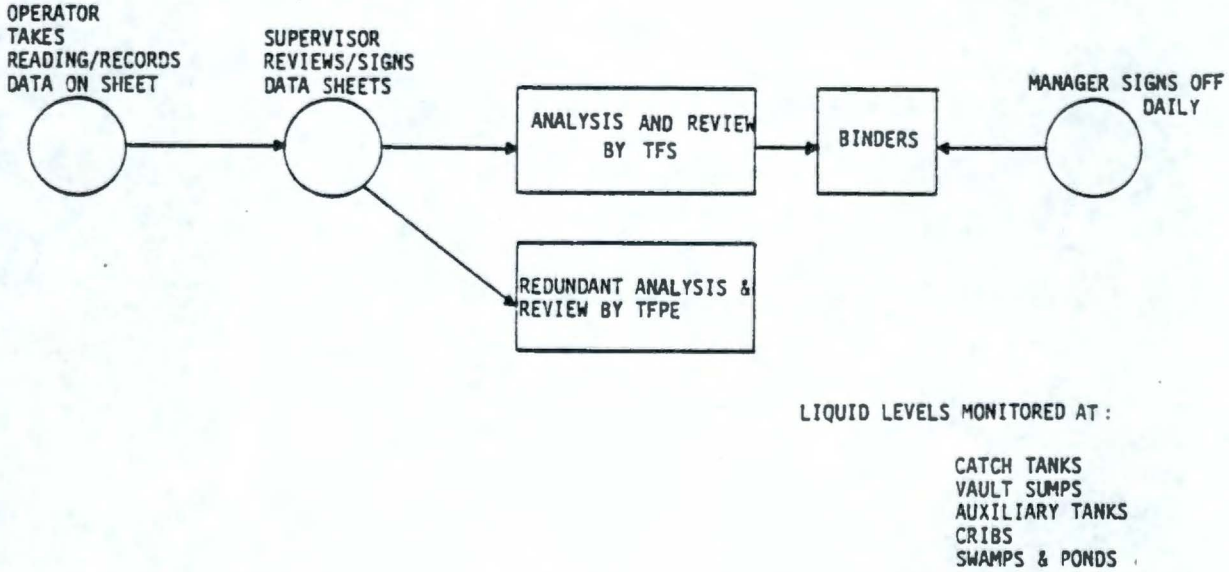


FIGURE 6-7

Waste Tank Auxiliary and Support Facilities Surveillance

(Data Flow Diagram)

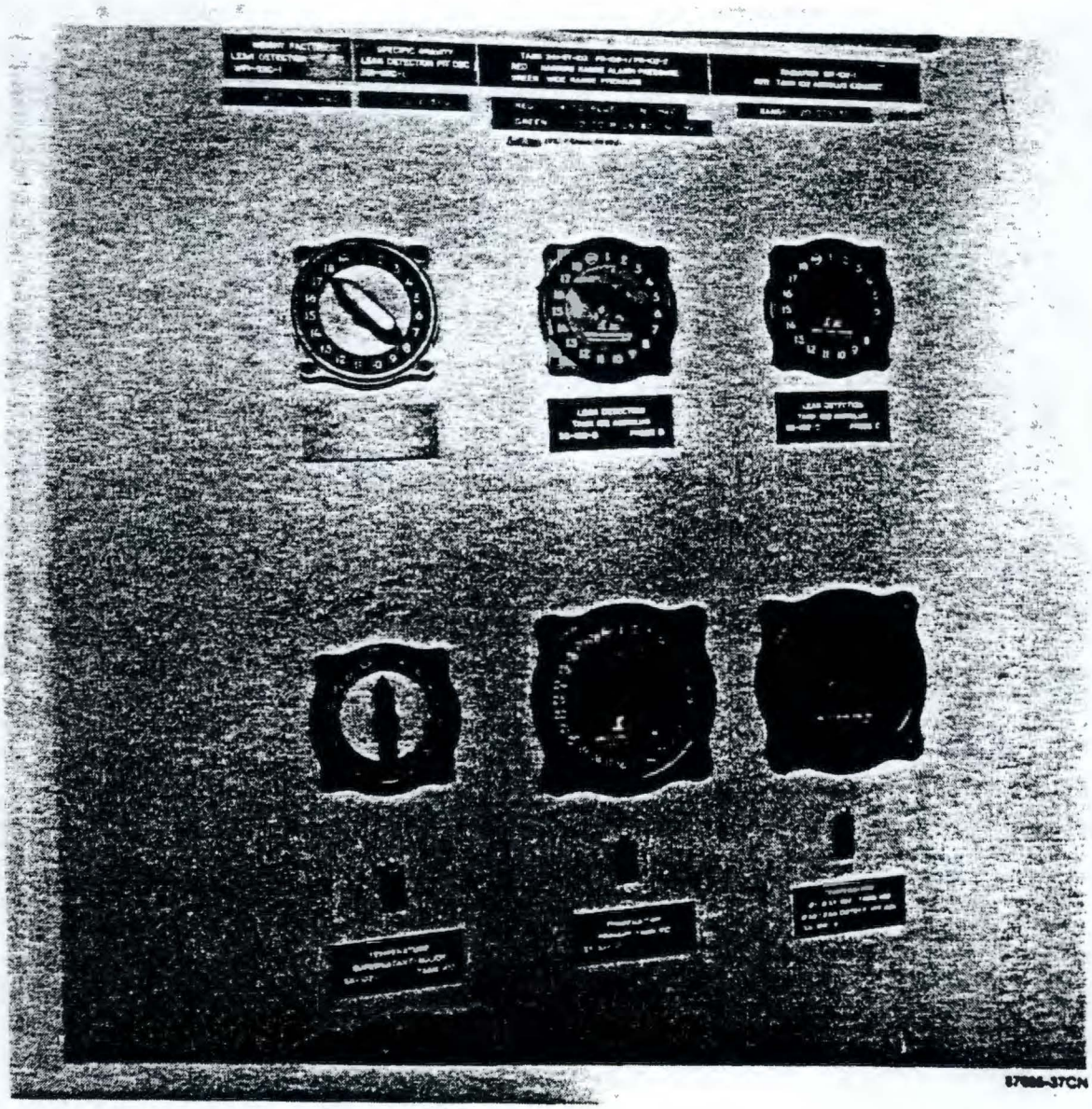


PHOTO 6-4

Leak Detection Pit Panelboard

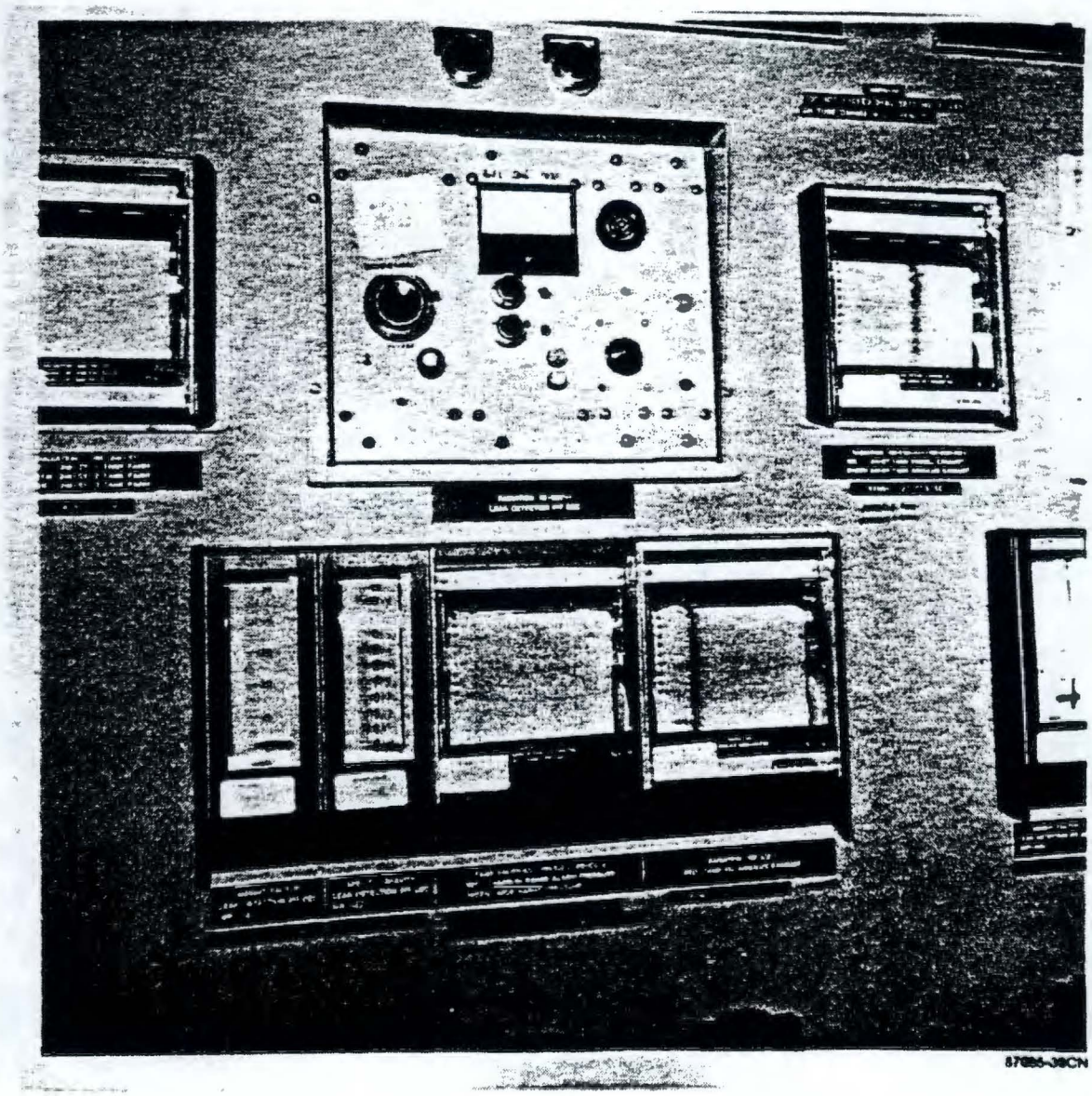


PHOTO 6-5
SY Annulus Leak Detection Board

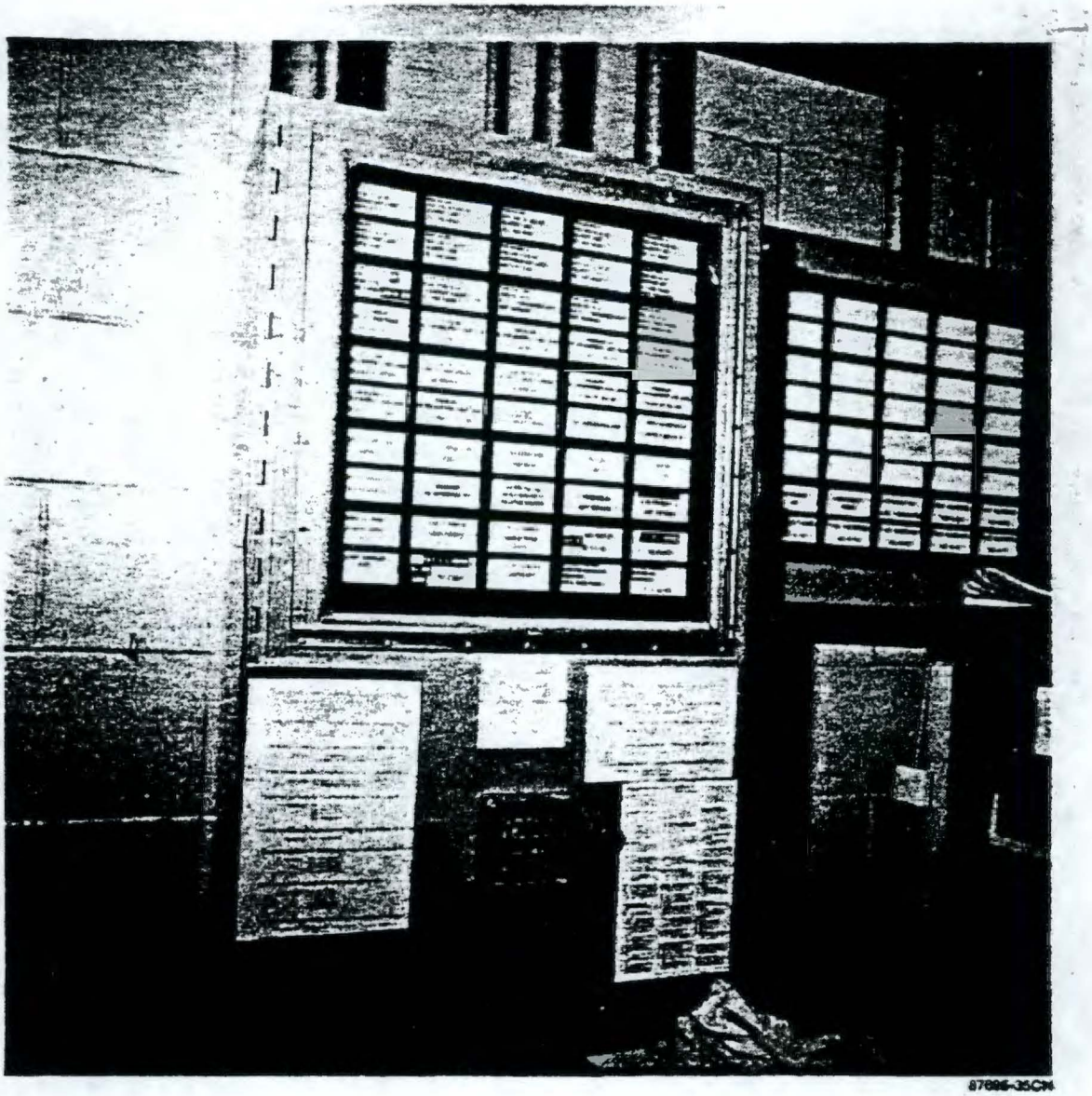


PHOTO 6-6
Control and Alarm Panelboard

Each annulus is surmounted by a pump pit in which a 10-gpm deep well turbine pump is installed. When in use, pump routing can be either directly back to the associated tank via the pump pit or floor drain or to a well nozzle in the tank's pump pit.

MONITORING OF WATER LEVELS IN PONDS

In addition to having primary responsibility for waste tank liquid level monitoring, TFS also monitors waste water generated from operating facilities within 200 East and West Area that has been routinely discharged to three surface ponds. These ponds are: B-Pond, (216-B-3), Gable Mountain Pond (216-A-25), and U-Pond (216-U-10). Radionuclides received into these sites, which in the past were accidental releases due to equipment failure, are now low level effluent wastes from facilities such as the laundry, are filled or sorbed and held in the soil beneath the pond or ditch area. The critical control item is the maintaining of water surface levels within specified limits to prevent overflow (upper limit) or to minimize exposure of contaminated sediments (lower limit).

Since the pond areas are in regulated radiation zones, personnel and vehicles are subject to all regulations which relate to entry into contaminated areas.

Each of the three ponds are monitored for water level on Monday, Wednesday, Friday and Saturday or Sunday during day shift.

Each pond has placed in it water level measuring sticks. These sticks are placed upright, have gauge markings in inches, and are located approximately 10 feet off shore of each pond. The water level is read to the nearest inch and recorded on the applicable data sheet. Water level limits have been established for each pond. They are as follows:

B Pond	76" Min.	89" Max.
Gable Pond	25" Min.	40" Max.
U Pond	12" Min.	30" Max.

WATER LEVEL LIMITS: INCHES

POND	MINIMUM	MAXIMUM
B POND (216-B-3)	76	89
Gable Mtn. (216-A-25)	25	40

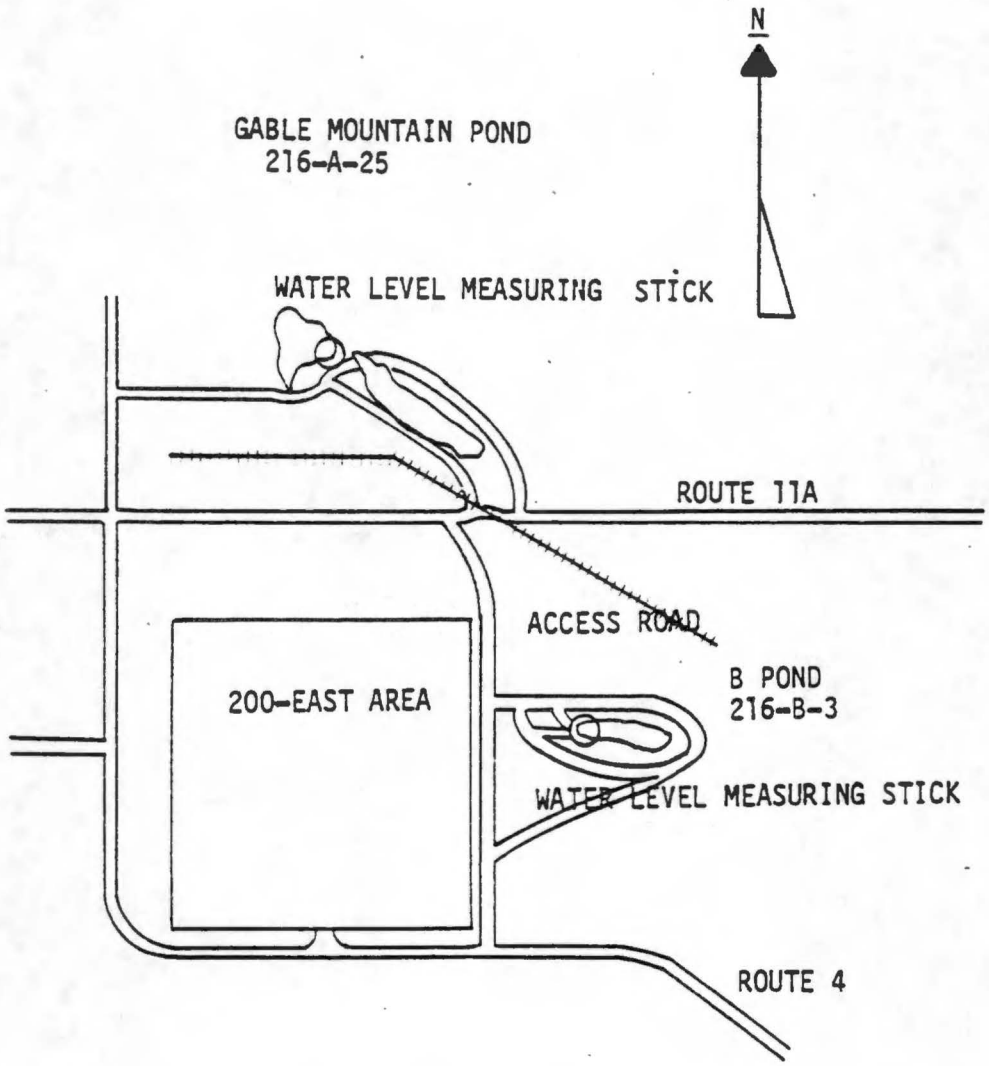


FIGURE 6-8 Area Map: Location of B Pond and Gable Mountain Pond

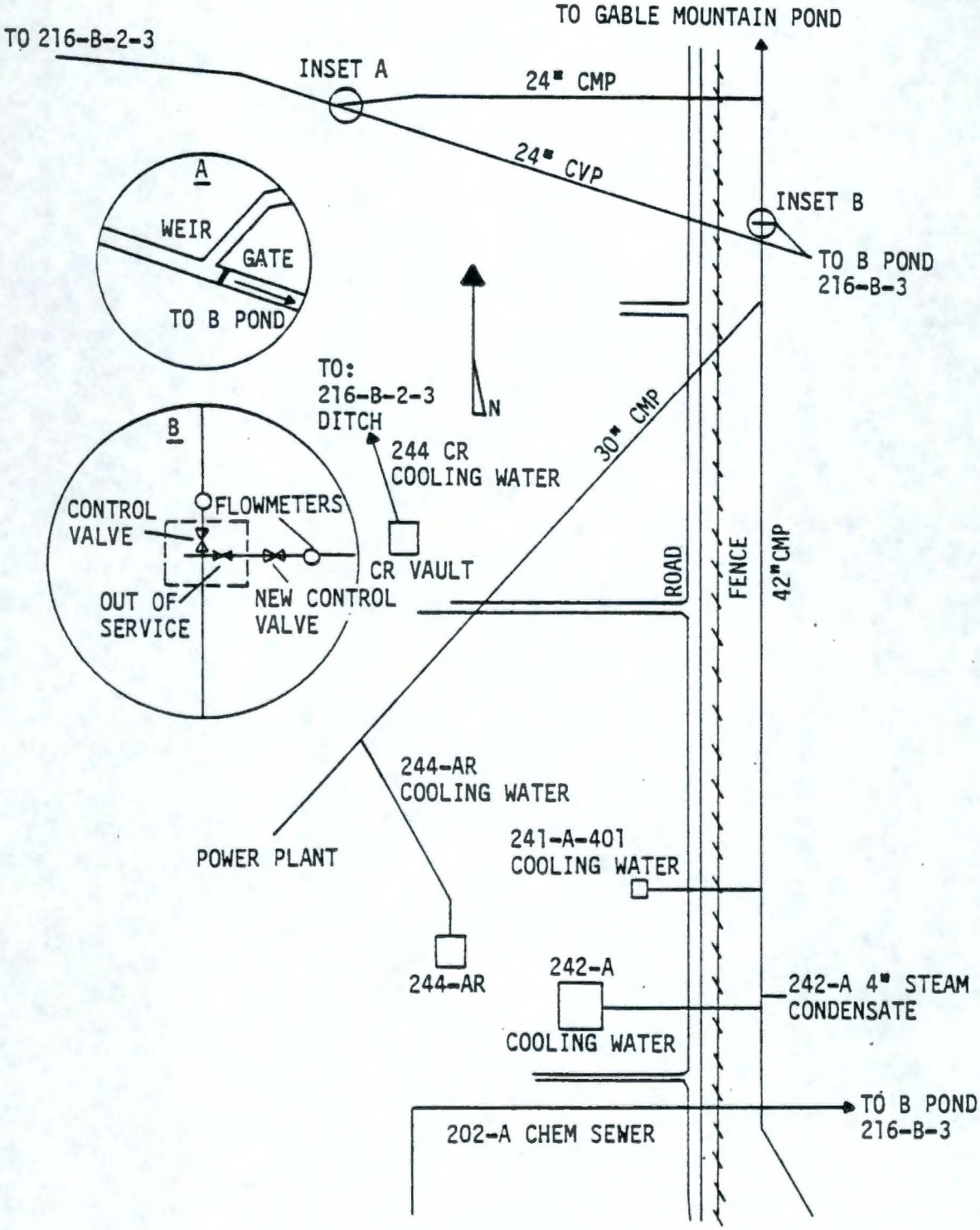
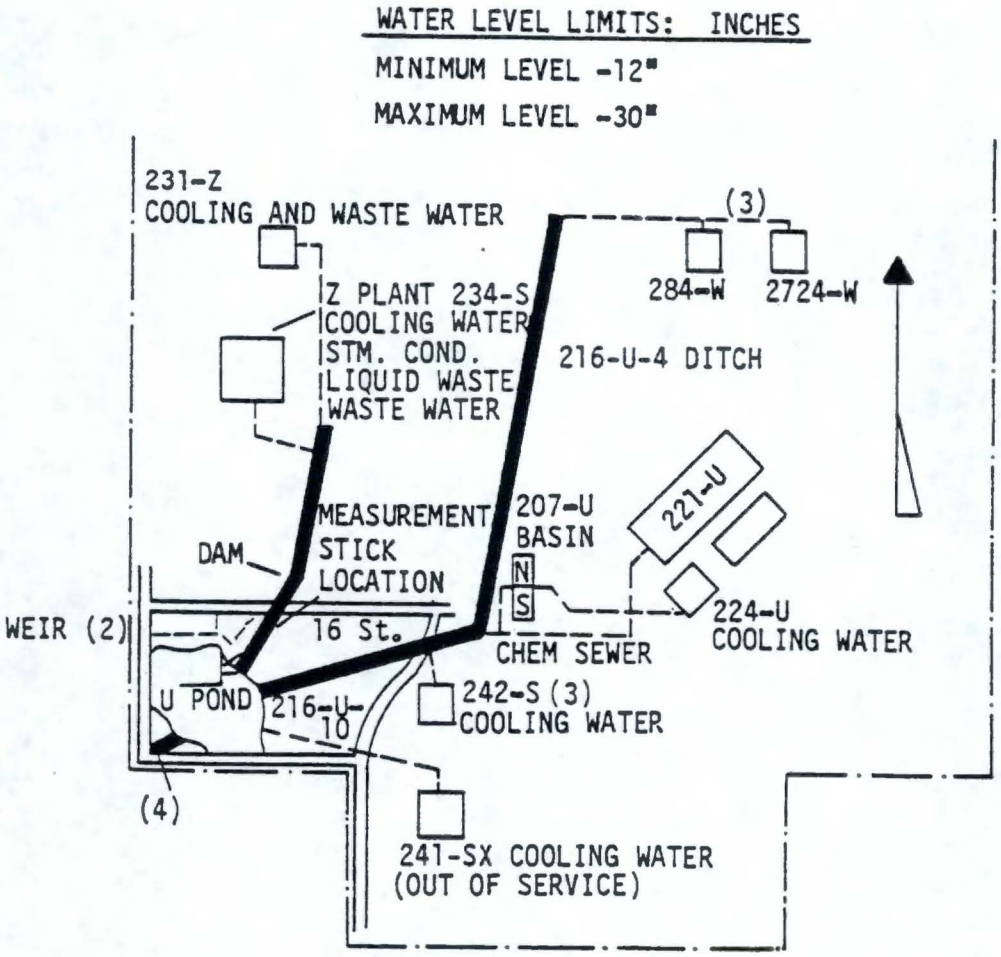


FIGURE 6-9. To Gable Mountain Pond - 216 - A - 25



(1) THE 216-z-11 DITCH IS ROUTINELY MONITORED BY 234-5 OPERATIONS.

(2) THE WEIR OVERFLOWS TO THE 216-U-11 POND

(3) WATER FLOW IS METERED

(4) TO THE 216-S-16 DITCH (THIS HAS BEEN REMOVED FROM SERVICE).

FIGURE 6-10 Area Map: U-Pond and Source Processing Facilities

Control valves regulating water flow into ponds are not to be operated unless instructed to do so by Tank Farm Supervision. Waste water generation from the various source facilities are subject to significant change upon occasion, therefore, Tank Farm Supervision must review the status of water flow to arrive at appropriate action response. In case of U-Pond, the only available course of action is to request that flows be adjusted at one or more source facilities. For regulation of flows to ponds associated with 200 East Area process activities there is the capability for diversion of the inlet stream to either pond.

SUBSURFACE MONITORING

The second basic method of leak detection used at Hanford is the subsurface surveys of the soil surrounding and supporting a waste tank.

In Hanford soils, liquids are expected to spread horizontally as well as downward and a waste tank leak would be indicated by increased levels of radiation in dry wells. At this time there are approximately 750 monitoring wells in the 200 East and West waste storage tank farms.

DRY WELL MONITORING

The dry wells in use are open bottom mild steel casings of either 6 or 8-inch diameter. Their depths range from 75 to 250 feet. All new wells will be grouted at the base and around the top to lessen the chance for surface water penetration into deeper soil. In addition, all new wells will be no deeper than 125 feet.

Although a number of wells are randomly situated within the tank farm, most are located adjacent to specific tanks at a distance of 6 to 10 feet from the outer walls. Each well bears a 6-digit identification. The first two denote the farm, the third and fourth are the last two digits of the tank number, and the fifth and sixth describe the clockwise location of the well from due north (See Photo 6-7). Also, if the third and fourth digits are followed by two digits in parentheses, this will identify another tank for which the well can monitor.

PHOTO 6-7
Vertical Dry Well

The equipment used to monitor dry wells includes: (1) a generator to power the unit; (2) a motor controller for the cable; (3) the printout controller; (4) the tape punch apparatus; (5) roll chart recorder. All of the above listed items are contained on or in the monitoring van. (See Photos 6-8 thru 6-10). The probes used to detect radiation within the dry well area are scintillation or Geiger Mueller (G-M).

A scintillation probe is used in those wells with a history of low-level radiation. These probes contain material which emits pulses of light in the presence of radiation. The light is detected by a photo-electric tube which generates a signal proportional to the radiation field being surveyed.

Those wells which have higher radiation levels, a G-M tube is used. This probe operates by measuring the radiation-induced ionization occurring in the gas-filled tube. Currently TFS uses two G-M probes designated red and green. The green G-M is more sensitive to radiation than the red and is used in those wells having lower radiation fields.

The effective ranges of both of these probe types may be extended by radiation shields placed on the probes. The shields are steel cup filled with lead which fits over the tip of the probe which houses the sensor tubes.

In addition, a probe shield may be fabricated with a hole in one side to provide a "window" for the probe. This permits directional surveys to be made in a well which helps indicate the direction the radiation is coming from.

The dry well monitoring apparatus is designed to detect radiation at any depth along the vertical length of the well. The procedure consists of lowering the detector to the bottom of the well and then obtaining a record of the radiation profile on the ascent. Radiation profiles of all wells are recorded on strip charts. A paper punch tape recorded for

computer processing of the data is now in use in conjunction with monitoring of the 200 East Area and West Area wells. The rate of ascent is a critical parameter and is maintained constant to preclude variance as a function of time that the detector is exposed to source radiation. The information recorded in the computer plot (radiation level in counts per second versus distance from the well bottom in feet) is presently the primary basis for evaluation of dry well status. Leakage from a tank would be determined from depth of a radiation peak and continued changes of the peak and profile.

SOP TO-040-320 (Vertical dry well monitoring) details the actions necessary for performance of this job.

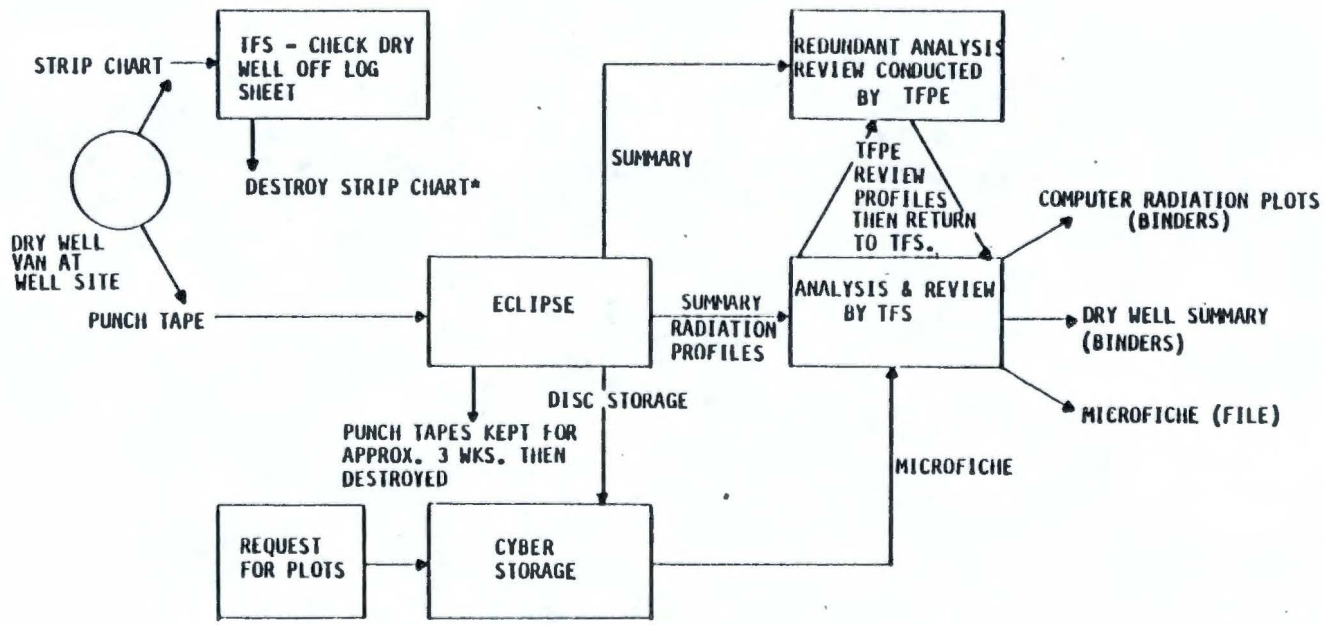


FIGURE 6-11. Dry Well Data Flow.

PHOTO 6-8

Inserting Probe in Well

PHOTO 6-9
Dry Well Van

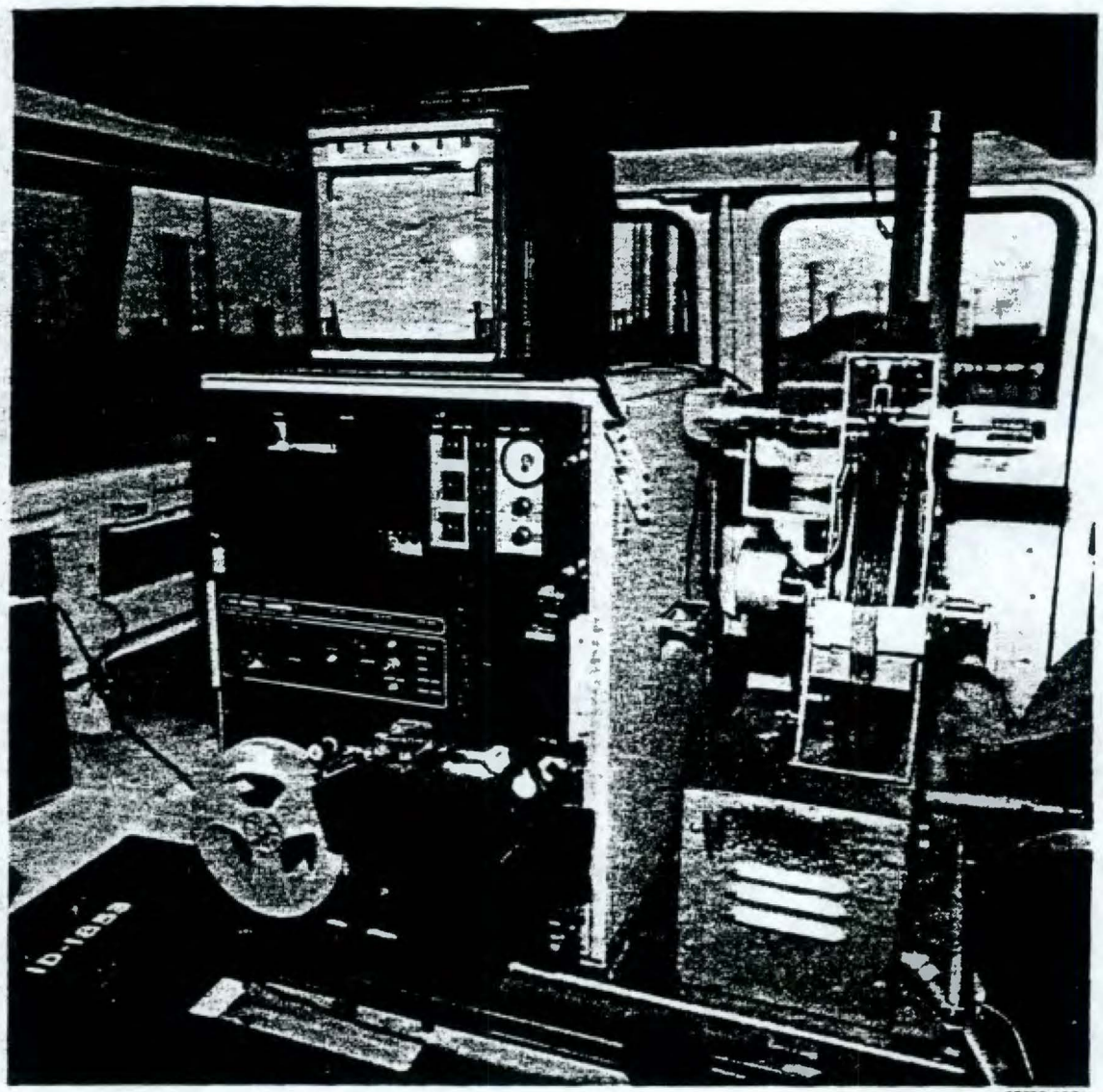


PHOTO 6-10
Dry Well Van Equipment

Neutron Probe Monitoring

The neutron probe consists of a fast neutron source (Americium-berylium, 1 1/2 curies,) and a slow neutron detector. Its application is based on the principles of a direct correlation between the count rate of the detector and the moisture content of the material surrounding the source and detector. The detector is a boron trifluoride-filled proportional counter. Boron trifluoride detectors are commonly called B-F3 counters.

At the present time the neutron probe is used in the monitoring of external dry well and in-tank dry wells. High gamma radiation fields in counter in the in-tank dry wells can produce an "elevated" count rate situation. For in-tank neutron monitoring, a gamma radiation shield is affixed to the probes.

The use of the neutron probe in external vertical dry wells is limited to investigative actions. The monitoring attempts to detect any moisture changes or shifts in the surrounding soil structure. Such a shift could indicate the presence of large amounts of subsurface water which could be linked to a tank leak.

The use of the neutron probe in in-tank dry well is still in the evaluation stages. The monitoring has been aimed at identifying the interstitial liquid level of solids in the waste storage tanks at Hanford. There are presently six in-tank dry well assemblies installed in 4 tanks. Pending further studies and evaluations, about 19 more in-tank dry well assemblies might be installed to monitor for tank solids moisture levels.

Presently dry well van No. 7 is used for neutron monitoring (see Photo 6-10). The same basic equipment and methods for obtaining the readings is used for obtaining external dry well gamma readings. The only exception is a change in the counting internal (12 inches down to 6 inches) and several amplifier adjustments made by Instrument Maintenance personnel prior to use.

NEUTRON PROBE SCANS IN INTERNAL DRY WELLS

Presently tanks 107-BY, 110-S, 111-S, and catch tank 361-B are outfitted with internal dry wells, and are monitored with a special prototype shielded neutron probe designed to detect the level of drainable interstitial liquid within the solid material.

The neutron probe consists of a fast neutron source (americium-berylium) and a slow neutron detector. Its application is based on the principles of direct correlation between the count rate of the detector and the moisture content of the material surrounding the source an detector. The major difference between it and the probe (neutron) applied to the external dry wells is the use of a high gamma radiation shield affixed above the source.

Currently, Dry well van #7 is used for this assignment. (See Photo 9-10). The same basic equipment and methods for obtaining the reading is used as for obtaining external dry well gamma and neutron readings. The only dry well gamma exception is special adjustment of the readout system must be performed by Instrument Maintenance personnel prior to its use of the probe. (See SOP TO-040-380).

LATERAL MONITORING OPERATIONS

In addition to the pattern of typical dry wells used for waste tank leak detection, there are also laterals in place for the six tanks in 241-A Tank Farm and for tanks 105-SX, 107-SX thru 112-SX, 114-SX and 115-SX.

Laterals are four-inch inner diameter tubes located ten feet beneath the tank's concrete base which extends to a point approximately ten feet beyond enclosures that surmount the adjacent caissons in which the lateral tubes rise to ground level. (See Figure 6-12). Three separate laterals monitor each tank.

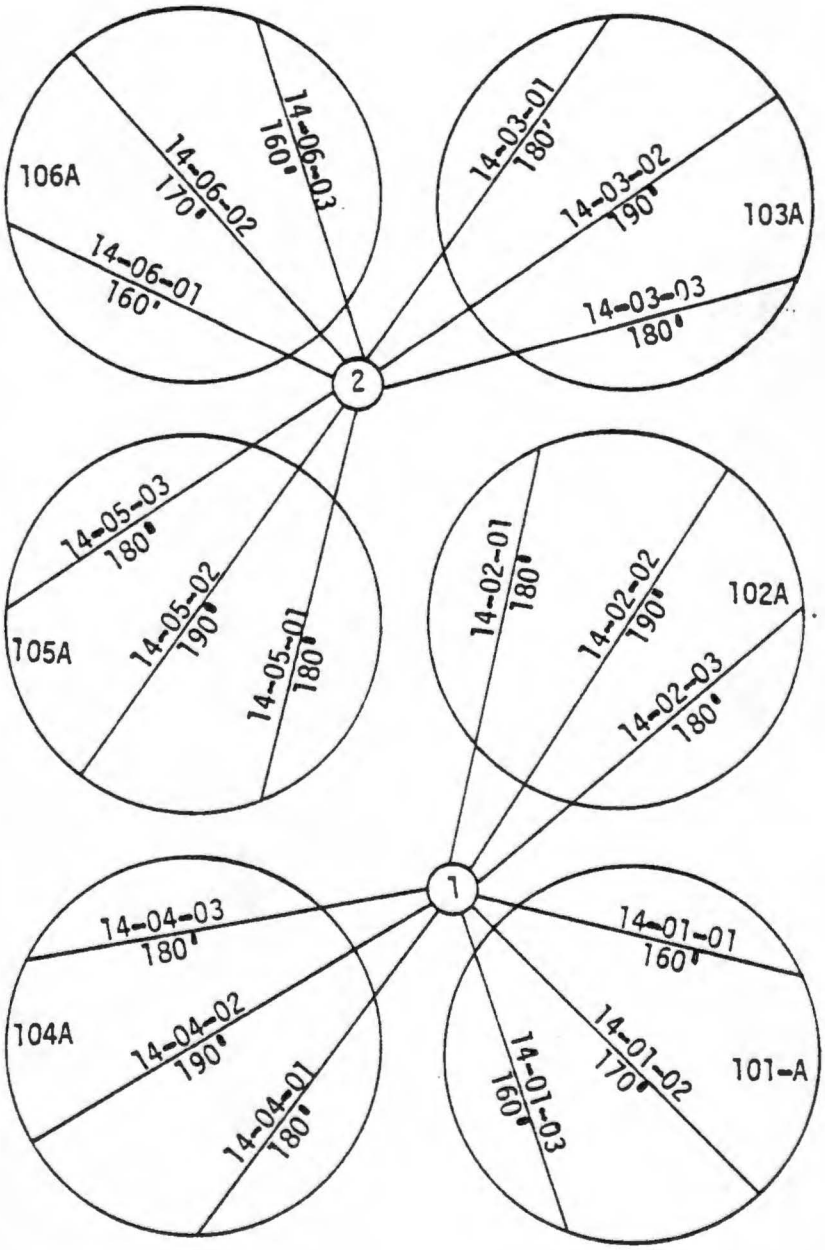


FIGURE 6-12

A Tank Farm Laterals

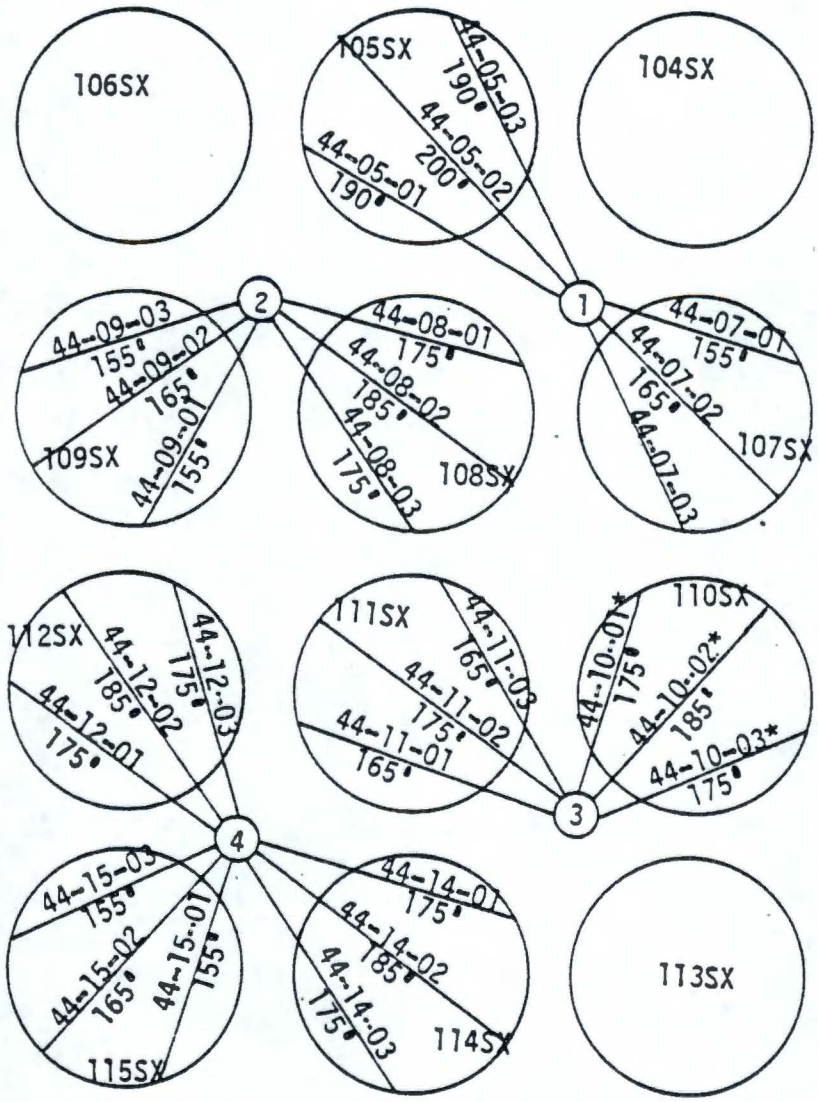


FIGURE 6-13

SX Tank Farm Laterals

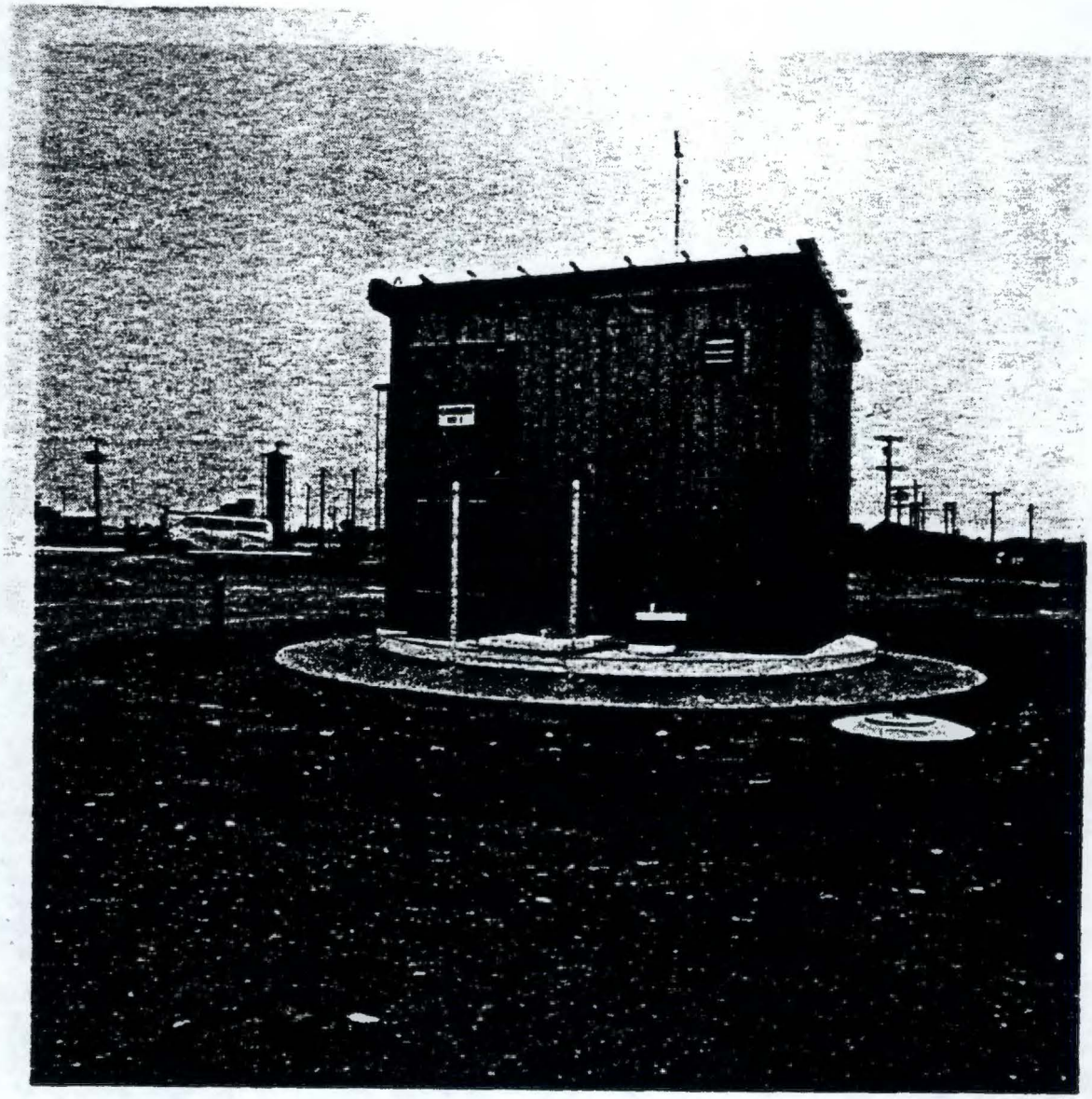
The equipment used to obtain lateral readings include a reel-mounted cable, a radiation probe, a pneumatic system which drives the probe to the end of the lateral, a drive mechanism for probe withdrawal, and X-Y-Z recorders (See Photos 6-12 and 6-13).

Two types of probes are specified for this operation - "Green" probes and "red" probes. The color coding designation indicates the useful range and sensitivity of the probes. A green probe is used for laterals with low radiation; and red probes are used for laterals with more intense radiation. The probe range detection setting for laterals in A-Farm and 105-SX, 107-SX, 110-SX, and 111-SX are permanently set. The range settings for 108-SX, 109-SX, 112-SX, 114-SX, and 115-SX are to be set at the range specified in Table I and II of SOP TO-040-140.

The lateral radiation readings are plotted by the instrument package (X-Y-Z recorders) on graph paper. Each lateral is plotted on a separate sheet of graph paper. All monitoring frequencies for SX laterals are every two weeks with the exception of 115-SX, which is taken quarterly. A-Farm laterals that are taken every two weeks are: 101-A, 102-A, 103-A, and 106-A. Tank 104-A is obtained quarterly and 105-A is taken weekly.

Prior to obtaining a lateral monitoring reading, a source check is made to determine if the system is within operating limits. This is accomplished by obtaining a radiation count with the lateral probe positioned in the calibration fixture installed in each caisson. If the count doesn't fall within limits specified in the SOP, Instrument Maintenance may be needed.

When the standard source check has been successfully completed, the lateral surveys may begin and the source check counts per minute are recorded on each chart used during the day for that probe and instrumentation.



87695-27CN

PHOTO 6-11
Lateral Building

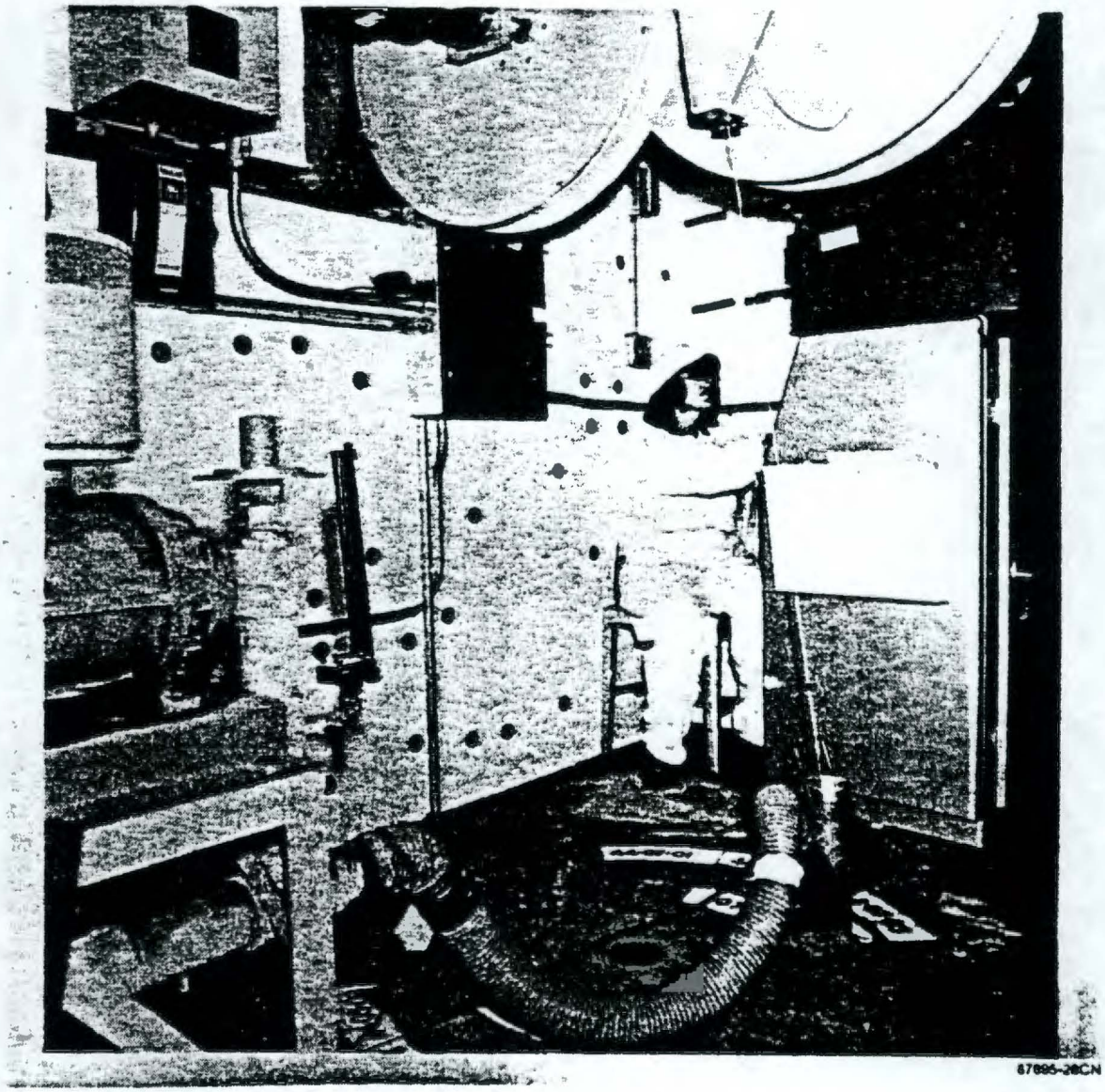


PHOTO 6-12

Interior - Lateral Building

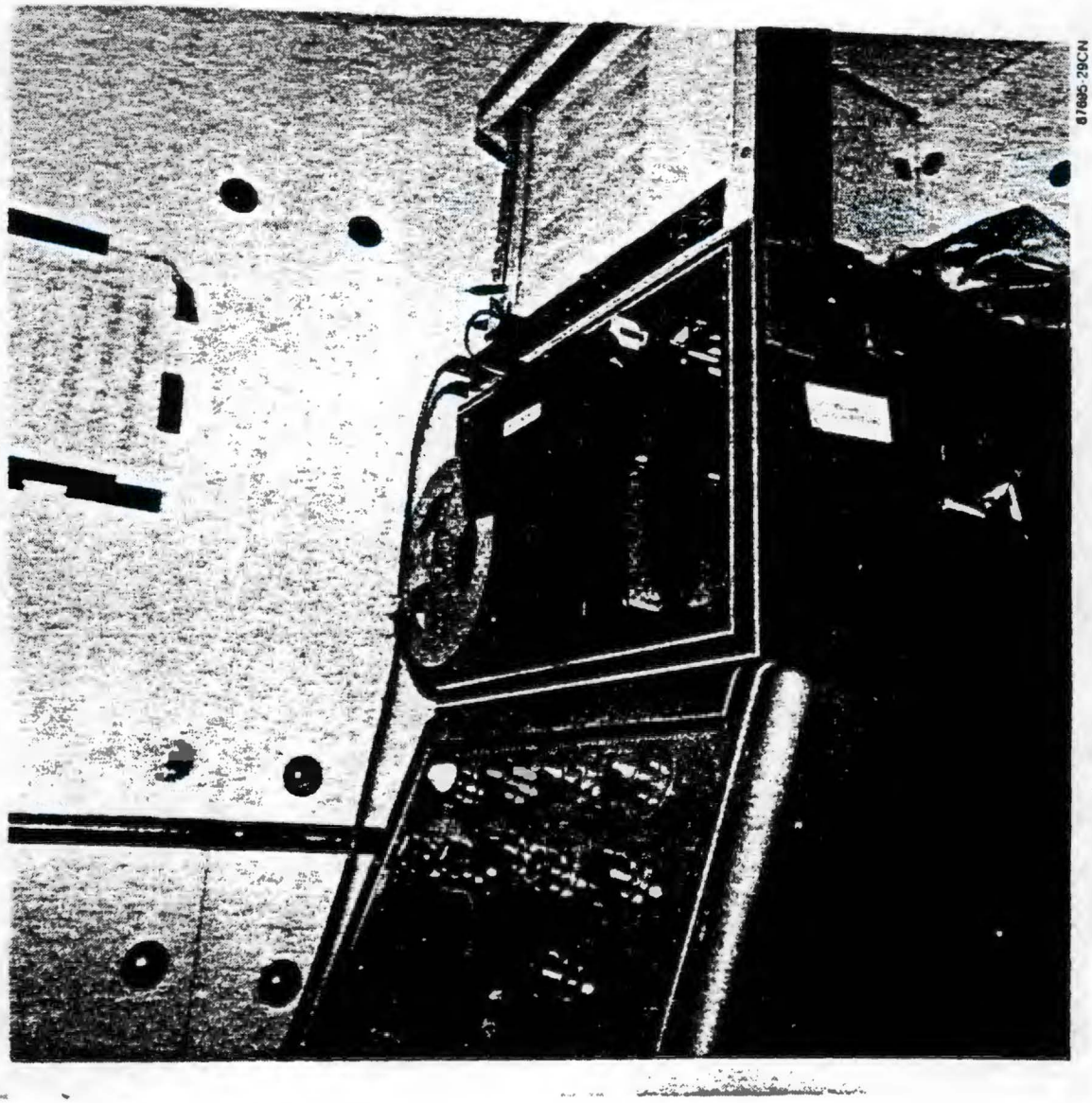


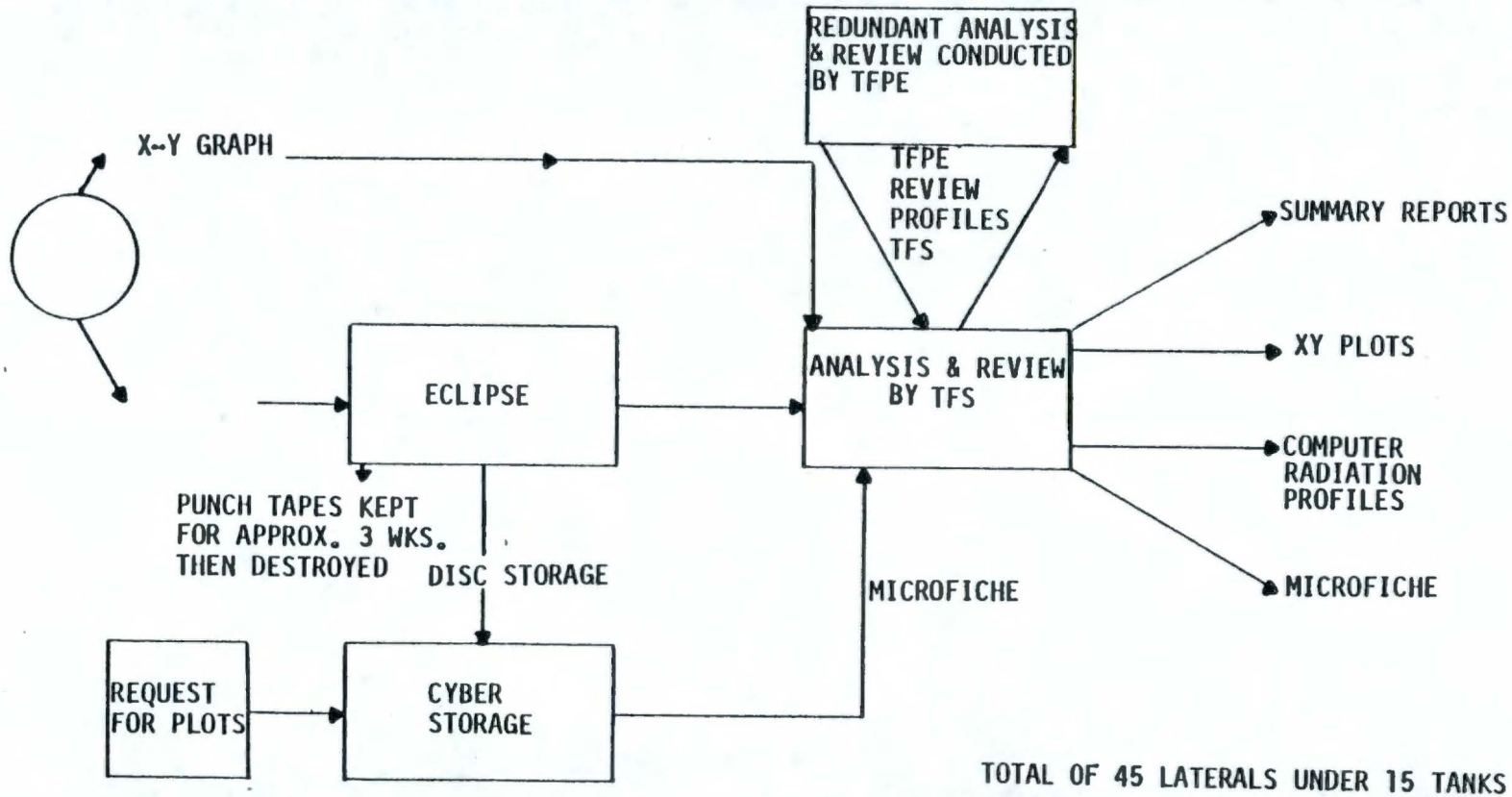
PHOTO 6-13
Lateral Monitoring Equipment

Lateral surveys are made by lowering the probe into a lateral riser and moving it to the end of the lateral air pressure. The probe is mechanically retrieved as the instrument package counts and records the radioactivity encountered in the lateral.

For comparison purposes, a baseline chart for each lateral is available in the instrument shelter. The operator is to inspect the lateral survey plot and report to TFO and TFS supervision any peak readings that exceed the 10 cps) scribed limits line in uncontaminated laterals, any new peaks in a contaminated lateral, and increases in existing peaks in a contaminated lateral, and increases in existing peaks of 50% or greater. For those laterals monitoring 108-SX, 109-SX, 112-SX, 114-SX and 115-SX peak readings of 100 cpm or more in a previously uncontaminated lateral shall be reported. The peaks resulting from the probe making the turn at about 70 feet (65 feet for 108-SX, 109-SX, 112-SX, 114-SX and 115-SX laterals) and from response to the source at about 20 feet are expected from this notification.

All lateral readings must be submitted to TFS within 24 hours. Those SOP's detailing lateral monitoring operations are:

- TO-040-060 (A-Farm)
- TO-040-100 (TK-105 & 107-SX)
- TO-040-120 (TK-110 & 111-SX)
- TO-040-140 (TK's 108, 109, 112, 114, and 115-SX)



TOTAL OF 45 LATERALS UNDER 15 TANKS

3 PER TANK 6 TANKS IN A FARM

9 TANKS IN SX FARM

FIGURE 6-14 Lateral Well Data Flow

CASS

(Computer Automated Surveillance System)

The Computer Automated Surveillance System (CASS), monitors all of the underground nuclear waste storage tanks. CASS consists of six field microprocessors, a central microprocessor that handles communications, and two central computers (Data General Eclipse C330). The central microprocessor and central computers are all located in the 2750-E Building in the 200 East Area. Ths six tank farm microprocessors are located in Buildings 241-A, 214-BY-301, 241-CR-271, 241-SX-271, 242-T, and 241-U-271.

The primary Eclipse computer collects the data from the tank farm microprocessors and also collects data from manually inputted field readings from the field terminals. If the primary computer fails the second Eclipse is available for back-up. (See Photo 6-14).

Currently there are seven remote terminals connected to CASS system. These terminals are keyboard/printers used to input field readings not connected to a microprocessor. The terminals are also used to receive schedules reports and to obtain requested reports. These terminals are located at 271-CR, 242-S, 242-A and 2750-E Building. In the 2750-E Building there are terminals in the Surveillance Room C-103, the Instrument Shop Room A-130 and the Operations Room B-105. (See Photo 6-15).

The types of instruments in place in the tank farm that CASS monitors are: (1) thermocouples, (2) automatic FIC liquid level gauges, (3) manual liquid level gauges, (4) area radiation detectors, (5) exhauster air monitors, and (6) annulus leak detectors.

The tank farm microprocessors, on command from the primary computer, collect data that is generated by the various tank farm instruments and transmit it to the central microprocessor. (See Photo 6-16).

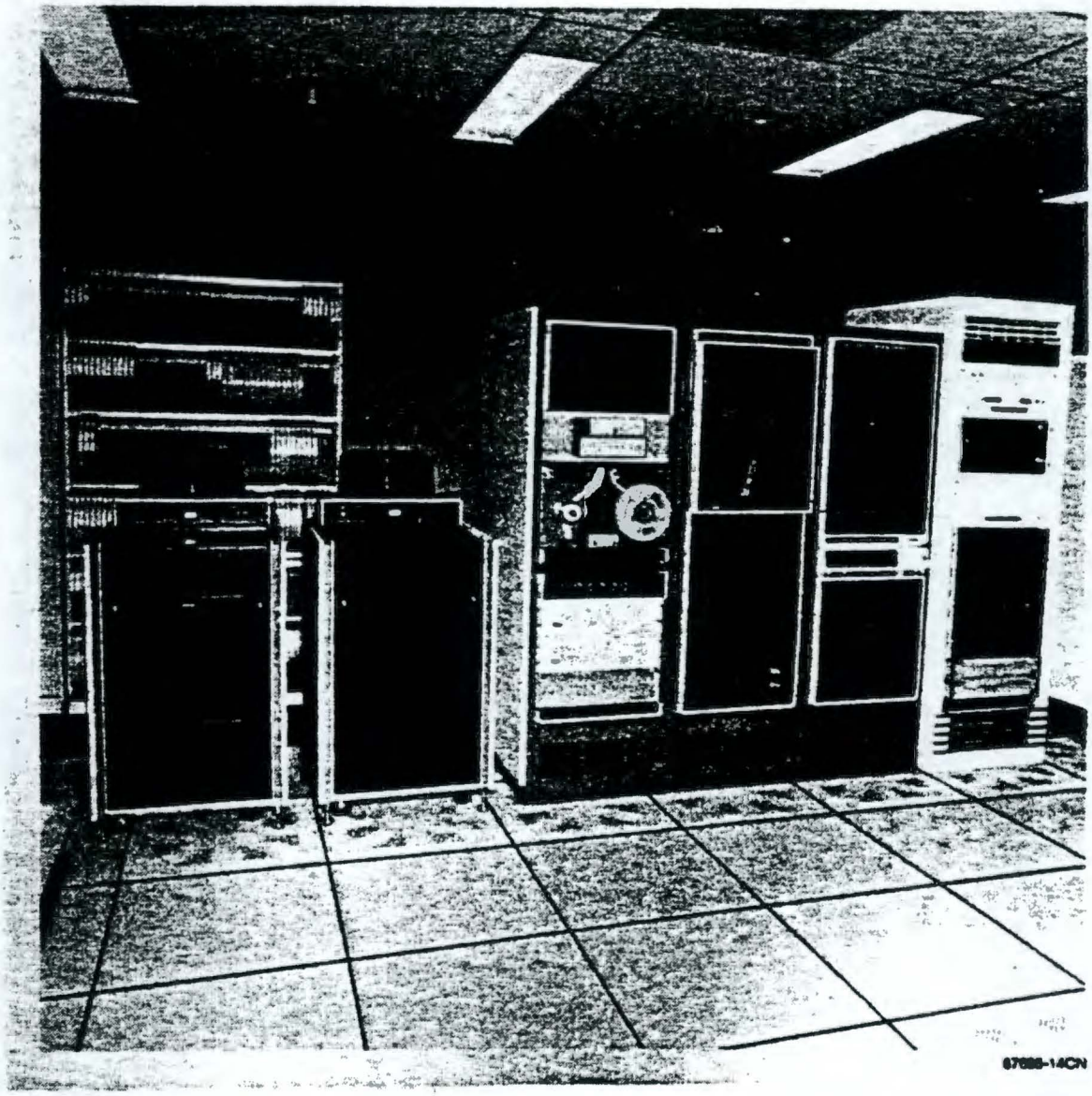
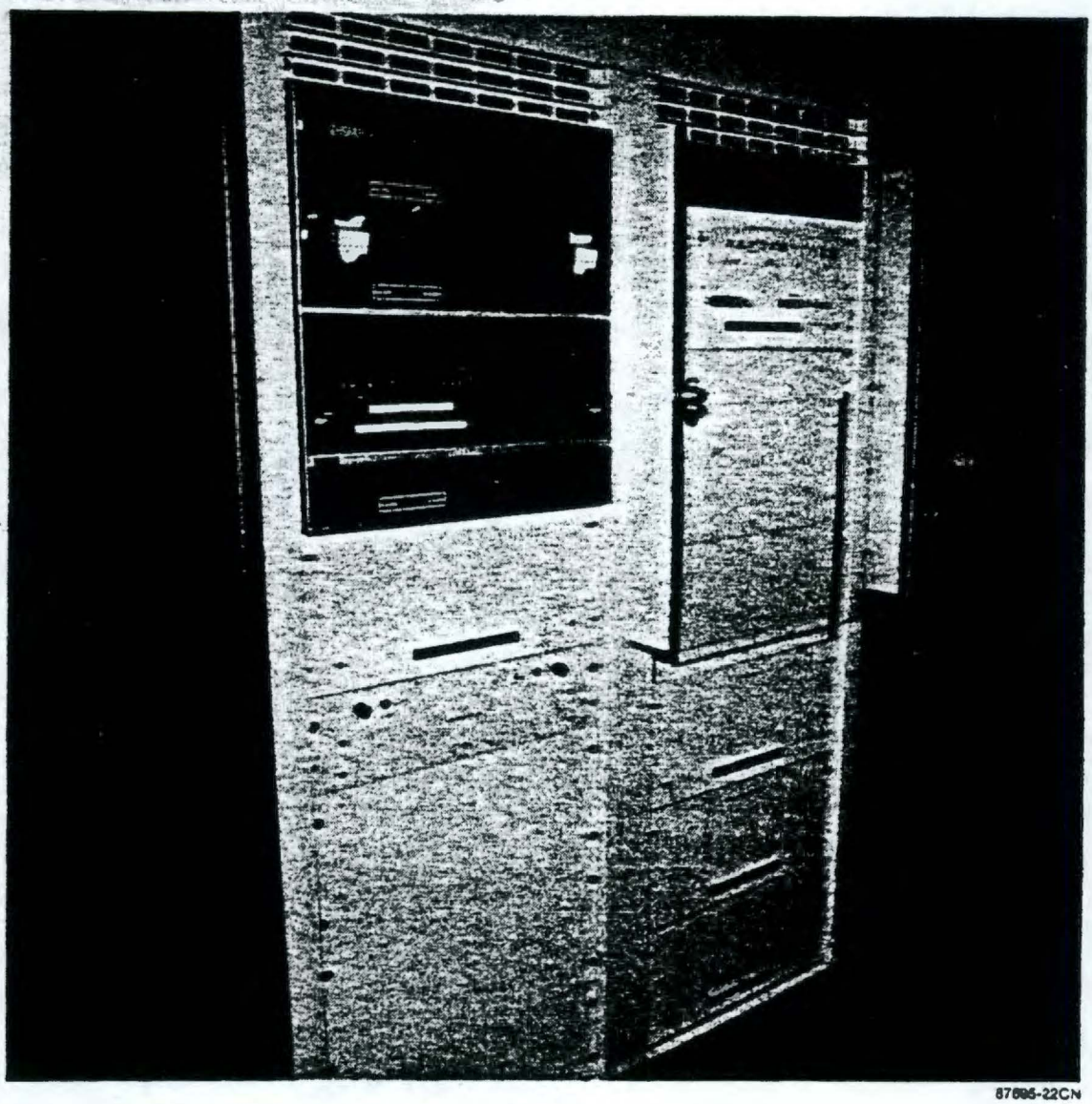


PHOTO 6-14
Eclipse Computers

PHOTO 6-15
CASS Terminal



87695-22CN

PHOTO 6-16
Tank Farm Microprocessors

The central microprocessor handles all communications between the central computer and the tank farm microprocessor, and checks the data stream for transmission validity. The microprocessors report changes in contact alarms immediately to the central microprocessor. Contact alarms include CASS equipment, area radiation detectors, exhaust air monitors and annulus leak detectors.

Equipment failure, liquid levels, and thermocouples data is sent to the primary computer for storage and analysis of the operating conditions (specifications, operating limits, procedure, etc.) The primary computer also performs all the required calculations to generate reports on tank status. All alarm data is displayed at specified remote terminals.

All data files are maintained on both Eclipse computers. In this way if the primary Eclipse should fail, these files will not be lost. On a routine basis all data files and programs are also copied to magnetic tape with a copy of them being stored in a location away from the 2750-E Building.

CASS Operator Duties

The CASS system is monitored by an operator on a 24-hour basis. The general duties of the CASS operator include:

1. The operator must report all alarms (contact or liquid levels out of limits).
2. The operator must report all equipment failures.
3. The operator will start/stop remote terminals upon request.
4. The operator will troubleshoot the Eclipse CASS system and follow the CASS operator manual to resolve computer related problems.

Any alarm that an operator receives from the CASS system is reported to his shift supervisor and the supervisor has the responsibility to follow-up and determine any corrective action that should be deemed necessary.

REMOTE VISUAL IMAGERY

The Remote Visual Imagery Unit of Tank Farm Surveillance is responsible for obtaining photographic data of waste tank interiors. The photographic information that is obtained is used to provide supporting visual data for waste tank investigations and various engineering studies.

Surveillance Operations personnel provide the manpower to support this activity. It is the role of the operators in preparing for a mission to bring along the necessary RWP equipment. This would consist of proper SWP clothing, radioactive waste cartons, rags, plastic bags, tape and miscellaneous tools. Operators also move the camera truck and equipment to the job site, prepare the entry riser, assist the photographer in preparing the camera equipment, build and/or install radiological containments, and handle the camera package during the photographing sequence.

The photographs are obtained by lowering the camera package (See Photos 6-17 through 6-19) through a 12" or larger riser into the vapor space of the tank. Once the camera package is in position, the photographer remotely snaps the shutter. The camera package is rotated as photos are shot in different directions. Usually three entries are made shooting 30 views.

PHOTO 6-17
12" Camera Package

PHOTO 6-18
Site Preparation

PHOTO 6-19

Inserting the Camera Package into a 12" Riser

In the past, this job had the potential for severe contamination to the equipment and personnel. However, the Remote Imagery staff developed a new containment which effectively isolates the equipment from the contamination on the riser walls. The contamination potential has now been greatly reduced.

Waste Packaging and Handling

Those surveillance jobs that normally require the handling and packaging of radioactive waste are in-tank photography and swab riser monitoring. Except in unusual circumstances, all waste handled will be well within the criteria limits of 10 MR/HR at the surface of the waste container. Liquid waste is not usually handled. Practically all waste generated will consist of used plastic, PVC, rags, swabs and paper.

It is the responsibility of the operator to use only those containers that have been approved by the packaging, shipping and safety committee. All containers shall be inner lined with plastic bags. Under no circumstances should an operator compact waste suddenly or with his hands. Compaction with the hands may result in puncture wounds, while sudden compaction could result in "blowing out" of contaminated dust.

The filling of a container should be discontinued if a dose rate of 10 MR/HR exists two inches from the container; the height of the uncompacted material in the container reaches the top; or the estimated weight of the package is approximately 70 pounds.

It is also permissible at this time to package large volume material such as folded plastic, paper, or rubber matting in large heavy duty plastic bags. The plastic bag is then taped securely shut. In some instances the material may require double bagging.

Other items to remember when packaging radioactive waste are:

- Solid wastes shall be dry. Damp wastes will be packaged in an inner waterproof container which will contain the moisture.
- Waste containing contamination which is easily airborne shall be contained by a sealed inner container.
- The exterior surfaces of the waste package shall have smearable contamination less than 1000 D/M beta-gamma and no detectable alpha.

If the outer package surfaces exceed these limits, the package should be decontaminated to acceptable levels or placed inside an additional container (i.e., another plastic bag, larger box, etc).

Once the waste has been properly packaged, notify supervision that the waste is ready for pickup. Operations supervision will complete and sign the on-site radioactive shipment record. (See Figure 6-15).

RHO-MA-230

DOE CONTRACTOR

☐ BNW ☐ RHO

☐ HEDL ☐ UNI

ONSITE RADIOACTIVE SHIPMENT RECORD

(NO INSPECTION PERMITTED)

	Yes	No
Material is Classified		
SNM Material		
Security Escort Required		

SHIPPER

	Name	Contractor and Component	Building and Area	Phone
To:				
From:				
Carrier:			Vehicle No.:	

Complete Description of Radioactive Contents:

Major Radionuclide(s) _____

Estimated Amount (Total Curies) _____

Estimated Max. Curies/Container _____

Grams Fissile Matl. _____

Transport Group	Quantity Category	Form
☐ I	☐ Limited	☐ Solid
☐ II	☐ LSA	☐ Liquid
☐ III	☐ Type A	☐ Gas
☐ IV	☐ Type B	
☐ V	☐ Large	
☐ VI		
☐ VII		

Material and Package Description:

_____

Material is: ☐ DOE ☐ Licensee

Container: ☐ Single Trip ☐ Reusable

Name of Container or Identification Number: _____

Absorbent Material Required: ☐ Yes ☐ No

Container Examined. No Evidence of Deterioration or Damage ☐

Required Labels and/or Placards Affixed To Shipment ☐

Nuclear Materials Management Review: Not Required ☐ Reviewed By _____ Date _____
Nuclear Matl's Management

This package has been prepared for onsite shipment in accordance with company shipping regulations: _____ Date _____
Shipping Organization Representative

RADIATION MONITORING

RADIATION CONDITIONS (mR/hr)

Package		Vehicle	
At Contact		At Side	
At 3 Feet		At 6 Feet	
		In Cab	

CONTAMINATION CONDITIONS (d/m / 100 cm²)

Package	
Beta-Gamma Smears	
Alpha Smears	

List Other Pertinent Information: _____

Rm Escort Required ☐ Yes ☐ No Speed Limit Restricted To: _____ MPH

Rm Supervisor Review: Not Required ☐ Reviewed By: _____ Date _____
Rm Supervisor

Surveyed By: _____ _____
Radiation Monitor Date

CARRIER

INSTRUCTIONS:

1. Do not leave shipment unattended between pick up and drop off points.
2. In case of accident or spill notify RM immediately. Phone No.: _____
3. Receiver to notify receiving RM and sender upon delivery.
4. Shipments during hazardous road conditions and/or congested traffic should be avoided.
5. Tie down or restrain packages to prevent shifting or loss of package during transport.
6. Declare material and present shipment record at each patrol check point.
7. Obtain Rm release survey of transport vehicle after delivery of radioactive materials.
8. _____

PATRL

Patrol Checkpoint	☐ In ☐ Out Area	☐ In ☐ Out Area	☐ In ☐ Out Area	☐ In ☐ Out Area	☐ In ☐ Out Area	☐ In ☐ Out Area
Time/Date						
Patrolman Number						

FIGURE 6-15

Onsite Radioactive Shipment Record Xerox

DISTRIBUTION: White - (Record Copy) To RM at Origin
Canary - Accompany Shipment to Receiver
Pink - Shipping Organization Representative

54-3000-609 (N-5-78)

GLOSSARY

absorbed dose - the quantity of energy imparted to a mass of material exposed to radiation expressed in rads (1 rad = 100 ergs/gram).

absorption - the process by which radiation imparts some or all of its energy to any material through which it passes; the taking up of substance through the interior of another substance; (not to be confused with adsorption which is the adhesion of one substance to the surface of another).

activity - chemically, the relative rate or degree of readiness or ease with which an element or compound or agent acts; and excited state of a gaseous substance due to ionization; the relative concentration of free ions; the magnitude or rate of disintegration of a radioactive emission in terms of its observable effect.

adsorption - a surface phenomenon in which one substance is taken up at the solid surface of another, resulting in a change of concentration at the interface.

aging - usually refers to decay of radioactivity.

active tank - a tank wich contains greater than a minimum heel of liquid and/or for which future material additions are planned.

aging waste - the high heat waste which has been processed for cesium and strontium removal and is stored for the decay of short lived fission products. The current storage period is approximately five years from dated of reactor discharge, after which time the material may be processed as evaporator feed.

airborne - supported by air. Usually applied to small particles whose free-fall velocity is so slow that they are carried by air currents. Airborne contamination applies to contamination loose in the air or filtered from the air or deposited from the air as contrasted with contamination spread by such means as splashing, dripping, or leaking.

air sample - a sample of the air for determining the amount of radioactivity present. A known volume of air is passed through a filter paper. The total activity which is concentrated on the surface of the filter paper can then be measured in specially designed counters.

alpha particle - nucleus of helium atom, emitted by some radioactive elements, emitters. Each alpha particle consists of two protons and two neutrons.

annular tank - a doughnut shaped tank; the annulus provides additional nuclear safety.

atom - the smallest unit quantity of an element that is capable of entering into chemical combination.

atomic number - position of an element in the periodic system, in which the elements are arranged according to increasing number of orbital electrons, with hydrogen as number one.

atomic weight - the relative weight of an atom of an element, as compared with the weight of one atom of oxygen taken as 16.

axis - the line about which a rotating body turns; the central line of any symmetrical body.

background - the amount of radiation that is present at a given location due to natural or induced radiation.

baffle - a plate in a piping or duct system used to control or direct the flow of fluids.

baseline - reference point. Specified liquid level or radiation peak against which new information is compared.

beam, radiation - a stream or ray of radiation, such as a stream of beta particles; the radiation escaping through an opening of a shield.

beta particle - an electron emitted from the nucleus of an atom of a beta emitter.

beta ray - a stream of beta particles.

BF_3 (boron trifluoride) - gas used in ion chambers for detection of a neutron flux by the neutron-alpha reaction; also, denotes both the tube and the entire instrument assembly.

biological hazards - the dangers involved in exposure of radioactive material to the human body.

bismuth phosphate process - first precipitation process used at Hanford for separation of Pu from the irradiated U fuels. This process was replaced by Redox and Purex processes to gain the advantage of separation and recovery of the U and Pu and fission products.

blue flash - visible light normally produced as a result of a nuclear burst.

body burden - the amount of radioactive material in the body at the time of interest.

breathing - of tanks, drawing in or giving out vapor or air due to changes in temperature or pressure.

breathing air - separate air supply for fresh air masks.

bumping - a violent emission of vapor from a boiling liquid, caused by super heating.

burial ground (garden) - a land area specifically designated to receive packaged contaminated wastes and equipment for burial.

burst - an exceptionally large release of uncontrolled radiation energy in a very short period of time.

calcine - to drive off volatile matter and to make powdery by action of heat.

camera package - the various assembled components (camera, housing, hose, etc. used to obtain in-tank photos.

canister - a small container, enclosing the filter media, attached to a mask.

cascade - equipment arrangement where process streams flow by gravity from vessel to vessel, column to column; also, radioactive decay scheme.

cask - a shielded container used to transport radioactive material.

CASS - Computer Automated Surveillance System.

catch tanks - small capacity single-shell tanks, associated with diversion boxes and diverter stations. The tanks are designed to receive any transfer line leakage from these boxes of adjacent pipe encasements.

certification - the action of determining, verifying, and attesting to the qualifications of personnel, processes, procedures, etc. in accordance with applicable requirements.

chain reaction - any chemical or nuclear process in which some of the products of the process or energy released by the process are instrumental in the continuation or magnification of the process.

classified information - information which requires safeguarding in the interest of national security.

clearance (Security) - access permit covering type of information one can receive and covering areas and building one is permitted to enter.

cold - uncontaminated; free of radioactivity; not irradiated when referring to uranium.

condensate - liquid formed from a gas or vapor.

conditional release - the release of contaminated materials from Radiation Zone areas for further use or disposal under stated conditions.

conductivity probe - the release of contaminated materials from Radiation Zone areas for further use or disposal under stated conditions.

confirmed or declared leaker - the designation of any underground waste storage tank which has leaked per the conclusion reached after a review of accumulated data.

constant monitoring - continuous determination of the amount of ionizing radiation or contamination present in a specified place.

containment - that which prevents escape and dispersion of radioactive material beyond specified confines.

contaminated waste - solid, gaseous, or liquid waste which contains radioactive materials.

contamination (radioactive) - the presence of radioactive materials where it is normally undesirable, harmful, or causes interference.

continuous air monitor (CAM) - instrumentation for detection or airborne radioactive contamination.

controlled area - an area in which access, occupancy, and working conditions are controlled to minimize exposure of personnel to radiation and contamination.

controlled exposure - the limiting of occupational exposures to ionizing radiation by administrative means.

count - act of measuring radioactivity; the specific amount of radioactivity present.

cover block - removable concrete shields over cell openings and diversion boxes.

C.P. - standard beta-gamma dose rate instrument used on the Hanford Project.

crash alarm - notification of an emergency made simultaneously to telephones on an automatic conference circuit.

crib - a porous underground structure for disposal of low-level liquid wastes.

critical - fulfilling the condition that a medium capable of sustaining a nuclear chain reaction has an effective multiplication factor equal to unity (1 to 1).

critical incident alarm (nuclear excursion alarm) - an audible evacuation alarm automatically activated by a radiation burst resulting from a nuclear excursion.

critical mass - the minimum mass of fissionable material required for producing a spontaneous fission chain reaction.

critical organ - the critical organ for internally deposited radionuclides is that organ of the body receiving the specified radioisotope that results in the greatest physiological damage to the body. The critical organ for exposure to ionizing forming organs, gonads, and eyes.

criticality - state of being critical; a self-sustaining neutron chain reaction in which there is an exact balance between the production of neutrons and the losses of neutrons in the absence of extraneous neutron sources.

crust - a hard surface layer which has formed in many waste tanks that contain concentrated solutions.

curie - the unit of the measurement of radioactivity; 1 curie = that quantity of any radioactive isotope which undergoes 2.7×10^{10} disintegrations per second.

data sheets - pre-printed forms used to record the various types of surveillance data, (i.e. liquid level, ponds, swab risers).

decay (radioactive) - the gradual diminishing of the quantity of a radioactive substance due to the spontaneous disintegration of nuclei by the emission of alpha or beta particles, or gamma rays.

decontamination - the cleaning or removal of radioactive contamination.

deposition - act or process of depositing or laying down; generally refers to radioactive materials deposited within the body.

detect - to discover the presence, existence, or fact of.

deviate - to change or turn from a course of action or procedure.

disabling injury - a work injury which results in death, permanent total disability, permanent partial disability, or temporary total disability as defined under the American Standards Association Code 216.1 - 1954.

discharge (on site) - liquid wastes discharged to on-site systems such as cribs, ditches, ponds, etc.

disintegration - a spontaneous nuclear transformation characterized by the emission of energy and/or mass from the nucleus.

ditch - long, narrow unlined excavation in the ground, used for conveying large volumes of liquid to a pond. Usually contain very low-levels of contamination.

diversion box - a below grade concrete enclosure containing the remotely maintained jumpers and spare nozzles for diversion of waste solution to storage tank farms.

do not operate tag - an inviolable tag placed on any equipment where a possibility of injury would exist in the event that the equipment were to be operated.

dose - a quantity of radiation absorbed from incident radiation by a specified mass. The unit of absorbed dose is a rad.

dose rate - radiation dose received per unit of time.

dosimeter - an instrument for measuring accumulated radiation dose. Common dosimeters are film badges and pencils.

double contingency - minimum safety limit used such that two errors are required before criticality is possible.

double-shell tank - the newer one million gallon underground waste storage tanks consisting of a concrete shell and two concentric carbon steel liners with an annulus.

dry well (in tank) - a sealed casing within a tank that is attached to a riser, and used for access of a neutron or an acoustical probe to determine the level of drainable interstitial liquor.

dry well - a steel casing, generally 6 inches in diameter, drilled into the ground to various depths, and used for access of monitoring instruments to measure the presence of radioactivity of moisture content.

effluent - waste stream from a process of facility.

electrode - a conductor used to establish electrical contact with a non-metallic part of a circuit.

emergency procedure - a special procedure for personnel to follow in the event of an abnormal occurrence or emergency.

emission - release of contaminated gas or liquid to the atmosphere.

environs - area immediately surrounding.

evaporator-crystallizers - 242-A and 242-X waste concentration facilities that operate at a reduced pressure (vacuum) and are capable of producing a slurry containing about 30 volume percent solids at a specific gravity of greater than 1.6.

evaporator feed - any liquid that forms acceptable salt cake with further concentration, e.g., low heat waste, dilute interstitial liquor, aged waste, and other radioactive waste solutions.

exclusion area - the fenced area enclosing the individual production facilities.

exposure record - records which date, list, and evaluate the occupational exposure of persons to ionizing radiation.

eye protection - safety devices used to protect the eyes from damage, such as welder hoods, shatter-proof glasses, and acid goggles.

FIC - a Food Instrument Corporation automatic liquid level gauge based on a conductivity probe installed in approximately 85 underground waste storage tanks and in most cases electrically connected to a computer for data transmission, analysis, and reporting. Local readings may also be obtained from a dial.

finger ring - a dosimeter in the form of a ring to be worn by employees to determine radiation doses to the hand.

fissile material - an element or isotope, the nuclei of which can by nuclear bombardment undergo nuclear fission and produce a chain reaction. This item can be applied only to uranium, plutonium, and thorium.

fission (nuclear) - the splitting of a nucleus into two essentially equal fragments.

fission product - a nuclide produced by the fission of a heavy element.

fissionable material - material such as certain isotopes of uranium and plutonium that have the property of capturing neutrons and thereupon splitting into two particles with great kinetic energy release.

flush - act of adding solution to process piping or equipment, for a specific purpose such as removal of solids or contamination.

fresh air mask - a tight fitting breathing mask supplied with fresh air from an external source.

friable - crumbles easily; reduced to powder.

fusion (nuclear) - the process of building up more complex nuclei by the combination, or fusion, or simpler ones. The formation is usually accompanied by the release of energy.

gamma ray - electromagnetic radiation emitted by the nuclei of radioactive substances during decay, similar in nature to X-rays.

GM instrument - instrument for detecting low-level beta and gamma radiation using a Geiger-Mueller tube.

greenhouse - temporary plastic enclosure for controlling contamination.

half-life - the time required by the radioactivity of a substance to decay to half its original value, that is, for half the atoms present to disintegrate.

half-life, biological - time required for the body to eliminate one-half of the administered dose of any substance by regular process of elimination.

half-life, effective - time required for a radioactive element fixed in the tissue of a living body to be diminished 50% as a result of combined radioactive decay and biological elimination.

heel - the amount left in a vessel or container after the bulk of the contents have been removed.

high efficiency filter - filters designed to achieve 99.95 percent minimum efficiency in the containment of radioactive particulate of greater than 0.3 micron size.

high level waste - radioactive waste which contains the bulk (99 percent) of fission products.

"hot" - a colloquial term meaning radioactive.

hot shop - a shop or room designed for handling or repair or radioactively contaminated equipment. The space may have special shielding, ventilation, or manipulating equipment.

inactive tank - a tank which has been removed from liquid processing service, pumped to a minimum supernatant heel and is awaiting, or is in the process of being stabilized and isolated, includes all tanks not in active or active restricted categories.

ingestion - the state of having been taken into the stomach - as taking radioactive materials into the digestive tract.

interpolution - estimating values which fall between two known values.

inverse square law (radiation) - the intensity of radiation decreases inversely with the square of the distance from a source, which is a point source or relatively small.

interstitial liquor - the liquid which fills the voids in the solids in the waste tank. This liquid is estimated to be about 50 percent of the solids volume. In salt cake, approximately 60 percent of the liquor is drainable and about 40 percent is held in place by capillary forces (non-drainable). In the sludge portion of the tank farm waste, this liquor is not considered pumpable or drainable, but may contain pockets of liquid which cannot be estimated. Interstitial liquor may be evaporator feed or terminal liquor.

ionization chamber - a device, consisting of an enclosed volume of gas between charged electrodes, used in measuring ionizing radiation in terms of electric charge associated with ions produced in the volume.

ionizing radiation - any electromagnetic or particulate radiation (contamination) capable or producing ions, directly or indirectly, in its passage through matter.

irradiation - the exposure of materials to radiation.

isolation - the act of sealing a tank against liquid intrusion from any creditable source and confining the atmosphere in the tank, except for filtered airways for normal tank breathing and ventilation for temperature control where necessary.

isotope - any of the two or more forms of the same element, containing the same number of protons but different numbers of neutrons.

jet pump - a modified commercially available jet pump used as a very effective salt well pump. A centrifugal pump in the pit recirculates a stream to serve as the motive fluid for the jet located at the bottom of the well which draws additional solution into the loop at a rate equal to the discharge rate that is controlled by a diaphragm operated valve (DOV).

klaxon - an audible signal device used to alert personnel of an existing emergency.

lateral - horizontal dry well under A Farm and certain SX Farm waste storage tanks.

leak detection pit - collection point for any leakage from AX Farm tanks. the pits are equipped with radiation and liquid detection instruments.

limits (operating) - volume, concentration, or weight limits in process vessels or areas designed to preclude personnel hazards, equipment damage, or processing upsets.

liquid level - determination of the amount of radioactivity present; the act of determining or the individual doing the monitoring; watch, observe or check with special purpose.

liquid waste - solutions contaminated with radionuclides in concentrations greater than environmental discharge limits.

lock and tag procedure - a procedure for locking out and tagging equipment where the possiblity of injury exists in the event the equipment is used or operated.

lost time injury - colloquial for disabling injury, which is defined as a work injury which results in death, permanent total disability, permanent partial disability, or temporary total disability as defined under the American Standard Association Code 216.1 - 1954.

low-level alarm - an instrument device set to alarm at a predetermined minimum level.

low-level waste - waste in which the radioactivity is sufficiently low that it may be safely discarded to cribs.

magenta - the color, purplish shade of red, of the symbol on a radiation zone sign.

maximum permissible concentration (MPC) - the dose of radiation or body burden of radionuclides which under any combination of circumstances is not expected to cause appreciable body injury to the average individual at any time during his lifetime.

millirad (mrad) - 1/1000 of a rad.

monitor - determination of the amount of radioactivity present; the act of determining or the individual doing the "monitoring."

monitoring wells - holes drilled into the ground to various depths, used for determining presence of radioactivity by instruments lowered into the well or by water samples.

neutron - stable particle of same mass as a proton but without an electrical charge.

neutron interaction - exchange of neutrons between masses of nuclear material.

neutron probe - probe equipped with a neutron source and detector which is used in monitoring wells to determine the moisture content of the soil as one means for detecting leaks in underground waste storage tanks or pipelines.

nuclear excursion - accidental criticality; an uncontrolled reaction event.

nuclear materials - uranium, plutonium, neptunium, and thorium held in custody for U. S. Gov't.

nuclear reaction - result of the bombardment of a nucleus with atomic or subatomic particles or very high energy radiation; also the decay of radioactive materials.

nuclear safety - the application of technical knowledge and administrative control to prevent an unplanned, uncontrolled nuclear chain reaction in nonreactor environment.

nucleus - the inner core of the atom, consisting of neutrons and protons.

nuclide - any species of atom that exists for a measurable length of time and has a nuclear structure distinct from that of any other species of atom.

occurrence report - a report to DOE-RL, covering an off-standard condition, accident, or incident.

open hole salt well - a pump inserted into a waste tank with the suction at or below the solids level, frequently used to remove the bulk of the liquid, particularly in tanks containing less than 2 feet of sludge.

operating procedures (SOP) - written procedures describing a sequence of operating steps, including safety instructions.

phantom liquid levels - false liquid levels obtained when conductivity probes contact a solid mound, discarded equipment, etc.

plummet - weighted plumb bob at the lower end of the measuring tape on liquid level gauges.

pond - also called a swamp, a body of water enclosed in a natural or diked surface depression, used for disposal of high-volume, low-level liquid effluents.

poppy - an alpha detection instrument that makes a popping noise when its probe is held close to a source of alpha particles.

probe - an instrument package designed to be inserted in dry wells, tank risers, or other access ports to measure conductivity, radiation, moisture, temperature, etc.

psychrometry - determination of the humidity or dew point of a gas from wet and dry bulb temperatures that is used in conjunction with flow rate data to calculate evaporation rates.

proton - a positively charged particle of about the same mass as a hydrogen atom (which is one on the chemist's scale) and about 1,800 times heavier than the electron. The electrical charge of the proton is equal and opposite to the charge of the electron. Protons and neutrons make up the nucleus of the atom.

questionable integrity - any tank which has a small decrease in liquid level or a radiation increase in an associated dry well, for which the data are insufficient to support a conclusion that the tank is sound.

quick-sort - procedure for checking personnel after a criticality accident to determine extent of radiation exposures and contamination.

rad - unit of absorbed radiation dose. It is 100 ergs per gram.

radiation (radioactivity) - the emission of atomic particles or rays by nuclei.

radiation occurrence (RO) - a condition or situation involving radiation which is an undesirable event of sufficient importance or widespread interest as to warrant investigative action by supervision.

radiation work procedure (RWP) - a written procedure for work in Radiation Zones defining radiological conditions and precautions and protective clothing requirements.

radiation zone - an area or item or equipment requiring access control for personnel due to radiation or contamination.

radioisotope (radionuclide) - unstable atoms of elements, giving off invisible particles of rays from the nuclei during the process of changing to more stable forms.

regulated shop - maintenance repair shop within a radiation zone.

regulated tools - tools and equipment used only in Radiation Zones.

rem - stands for "roentgen equivalent man," it is the quantity of any type radiation having the same effect on the body as one rad of X or gamma radiation.

removed from service - any tank which is a confirmed leaker or is not intended for reuse.

respiratory protection - equipment, such as assault masks, MSA masks, or fresh air masks, worn to protect personnel from inhaling harmful gases or particulate matter.

riser - the upright pipe projection from a tank; any vertical pipe.

salt cake - nondeliquescent crystals (at average Hanford air conditions) formed by evaporation, cooling and/or settling.

salt well - a screened casing inserted into a waste tank containing solids that extends to within about 2 inches of the bottom. The larger solid particles are rejected by the screen while liquid is allowed to migrate into the well for pumping.

salt well pump - a low capacity pump used to remove interstitial liquor from salt wells.

scintillation monitor - a radiation detection or measuring instrument based on the principle that light pulses are produced in some materials when they are exposed to radiation.

shielding - the material interposed between a source of radiation and personnel for protection against danger of radiation; common shielding materials are concrete, water, and lead.

shipping cask - specially designed container used for shipping radioactive product.

sight glass - view port or window in a vessel or pipe for viewing contents or flows.

single shell tanks - tanks constructed of a concrete shell and one steel liner, used to contain high-level wastes.

sludge - solids formed by precipitation without additional concentration.

smear - to wipe a surface with a rag, kleenex, or paper to determine if any loose contamination is present.

software - the totality of programs and routines used to extend the capabilities and operation of a computer.

source (radiation) - calibrated sample of radioactive material used to check instrument response and ability to measure; and point or area from which radiation originates.

special nuclear materials - plutonium, uranium-233, uranium enriched in the isotope U-233 or in the isotope U-235, and any other material which the DOE determines to be special nuclear material.

stabilization - the removal or immobilization, as completely as possible, of the liquid contained in a radioactive waste storage tank by salt well pumping, open hole salt well pumping, diatomaceous earth addition, etc.

static tank - a tank with no significant change in liquid level or involvement in transfer operations during a stated period of time.

step-off (pad) - area between designated zones, passage through which requires survey and may require removal of protective clothing, such as shoe covers, coveralls, gloves.

supernate (supernatant liquid) - the volume difference between the measured liquid level and the measured average solids level in any tank.

surveillance - the act of watching closely.

survey - to determine with instruments the amount of contamination or radiation present.

swamp - ground area where uncontaminated or low-level waste water is discharged to seep into the ground.

tank farm - area containing a number of storage tanks; i.e., chemical tank farm for storage of chemicals used in a plant, or underground waste tank farm for storage of radioactive waste.

terminal liquor - the liquid product from the evaporation-crystallization process which upon further concentration forms an unacceptable solid for storage in single-shell tanks. Terminal liquor is characterized by a caustic concentration of approximately 5.5M (the caustic molarity will be lower if the aluminum salt saturation if reached first).

thermocouple - a device for measuring temperature, consisting of two dissimilar metal wires joined at one end (hot junction) with the free ends joined to measuring instrument. Electrical potential charges due to temperature charges at the hot end are measured at the cold end and calibrated to read out as temperature.

time limit - the amount of time a person may be exposed to a specified dose rate or may stay in a radiation zone.

timekeeping - timing personnel in a radiation zone so that personnel exposure records may be maintained.

transuranic elements - those elements which have an atomic number higher than 92. These elements do not occur in nature and have to be produced artificially from uranium, either directly or indirectly by successive steps of transmutations. (Neptunium-93, plutonium-94, americium-95, curium-96, berkelium-97, californian-98, einsteinium-99, fermium-100, mendelevium-101, and nobelium-102).

utilities - services, such as electric, steam, and water.

vacuum - a pressure less than atmospheric pressure.

vent - an opening or hole for passage or escape of air, gas, or fluid, such as a tank vent.

ventilation balance - control of the building air supply to maintain proper air flow in a direction towards areas of potentially greater contamination.

vessel vent system - system under a slight negative pressure through which a series of process vessels are vented, and the off-gas is treated and filtered.

waste management - the storage and disposal of radioactive waste materials, including processing to recover valuable constituents.

"whites" - white coveralls worn in radiation zones for protection against radioactive contamination.

whole body count - radiation survey which measures the amount of radioactive material in the body.

X-ray - electromagnetic ionizing radiation which is highly penetrating.

yield - amount of product produced.

NPO PROGRESSION EXAM STUDY QUESTIONS

1. Briefly describe the events(s) and reason(s) for the creation of the Tank Farm Surveillance Group? (1-1)

2. What is the primary function of the TFS Analysis Unit? (1-1)

3. According to the TFS Charter, what are the two (2) primary responsibilities of Tank Farm Surveillance? (1-2 and 15)

4. Waste tank storage capacities range from _____gallons to _____gallons. (1-2)

5. List the four oldest tank farms and their dates of construction. (1-2)

6. Briefly describe the basic design concept of the first twelve (12) tank farms. (1-3)

7. To date, how many tanks have been designated as confirmed leakers? (1-3)

8. What are the advantages of the double-shell tank design over the single shell design? (1-3)

9. Name the four basic chemical processing operations that were the source of the radioactive waste solutions. (1-3)

10. What two elements were these four chemical processing operations attempting to recover? (1-3)

11. Name the three most essential ingredients in effectively combating an emergency. (2-1)

12. What are the two initial steps to be taken upon observing an emergency situation? (2-1)

13. Each employee has emergency-related responsibilities that help ensure his own safety and that of fellow employees. List three things you should do if discovering the emergency. (2-6)

14. What are your duties if assigned to an emergency response team? (2-6, 2-7)

15. If you are not assigned to recovery operations or are not part of a response group, what are your responsibilities? (2-6)

16. Name several ways to initiate an emergency alarm. (2-8)

17. Name five types of group 1 emergencies. (2-8)

18. Name three types of group 2 emergencies. (2-8)

19. Describe the emergency signal and action to be taken during the following emergency conditions: (2-10)

    - Criticality
    - Fire
    - Airborne contamination
    - Evacuation and attention

20. What is the Rockwell emergency phone number? (2-5)

21. Under which three emergency conditions are the evacuation buses used? (2-24)

22. Why is "quick sort" monitoring conducted during a criticality emergency? (2-26 to 27)

23. Describe what actions you should take upon receiving a bomb threat. (2-34)

24. Does a possibility of a criticality emergency exist in the tank farms? (2-38)

25. If you encounter a fire in the tank farm, what are your responsibilities? (2-39, 40)

26. If the fire is in a radiation zone, the minimum respiratory protection required is_____? (2-40)

27. In TSF Plant Operations what condition(s) require nuclear criticality considerations? (3-1)

28. Briefly describe Rockwell's contingency philosophy for criticality prevention. (3-1)

29. In which Rockwell Hanford Plant do we find fissile material handled and stored? (3-1)

30. What is meant by chain reaction and nuclear incident? (3-6)

31. What is airborne radioactivity? (3-7)

32. Why must airborne radioactivity be controlled? (3-7)
    Name some of the methods available to minimize airborne radioactivity. (3-7)

33. Describe four circumstances when respiratory equipment is required. (3-7, 8)

34. At_____ Ci/cc, filtered respiratory protection is required for beta-gamma emitters. (3-8, 9)

35. When air concentrations for fission products exceed 2 X 10-8 uci/cc what type of respiratory equipment must be worn? (3-9)

36. The air concentration inside a certain facility is 1 X 10-4 Ci/cc for beta-gamma emitters. Can you enter this facility for routine operations? Explain your answer. (3-8 thru 10) + (math calculation of your own).

37. What is a CAM? What is your response if you're in a facility and one alarms? (3-10, 11)

38. What action do you take if you can not obtain a proper mask seal and are scheduled to enter a controlled area? (3-10)

39. Why must surface contamination be controlled? (3-11)

40. Name three (3) ways radioactive material can be taken into the body. (3-11)

41. Define "removable" and "total" contamination. (3-11)

42. Can you smoke or drink in a contaminated area?
Within a surface contamination area? (3-12)

43. Name two areas where SWP clothing cannot be worn. (3-13)

44. The most important aspect of contamination control is
_____(3-13)

45. If you are trained in self-survey, can you survey and release other personnel? (3-13)

46. In all cases of personnel contamination, who should be notified immediately? (3-13)

47. Explain the differnece between a radiation area and a high radiation area. (Gen-0, p. 2, 3)

48. Briefly describe the regulations regarding personal property in radiation zones. (Gen-0, p.7)

49. What actions are required if you suffer a cut or injure yourself while in a radiation zone? (Gen-0, p.17)

50. Generally speaking, which type(s) of radiological conditions require a greenhouse? (Gen-0, p.17)

51. What are the doserate limits for hand tools used routinely in radiation zone work? (Gen-0, p.18)

52. At what levels of smearable contamination are you required to change (or remove) your SWP's for a clean pair? (Gen-0, p. 25)

53. Describe the proper method for wearing the multi-purpose dosimeter. (Gen-0, p. 13).

54. Define self-monitoring. (Gen-0, p. 19)

55. Name the four conditions required before an individual can perform self-monitoring. (Gen-0, p. 20)

56. Can SWP's be reused? If so, under what conditions? (Gen-0, p. 25)

57. Your SWP's are contaminated to levels of 50 mrad/hr (B-G), what should you do with them?

58. What are the contamination limits for regulated SWP jackets? Where should they be stored? (Gen-0, p. 32).

59. Can private or non-regulated vehicles be used to transport radioactive material? (Gen-0, p. 32)

60. What three conditions must be met before an item can be unconditionally released by RM?

61. Is alpha contamination possible in tank farm work? (RWP's)

62. In which of the TFS plant jobs must you be aware of potential neutron dose rates and potential alpha contamination? (RWP,-F-14, 3-56)

63. Should you undertake to perform a job which you do not understand or for which you're not trained or qualified? (4-3)

64. Briefly explain the following: (4-8)

    - Master Safety Rules
    - Job Site Safety Rules
    - General Plant Rules
    - Specific Job Rules.

65. Explain the purpose of the "Lock and Tag" procedure. What is the procedure intended to provide? How is the procedure carried out? (4-9, 10)

66. Is there a Safety Section in all approved SOP's? (4-9, 10)

67. What is the emergency medical aid number? (4-11)

68. Briefly describe how mouth-to-mouth resuscitation is given. (4-12)

69. What is the proper method one should use to control severe bleeding? (4-13)

70. Explain the term "housekeeping." Why is it an important part of Industrial Safety? (4-14, 15)

71. What are the three types of respiratory protection equipment in general use at Rockwell? (4-16)

72. If you're using a Scott Air Pak in an oxygen-deficient atmosphere how much breathing air time (maximum) would you have? (4-19)

73. Name the three elements that need to be present in order to have and sustain a fire. (4-20)

74. Explain the importance good housekeeping plays in fire prevention. (4-21, 22)

75. Define the terms flammable liquid and flash points. Give three examples of flammable liquids. (4-22)

76. What are the two conditions necessary for spontaneous ignition to occur. (4-25)

77. What type of material constitutes a Class A fire? What kind of fire extinguisher should be used on these fires? (4-26, 29)

78. You should use CO_2 and dry chemical fire extinguishers on which classes of fires? (4-26, 27, 30)

79. What type of fire is a Class D fire? How are these fires extinguished? (4-27, 30)

80. Name two (2) TFS jobs in which the operator must be aware of potential electrical hazards. (4-35, 36)

81. What Congressional Act serves as the basis for security authority at Hanford? (5-1)

82. Briefly define the following (5-1, 2)

- Controlled access area
- Security area
- Protected area

83. A "Q" clearance entitles an employee access to what type of information and security areas. (5-2, 4)

84. Explain the purpose of the "challenge system." (5-7)

85. List four (4) types of prohibited articles. (5-7)

86. Name four (4) types of security infractions. (5-9, 10)

87. Are special nuclear materials or classified information normally handled by TFS personnel?

88. Explain the purpose of the grid slots beneath the tank liners in AX Farm. (6-4)

89. Which farms are comprised exclusively of double-shell tanks? (6-4)

90. What was the original purpose of arranging tanks in cascades of three, four or six tanks? (6-4)

91. Briefly explain the means used to route liquid waste from process buildings to tank farms. (6-4, 6)

92. During the period of transfer,_____is constantly monitored for leaks. (6-6)

93. What is meant by aging waste? (6-6, 7-1)

94. Name the five aging waste tank farms currently in use. (6-6)

95. A, AX, AY, and AZ tank farms store waste from which two process buildings? (6-6)

96. The rate of heat generation in a tank is dependent upon the quantity of fission products present which, in turn is dependent upon what? (6-7)

97. Why must a 7 inch water heel be added to any newly constructed tank? (6-7)

98. Explain the purpose of airlift circulators. (6-8)

99. What are the two (2) general characteristics associated with the waste tank farms that simplify the job of monitoring liquid levels? (6-11)

100. In which RHO document would you find leak detection criteria data? (6-12)

101. What is an FIC? How are "field" FIC liquid levels obtained? (6-12, 13)

102. The zero position on a liquid level electrode tape represents the _____(6-17)

103. Explain how manual liquid levels are obtained. (6-17 to 21)

104. A salt "icicle" on a liquid level electrode will indicate a _____ liquid level. (6-20)

105. What complication(s) can floating crust cause to liquid level measurements? (6-20)

106. What type(s) of problem(s) does dry sludge cause when attempting liquid level measurements. (6-20)

107. What is the purpose of swab riser monitoring? (6-21)

108. What changes in previous swab riser reading require an immediate repeat of the sampling procedure. (6-21)

109. How often do TFS personnel monitor leak pits and annulus leak detection systems? (6-23)

110. What are the three basic instrument systems installed in a leak detection pit? (6-23, 24)

111. What is the primary method of leak detection employed in the double-shell tanks? Explain how this system works. (6-24, 25)

112. Name the three surface ponds designated for low level effluent discharge. (6-29)

113. What data (information) is sought in pond monitoring? (6-29)

114. In Hanford soils, what is liquid spillage expected to do? (6-33)

115. What is a dry well? How are dry wells identified? (6-33)

116. Describe the basic radiation detection principles of (6-35)

Scintillation probe
G-M probes

117. When are green and red G-M probes used? (6-35)

118. Briefly describe how dry well data is obtained. (6-35, 36)

119. Explain when a neutron probe is used. (6-41)

120. Does the neutron source require special handling? (6-41, 42) Explain your answer.

121. List those tanks having internal dry wells. What is this prototype neutron probe trying to detect? (6-42)

122. How many laterals monitor each tank? (6-42)

123. What is the purpose of a lateral source check? (6-45)
When lateral monitoring curves are compared to baseline curves, what are the deviations of interest? (6-49)

124. What is CASS? (6-51)

125. Name the four types of instruments in place in the tank farms that CASS monitors. (6-51)

126. What are the duties of a CASS operator? (6-55)

127. Explain how Tank Farm Surveillance Data is acquired by CASS. (6-51, 55)

128. What is the role of the operator on in-tank photo missions? (6-56)

129. What role does Remote Imagery serve in the overall leak detection process? (6-56)

130. Under which conditions should the filling of a waste packaging container be discontinued? (6-60)

131. What is an ORSR? When is one required? (6-61)

132. What are some of the safework practices to remember when packaging radioactive waste? (6-60, 61)

FORTY-TWO MONTH PROGRESSION EXAM STUDY QUESTIONS

1. Briefly describe the events(s) and reason(s) for the creation of the Tank Farm Surveillance Group? (1-1)

2. What is the primary function of the TFS Analysis Unit? (1-1)

3. According to the TFS Charter, what are the two (2) primary responsibilities of Tank Farm Surveillance? (1-2, 5)

4. Waste tank storage capacities range from _____gallons to _____gallons. (1-2)

5. List the four oldest tank farms and their dates of construction. (1-2)

6. Briefly describe the basic design concept of the first twelve (12) tank farms. (1-3)

7. To date, how many tanks have been designated as confirmed leakers? (1-3)

8. What are the advantages of the double-shell tank design over the single shell design? (1-3)

9. Name the four basic chemical processing operations that were the source of the radioactive waste solutions. (1-3)

10. What two elements were these four chemical processing operations attempting to recover? (1-3)

11. Name the three most essential ingredients in effectively combating an emergency. (2-1)

12. What are the two initial steps to be taken upon observing an emergency situation? (2-1)

13. Each employee has emergency-related responsibilities that help ensure his own safety and that of fellow employees. List three things you should do if discovering the emergency. (2-6)

14. Name several ways to initiate an emergency alarm. (2-8)

15. Name five types of group 1 emergencies. (2-8)

16. Name three types of group 2 emergencies. (2-8)

17. Describe the emergency signal and action to be taken during the following emergency conditions: (2-10)

    - Criticality
    - Fire
    - Airborne contamination
    - Evacuation and attention

18. What is the Rockwell emergency phone number? (2-15)

19. Under which three emergency conditions are the evacuation buses used? (2-24)

20. Why is "quick sort" monitoring conducted during a criticality emergency? (2-26 to 2-27)

21. Describe what actions you should take upon receiving a bomb threat. (2-34)

22. Does a possibility of a criticality emergency exist in the tank farms? (2-38)

23. If you encounter a fire in the tank farm, what are your responsibilities? (2-39, 40)

24. If the fire is in a radiation zone, the minimum respiratory protection required is_____? (2-40)

25. Under which condition(s) are nuclear criticality considerations involved in TFS plant operations. (3-1)

26. Briefly describe Rockwell's contingency philosophy for criticality prevention. (3-1)

27. In which Rockwell Hanford Plant do we find fissile material handled and stored? (3-1)

28. What is meant by chain reaction and nuclear incident? (3-6)

29. What is airborne radioactivity? (3-7)

30. Why must airborne radioactivity be controlled? (3-7) Name some of the methods available to minimize airborne radioactivity. (3-7)

31. Describe four circumstances when respiratory equipment is required. (3-7, 8)

32. At_____ Ci/cc, filtered respiratory protection is required for beta-gamma emitters. (3-8, 9)

33. When air concentrations for fission products exceed 2 X 10-8 uci/cc what type or respiratory equipment must be worn? (3-9)

34. The air concentration inside a certain facility is 1 X 10-4 Ci/cc for beta-gamma emitters. Can you enter this facility for routine operations?
Explain your answer. (3-8 thru 10) + (math calculation of your own).

35. What is a CAM? What is your response if you're in a facility and one alarms? (3-10, 11)

36. What action do you take if you can not obtain a proper mask seal and are scheduled to enter a controlled area? (3-10)

37. Why must surface contamination be controlled? (3-11)

38. Name three (3) ways radioactive material can be taken into the body. (3-11)

39. Define "removable" and "total" contamination. (3-11)

40. Can you smoke or drink in a contaminated area? (3-12)
Within a surface contamination area? (3-12)

41. Name two areas where SWP clothing cannot be worn. (3-13)

42. The most important aspect of contamination control is
_____(3-13)

43. If you are trained in self-survey, can you survey and release other personnel? (3-13)

44. In all cases of personnel contamination, who should be notified immediately? (3-13)

45. Explain the difference between a radiation area and a high radiation area. (Gen-0, p. 2, 3)

46. Briefly describe the regulations regarding personal property in radiation zones. (Gen-0, p. 7)

47. What actions are required if you suffer a cut or injure yourself while in a radiation zone? (Gen-0, p. 17)

48. Generally speaking, which type(s) of radiological conditions require a greenhouse? (Gen-0, p. 17)

49. What are the doserate limits for hand tools used routinely in radiation zone work? (Gen-0, p. 18)

50. At what levels of smearable contamination are you required to change (or remove) your SWP's for a clean pair? (Gen-0, p. 25)

51. Describe the proper method for wearing the multi-purpose dosimeter. (Gen-0, p. 13).

52. Define self-monitoring. (Gen-0, p. 19)

53. Name the four conditions required before an individual can perform self-monitoring. (Gen-0, p. 20)

54. Can SWP's be reused? If so, under what conditions? (Gen-0, p. 25)

55. Your SWP's are contaminated to levels of 50 mrad/hr (B-G), what should you do with them? (Gen-0 p. 25)

56. What are the contamination limits for regulated SWP jackets? Where should they be stored? (Gen-0, p. 32).

57. Can private or non-regulated vehicles be used to transport radioactive material? (Gen-0, p. 32)

58. Is alpha contamination possible in tank farm work? (RWP's)

59. In which of the TFS plant jobs must you be aware of potential neutron dose rates and potential alpha contamination? (RWP, -F-14, 3-56)

60. Should you undertake to perform a job which you do not understand or for which you're not trained or qualified? (4-3)

61. Briefly explain the following: (4-8)

    - Master Safety Rules
    - Job Site Safety Rules
    - General Plant Rules
    - Specific Job Rules.

62. Explain the purpose of the "Lock and Tag" procedure. What is the procedure intended to provide? How is the procedure carried out? (4-9, 10)

63. Is there a Safety Section in all approved SOP's? (4-9, 10)

64. What is the emergency medical aid number? (4-11)

65. Briefly describe how mouth-to-mouth resuscitation is given. (4-12)

66. What is the proper method one should use to control severe bleeding? (4-13)

67. Explain the term "housekeeping." Why is it an important part of Industrial Safety? (4-14, 15)

68. What are the three types of respiratory protection equipment in general use at Rockwell? (4-16)

69. If you're using a Scott Air Pak in an oxygen-deficient atmosphere how much breathing air time (maximum) would you have? (4-17)

70. Name the three elements that need to be present in order to have and sustain a fire. (4-20)

71. Explain the importance good housekeeping plays in fire prevention. (4-21), 22)

72. Define the terms flammable liquid and flash points. Give three examples of flammable liquids. (4-22)

73. What are the two conditions necessary for spontaneous ignition to occur. (4-25)

74. What type of material constitutes a Class A fire? What kind of fire extinguisher should be used on these fires? (4-26, 29)

75. You should use CO_2 and dry chemical fire extinguishers on which classes of fires? (4-26, 27, 30)

76. What type of fire is a Class D fire? How are these fires extinguished? (4-27, 30)

77. Name two (2) TFS jobs in which the operator must be aware of potential electrical hazards. (4-35, 36)

78. Briefly define the following (5-1, 2)

    - Controlled access area
    - Security area
    - Protected area

79. A "Q" clearance entitles an employee access to what type of information and security areas. (5-2, 4)

80. Explain the purpose of the "challenge system." (5-7)

81. List four (4) types of prohibited articles. (5-7)

82. Name four (4) types of security infractions. (5-9, 10)

83. Are special nuclear materials or classified information normally handled by TFS personnel?

84. Explain the purpose of the grid slots beneath the tank liners in AX Farm. (6-4)

85. Which farms are comprised exclusively of double-shell tanks? (6-4)

86. What was the original purpose of arranging tanks in cascades of three, four or six tanks? (6-3)

87. Briefly explain the means used to route liquid waste from process buildings to tank farms. (6-4, 6)

88. During the period of transfer,_____is constantly monitored for leaks. (6-6)

89. What is meant by aging waste? (6-6, 7-1)

90. Name the five aging waste tank farms currently in use. (6-6)

91. A, AX, AY, and AZ tank farms store waste from which two process buildings? (6-6)

92. Why must a 7 inch water heel be added to any newly constructed tank? (6-7)

93. What are the two (2) general characteristics associated with the waste tank farms that simplify the job of monitoring liquid levels? (6-11)

94. In which RHO document would you find leak detection criteria data? (6-12)

95. What is an FIC? How are "field" FIC liquid levels obtained? (6-12, 13)

96. The zero position on a liquid level electrode tape represents the _____(6-17)

97. Explain how manual liquid levels are obtained. (6-17 to 21)

98. A salt "icicle" on a liquid level electrode will indicate a _____ liquid level. (6-20)

99. What complication(s) can floating crust cause to liquid level measurements? (6-20)

100. What type(s) of problem(s) does dry sludge cause when attempting liquid level measurements. (6-20)

101. What is the purpose of swab riser monitoring? (6-21)

102. What changes in previous swab riser reading require an immediate repeat of the sampling procedure. (6-18)

103. How often do TFS personnel monitor leak pits and annulus leak detection systems? (6-23)

104. What is the primary method of leak detection employed in the double-shell tanks? Explain how this system works. (6-24, 25)

105. Name the three surface ponds designated for low level effluent discharge. (6-29)

106. What data (information) is sought in pond monitoring? (6-29)

107. In Hanford soils, what is liquid spillage expected to do? (6-33)

108. What is a dry well? How are dry wells identified? (6-33)

109. Describe the basic radiation detection principles of (6-35)

Scintillation probe
G-M probes

110. When are green and red G-M probes used? (6-35)

111. Briefly describe how dry well data is obtained. (6-35, 36)

112. Explain when a neutron probe is used. (6-41)

113. Does the neutron source require special handling? (6-41, 42) Explain your answer.

114. List those tanks having internal dry wells. What is this prototype neutron probe trying to detect? (6-42)

115. How many laterals monitor each tank? (6-42)

116. What is the purpose of a lateral source check? (6-45)
When lateral monitoring curves are compared to baseline curves, what are the deviations of interest? (6-49)

117. What is CASS? (6-51)

118. Name the four types of instruments in place in the tank farms that CASS monitors. (6-51)

119. What are the duties of a CASS operator? (6-55)

120. What is the role of the operator on in-tank photo missions? (6-56)

121. What role does Remote Imagery serve in the overall leak detection process? (6-56)

122. Under which conditions should the filling of a waste packaging container be discontinued? (6-60)

123. What is an ORSR? When is one required? (6-61)

124. What are some of the safework practices to remember when packaging radioactive waste? (6-60, 61)

1. Briefly describe the event(s) and reason(s) for the creation of the Tank Farm Surveillance Group? (1-1)

2. What is the primary function of the TFS Analysis Unit? (1-1)

3. According to the TFS Charter, what are the two (2) primary responsibilities of Tank Farm Surveillance? (1-2 and 5)

4. Waste tank storage capacities range from_____gallons to _____gallons. (1-2)

5. List the four oldest tank farms and their dates of construction. (1-2)

6. Briefly describe the basic design concept of the first twelve (12) tank farms. (1-3)

7. To date, how many tanks have been designated as confirmed leakers? (1-3)

8. What are the advantages of the double-shell tank design over the single shell design? (1-4)

9. Name the four basic chemical processing operations that were the source of the radioactive waste solutions. (1-3)

10. What two elements were these four chemical processing operations attempting to recover? (1-3)

11. Name the three most essential ingredients in effectively combating an emergency.

12. What are the two initial steps to be taken upon observing an emergency situation? (2-1)

13. Each employee has emergency-related responsibilities that help ensure his own safety and that of fellow employees. List three things you should do if discovering the emergency. (2-6)

14. Name several ways to initiate an emergency alarm. (2-8)

15. Name five types of group 1 emergencies. (2-8)

16. Name three types of group 2 emergencies. (2-8)

17. Describe the emergency signal and action to be taken during the following emergency conditions: (2-10)

    - Criticality
    - Fire
    - Airborne contamination
    - Evacuation and attention

18. What is the Rockwell emergency phone number? (2-15)

19. Under which three emergency conditions are the evacuation buses used? (2-24)

20. Why is "quick sort" monitoring conducted during a criticality emergency? (2-26, 27)

21. Describe what actions you should take upon receiving a bomb threat. (2-34)

22. Does a possibility of a criticality emergency exist in the tank farms? (2-38)

23. If you encounter a fire in the tank farm, what are your responsibilities? (2-39, 40)

24. If the fire is in a radiation zone, the minimum respiratory protection required is_____? (2-40)

25. Under which condition(s) are nuclear criticality considerations involved in TFS plant operations. (3-1)

26. In which Rockwell Hanford Plant do we find fissile material handled and stored? (3-1)

27. What is meant by chain reaction and nuclear incident? (3-6)

28. What is airborne radioactivity? (3-7)

29. Why must airborne radioactivity be controlled? (3-7) Name some of the methods available to minimize airborne radioactivity. (3-7)

30. Describe four circumstances when respiratory equipment is required. (3-7, 8)

31. At_____ Ci/cc, filtered respiratory protection is required for beta-gamma emitters. (3-8, 9)

32. When air concentrations for fission products exceed 2 X 10-8 uci/cc what type of respiratory equipment must be worn? (3-9)

33. What is a CAM? What is your response if you're in a facility and one alarms? (3-10, 11)

34. What action do you take if you can not obtain a proper mask seal and are scheduled to enter a controlled area? (3-10)

35. Why must surface contamination be controlled? (3-11)

36. Name three (3) ways radioactive material can be taken into the body. (3-11)

37. Can you smoke or drink in a contaminated area? Within a surface contamination area? (3-12)

38. Name two areas where SWP clothing cannot be worn. (3-13)

39. The most important aspect of contamination control is _____ (3-13)

40. If you are trained in self-survey, can you survey and release other personnel? (3-13)

41. In all cases of personnel contamination, who should be notified immediately? (3-13)

42. Explain the difference between a radiation area and a high radiation area. (Gen-0, p. 2, 3)

43. Briefly describe the regulations regarding personal property in radiation zones. (Gen-0, p. 7)

44. What actions are required if you suffer a cut or injure yourself while in a radiation zone? (Gen-0, p.17)

45. Describe the proper method for wearing your multi-purpose dosimeter. (Gen-0, p. 13)

46. Generally speaking, which type(s) of radiological conditions require a greenhouse? (Gen-0, p. 17)

47. What are the doserate limits for hand tools used routinely in radiation zone work? (Gen-0, p. 18)

48. At what levels of smearable contamination are you required to change (or remove) your SWP's for a clean pair? (Gen-0, p. 25)

49. Define self-monitoring. (Gen-0, p. 19)

50. Name the four conditions required before an individual can perform self-monitoring. (Gen-0, p. 20)

51. Can SWP's be reused? If so, under what conditions? (Gen-0, p. 25)

52. Your SWP's are contaminated to levels of 50 mrad/hr (B-G), what should you do with them? (Gen-0 p. 25)

53. What are the contamination limits for regulated SWP jackets? Where should they be stored? (Gen-0, p. 27).

54. Can private or non-regulated vehicles be used to transport radioactive material? (Gen-0, p. 32)

55. Is alpha contamination possible in tank farm work? (RWP's)

56. In which of the TFS plant jobs must you be aware of potential neutron dose rates and potential alpha contamination? (RWP,-F-14, 3-56)

57. Should you undertake to perform a job which you do not understand or for which you're not trained or qualified? (4-3)

58. Briefly explain the following: (4-8)

    - Master Safety Rules
    - Job Site Safety Rules
    - General Plant Rules
    - Specific Job Rules.

59. Explain the purpose of the "Lock and Tag" procedure. What is the procedure intended to provide? How is the procedure carried out? (4-9, 10)

60. Is there a Safety Section in all approved SOP's? (4-9, 10)

61. What is the emergency medical aid number? (4-11)

62. Briefly describe how mouth-to-mouth resuscitation is given. (4-12)

63. What is the proper method one should use to control severe bleeding? (4-13)

64. Explain the term "housekeeping." Why is it an important part of Industrial Safety? (4-14, 15)

65. What are the three types of respiratory protection equipment in general use at Rockwell? (4-16)

66. Name the three elements that need to be present in order to have and sustain a fire. (4-20)

67. Explain the importance good housekeeping plays in fire prevention. (4-21), 22)

68. Define the terms flammable liquid and flash points. Give three examples of flammable liquids. (4-22)

69. What are the two conditions necessary for spontaneous ignition to occur. (4-25)

70. What type of material constitutes a Class A fire? What kind of fire extinguisher should be used on these fires? (4-26, 29)

71. You should use CO_2 and dry chemical fire extinguishers on which classes of fires? (4-26, 27, 30)

72. What type of fire is a Class D fire? How are these fires extinguished? (4-27, 30)

73. Name two (2) TFS jobs in which the operator must be aware of potential electrical hazards. (4-35, 36)

74. Briefly define the following (5-1, 2)

    - Controlled access area
    - Security area
    - Protected area

75. A "Q" clearance entitles an employee access to what type of information and security areas. (5-2, 4)

76. Explain the purpose of the "challenge system." (5-7)

77. List four (4) types of prohibited articles. (5-7)

78. Name four (4) types of security infractions. (5-9, 10)

79. Are special nuclear materials or classified information normally handled by TFS personnel?

80. Explain the purpose of the grid slots beneath the tank liners in AX Farm. (6-4)

81. Which farms are comprised exclusively of double-shell tanks? (6-4)

82. What was the original purpose of arranging tanks in cascades of three, four or six tanks? (6-4)

83. During the period of transfer,_____is constantly monitored for leaks. (6-6)

84. What is meant by aging waste? (6-6, 7-1)

85. Name the five aging waste tank farms currently in use. (6-6)

86. A, AX, AY, and AZ tank farms store waste from which two process buildings? (6-6)

87. What are the two (2) general characteristics associated with the waste tank farms that simplify the job of monitoring liquid levels? (6-11)

88. In which RHO document would you find leak detection criteria data? (6-12)

89. What is an FIC? How are "field" FIC liquid levels obtained? (6-12, 13)

90. The zero position on a liquid level electrode tape represents the _____(6-17)

91. Explain how manual liquid levels are obtained. (6-17 to 21)

92. A salt "icicle" on a liquid level electrode will indicate a _____liquid level. (6-20)

93. What complication(s) can floating crust cause to liquid level measurements? (6-20)

94. What type(s) of problem(s) does dry sludge cause when attempting liquid level measurements. (6-20)

95. What is the purpose of swab riser monitoring? (6-21)

96. What changes in previous swab riser reading require an immediate repeat of the sampling procedure. (6-21)

97. How often do TFS personnel monitor leak pits and annulus leak detection systems? (6-23)

98. What is the primary method of leak detection employed in the double-shell tanks? Explain how this system works. (6-24, 25)

99. Name the three surface ponds designated for low level effluent discharge. (6-29)

100. What data (information) is sought in pond monitoring? (6-29)

101. In Hanford soils, what is liquid spillage expected to do? (6-33)

102. What is a dry well? How are dry wells identified? (6-33)

103. Describe the basic radiation detection principles of (6-35)

Scintillation probe
G-M probes

104. When are green and red G-M probes used? (6-35)

105. Briefly describe how dry well data is obtained. (6-35, 36)

106. Explain when a neutron probe is used. (6-41)

107. Does the neutron source require special handling? (6-41, 42) Explain your answer.

108. List those tanks having internal dry wells.
What is this prototype neutron probe trying to detect? (6-42)

109. How many laterals monitor each tank? (6-42)

110. What is the purpose of a lateral source check? (6-45)

111. When lateral monitoring curves are compared to baseline curves, what are the deviations of interest? (6-49)

112. What is CASS? (6-51)

113. Name the four types of instruments in place in the tank farms that CASS monitors. (6-51)

114. What is the role of the operator on in-tank photo missions? (6-56)

115. What role does Remote Imagery serve in the overall leak detection process? (6-56)

116. Under which conditions should the filling of a waste packaging container be discontinued? (6-60)

117. What is an ORSR? When are you required to use one? (6-61)

118. What are some of the safework practices to remember when packaging radioactive waste? (6-60, 61)

SIX MONTH PROGRESSION EXAM STUDY QUESTIONS

1. Briefly describe the events(s) and reason(s) for the creation of the Tank Farm Surveillance Group? (1-1)

2. What is the primary function of the TFS Analysis Unit? (1-1)

3. According to the TFS Charter, what are the two (2) primary responsibilities of Tank Farm Surveillance? (1-2, 5)

4. Waste tank storage capacities range from _____gallons to _____gallons. (1-2)

5. To date, how many tanks have been designated as confirmed leakers? (1-3)

6. What are the two initial steps to be taken upon observing an emergency situation? (2-1)

7. Name several ways to initiate an emergency alarm. (2-8)

8. Describe the emergency signal and action to be taken during the following emergency conditions: (2-10)

   - Criticality
   - Fire
   - Airborne contamination
   - Evacuation and attention

9. What is the Rockwell emergency phone number? (2-15)

10. Does a possibility of a criticality emergency exist in the tank farms? (2-38)

11. If you encounter a fire in the tank farm, what are your responsibilities? (2-39, 40)

12. If the fire is in a radiation zone, the minimum respiratory protection required is_____? (2-40)

13. Under which condition(s) are nuclear criticality considerations involved in TFS plant operations. (3-1)

14. What is airborne radioactivity? (3-7)

15. When air concentrations for fission products exceed 2 X 10-8 uci/cc what type of respiratory equipment must be worn? (3-9)

16. What action do you take if you can not obtain a proper mast seal and are scheduled to enter a controlled area? (3-9)

17. Why must surface contamination be controlled? (3-11)

18. Can you smoke or drink in a contaminated area? (3-12)
    Within a surface contamination area? (3-12)

19. Name two areas where SWP clothing cannot be worn. (3-13)

20. The most important aspect of contamination control is_____
    _____. (3-13)

21. In all cases of personnel contamination, who should be notified immediately? (3-13)

22. Briefly describe the regulations regarding personal property in radiation zones. (Gen-0, p. 7)

23. What actions are required if you suffer a cut or injure yourself while in a radiation zone? (Gen-0 p. 8 to 10)

24. Describe the proper method for wearing your multipurpose dosimeter (Gen-0, p. 13)

25. What are the doserate limits for hand tools used routinely in radiation zone work? (Gen-0, p. 18)

26. Define self-monitoring. (Gen-0, p. 19)

27. Name the four conditions required before an individual can perform self-monitoring. (Gen-0, p. 20)

28. At what levels of smearable contamination are you required to change (or remove) your SWP's for a clean pair? (Gen-0, p. 25)

29. Can SWP's be reused? If so, under what conditions? (Gen-0, p. 25)

30. Can private or non-regulated vehicles be used to transport radioactive material? (Gen-0, p. 32)

31. In which of the TFS plant jobs must you be aware of potential neutron dose rates and potential alpha contamination? (RWP, -F-14, 3-56)

32. Should you undertake to perform a job which you do not understand or for which you're not trained or qualified? (4-3)

33. What is the emergency medical aid number? (4-11)

34. Briefly describe how mouth-to-mouth resuscitation is given. (4-12)

35. What is the proper method one should use to control severe bleeding? (4-13)

36. Name the three elements that need to be present in order to have and sustain a fire. (4-28)

37. Explain the importance good housekeeping plays in fire prevention. (4-21, 22)

38. Define the terms flammable liquid and flash points. Give three examples of flammable liquids. (4-22)

39. What are the two conditions necessary for spontaneous ignition to occur. (4-25)

40. What type of material constitutes a Class A fire? What kind of fire extinguisher should be used on these fires? (4-26, 29)

41. You should use CO_2 and dry chemical fire extinguishers on which classes of fires? (4-26, 27, 30)

42. What type of fire is a Class D fire? How are these fires extinguished? (4-27, 30)

43. Name two (2) TFS jobs in which the operator must be aware of potential electrical hazards. (4-35, 36)

44. Explain the purpose of the "challenge system." (5-7)

45. List four (4) types of prohibited articles. (5-7)

46. Name four (4) types of security infractions. (5-9, 10)

47. Are special nuclear materials or classified information normally handled by TFS personnel?

48. Which farms are comprised exclusively of double-shell tanks? (6-4)

49. What is an FIC? How are "field" FIC liquid levels obtained? (6-12, 13)

50. The zero position on a liquid level electrode tape represents the _____ (6-17)

51. Explain how manual liquid levels are obtained. (6-17 to 21)

52. What is the purpose of swab riser monitoring? (6-21)

53. What changes in previous swab riser readings require an immediate repeat of the sampling procedure. (6-21)

54. Name the three surface ponds designated for low level effluent discharge. (6-29)

55. What data (information) is sought inpond monitoring? (6-29)

56. What is a dry well? How are dry wells identified? (6-33)

57. Why does the neutron source require special handling? (6-41, 42) Explain your answer.

58. Under which conditions should the filling of a waste packaging container be discontinued? (6-60)

59. What are some of the safework practices to remember when packaging radioactive waste? (6-60, 61)

EIGHTEEN (18) MONTH PROGRESSION EXAM STUDY QUESTIONS

1. Briefly describe the event(s) and reason(s) for the creation of the Tank Farm Surveillance Group? (1-1)

2. What is the primary function of the TFS Analysis Unit? (1-1)

3. According to the TFS Charter, what are the two (2) primary responsibilities of Tank Farm Surveillance? (1-2 and 5)

4. Waste tank storage capacities range from_____gallons to _____gallons. (1-2)

5. Briefly describe the basic design concept of the first twelve (12) tank farms. (1-3)

6. To date, how many tanks have been designated as confirmed leakers? (1-3)

7. What are the advantages of the double-shell tank design over the single shell design? (1-3)

8. Name the four basic chemical processing operations that were the source of the radioactive waste solutions. (1-3)

9. What two elements were these four chemical processing operations attempting to recover? (1-3)

10. Name the three most essential ingredients in effectively combating an emergency.

11. What are the two initial steps to be taken upon observing an emergency situation? (2-1)

12. Each employee has emergency-related responsibilities that help ensure his own safety and that of fellow employees. List three things you should do if discovering the emergency. (2-6)

13. Name several ways to initiate an emergency alarm. (2-8)

14. Name five types of group 1 emergencies. (2-8)

15. Name three types of group 2 emergencies. (2-8)

16. Describe the emergency signal and action to be taken during the following emergency conditions: (2-10)

    - Criticality
    - Fire
    - Airborne contamination
    - Evacuation and attention

17. What is the Rockwell emergency phone number? (2-15)

18. Describe what actions you should take upon receiving a bomb threat. (2-34)

19. Does a possibility of a criticality emergency exist in the tank farms? (2-38)

20. If you encounter a fire in the tank farm, what are your responsibilities? (2-39, 40)

21. If the fire is in a radiation zone, the minimum respiratory protection required is_____? (2-40)

22. Under which condition(s) are nuclear criticality considerations involved in TFS plant operations. (3-1)

23. In which Rockwell Hanford Plant do we find fissile material handled and stored? (3-1)

24. What is airborne radioactivity? (3-7)

25. Why must airborne radioactivity be controlled? (3-7) Name some of the methods available to minimize airborne radioactivity. (3-7)

26. When must fresh-air respirators be worn? (3-8, 9)

27. What is a CAM? What is your response if you're in a facility and one alarms? (3-10, 11)

28. What action do you take if you can not obtain a proper mask seal and are scheduled to enter a controlled area? (3-10)

29. Why must surface contamination be controlled? (3-11)

30. Name three (3) ways radioactive material can be taken into the body. (3-11)

31. Can you smoke or drink in a contaminated area? Within a surface contamination area? (3-12)

32. Name two areas where SWP clothing cannot be worn. (3-13)

33. The most important aspect of contamination control is _____(3-13)

34. If you are trained in self-survey, can you survey and release other personnel? (3-13)

35. In all cases of personnel contamination, who should be notified immediately? (3-13)

36. Explain the difference between a radiation area and a high radiation area. (Gen-0, p. 2, 3)

37. Briefly describe the regulations regarding personal property in radiation zones. (Gen-0, p. 7)

38. What actions are required if you suffer a cut or injure yourself while in a radiation zone? (Gen-0, p. 17)

39. Describe the proper method for wearing your multi-purpose dosimeter. (Gen-0, p. 13)

40. Generally speaking, which type(s) of radiological conditions require a greenhouse? (Gen-0, p. 17)

41. What are the doserate limits for hand tools used routinely in radiation zone work? (Gen-0, p. 18)

42. At what levels of smearable contamination are you required to change (or remove) your SWP's for a clean pair? (Gen-0, p. 25)

43. Define self-monitoring. (Gen-0, p. 19)

44. Name the four conditions required before an individual can perform self-monitoring. (Gen-0, p. 20)

45. Can SWP's be reused? If so, under what conditions? (Gen-0, p. 25)

46. Your SWP's are contaminated to levels of 50 mrad/hr (B-G), what should you do with them? (Gen-0 p. 25)

47. What are the contamination limits for regulated SWP jackets? Where should they be stored? (Gen-0, p. 27).

48. Can private or non-regulated vehicles be used to transport radioactive material? (Gen-0, p. 32)

49. Is alpha contamination possible in tank farm work? (RWP's)

50. In which of the TFS plant jobs must you be aware of potential neutron dose rates and potential alpha contamination? (RWP, -F-14, 3-56)

51. Should you undertake to perform a job which you do not understand or for which you're not trained or qualified? (4-3)

52. Briefly explain the following: (4-8)

    - Master Safety Rules
    - Job Site Safety Rules
    - General Plant Rules
    - Specific Job Rules.

53. Is there a Safety Section in all approved SOP's? (4-9, 10)

54. What is the emergency medical aid number? (4-11)

55. Briefly describe how mouth-to-mouth resuscitation is given. (4-12)

56. What is the proper method one should use to control severe bleeding? (4-13)

57. Explain the term "housekeeping." Why is it an important part of Industrial Safety? (4-14, 15)

58. Name the three elements that need to be present in order to have and sustain a fire. (4-20)

59. Explain the importance good housekeeping plays in fire prevention. (4-21), 22)

60. Define the terms flammable liquid and flash points. Give three examples of flammable liquids. (4-22)

61. What are the two conditions necessary for spontaneous ignition to occur. (4-25)

62. What type of material constitutes a Class A fire? What kind of fire extinguisher should be used on these fires? (4-26, 29)

63. You should use CO_2 and dry chemical fire extinguishers on which classes of fires? (4-26, 27, 30)

64. What type of fire is a Class D fire? How are these fires extinguished? (4-27, 30)

65. Name two (2) TFS jobs in which the operator must be aware of potential electrical hazards. (4-35, 36)

66. A "Q" clearance entitles an employee access to what type of information and security areas. (5-2, 4)

67. Explain the purpose of the "challenge system." (5-7)

68. List four (4) types of prohibited articles. (5-7)

69. Name four (4) types of security infractions. (5-9, 10)

70. Are special nuclear materials or classified information normally handled by TFS personnel?

71. Which farms are comprised exclusively of double-shell tanks? (6-3)

72. What was the original purpose of arranging tanks in cascades of three, four or six tanks? (6-4)

73. During the period of transfer,_____is constantly monitored for leaks. (6-6)

74. A, AX, AY, and AZ tank farms store waste from which two process buildings? (6-6)

75. What are the two (2) general characteristics associated with the waste tank farms that simplify the job of monitoring liquid levels? (6-11)

76. What is an FIC? How are "field" FIC liquid levels obtained? (6-12, 13)

77. The zero position on a liquid level electrode tape represents the _____(6-17)

78. Explain how manual liquid levels are obtained. (6-17 to 21)

79. A salt "icicle" on a liquid level electrode will indicate a _____liquid level. (6-20)

80. What complication(s) can floating crust cause to liquid level measurements? (6-20)

81. What type(s) of problem(s) does dry sludge cause when attempting liquid level measurements. (6-20)

82. What is the purpose of swab riser monitoring? (6-21)

83. What changes in previous swab riser reading require an immediate repeat of the sampling procedure. (6-21)

84. How often do TFS personnel monitor leak pits and annulus leak detection systems? (6-23)

85. What is the primary method of leak detection employed in the double-shell tanks? Explain how this system works. (6-24, 25)

86. Name the three surface ponds designated for low level effluent discharge. (6-29)

87. What data (information) is sought in pond monitoring? (6-29)

88. In Hanford soils, what is liquid spillage expected to do? (6-33)

89. What is a dry well? How are dry wells identified? (6-33)

INFORMATION RELEASE REQUEST

References: WHC-CM-3-4

COMPLETE FOR ALL TYPES OF RELEASE

Purpose

[] Speech or Presentation
- [] Full Paper
- [] Summary
- [] Abstract
- [] Visual Aid

(Check only one suffix)

[] Speakers Bureau
[] Poster Session
[] Videotape

[] Reference
[] Technical Report
[] Thesis or Dissertation
[X] Manual
[] Brochure/Flier
[] Software/Database
[] Controlled Database
[] Other

New ID Number

Existing ID Number (include revision, volume, etc.)
RHO-MA-230

If previously cleared, list ID number
Not Applicable

Date Release Required
March 23, 1992

Title
Tank Farm Surveillance Operations Training Manual
Production Operations

Unclassified Category
UC-

Impact Level 4

COMPLETE FOR SPEECH OR PRESENTATION

Title of Journal
Not Applicable

Group or Society Sponsoring
Not Applicable

Date(s) of Conference or Meeting
Not Applicable

City/State
Not Applicable

Will proceedings be published? [] Yes [] No
Will material be handed out? [] Yes [] No

Title of Conference or Meeting
Not Applicable

CHECKLIST FOR SIGNATORIES

Review Required per WHC-CM-3-4	Yes	No	Reviewer Name (printed)	Signature	Date
Classification/Unclassified Controlled Nuclear Information	[X]	[]	J.D. ORTON		3/18/92
Patent - General Counsel	[✓]	[✓]	SW Berglin		3/19/92
Legal - General Counsel	[X]	[]	Stanley Berglin		3/19/92
Applied Technology/Export Controlled Information or International Program	[]	[X]			
WHC Program	[X]	[]	~~Carol Geier~~ G.T. BERLIN		3/30/92
Communications	[]	[X]			
DOE-RL Program	[X]	[]	Steven D. Stites SDS		3/31/92
Publication Services	[]	[X]			
Other Program	[]	[X]			
References Available to Intended Audience	[]	[X]	NOTE: Historical document (not used)		
Transmit to DOE-HQ/Office of Scientific and Technical Information	[]	[X]			

Information conforms to all applicable requirements. The above information is certified to be correct.

Author/Requestor (Printed/Signature) Date
Melinda J. Brown March 16, 1992

Responsible Manager (Printed/Signature) Date
Bradley G. Erlandson March 16, 1992

Intended Audience

INFORMATION RELEASE ADMINISTRATION APPROVAL STAMP

Stamp is required before release. Release is contingent upon resolution of mandatory comments.

INFORMATION

APPROVED FOR RELEASE
OFFICIAL DOCUMENT
CW
Date 4-1-92

RHO-MA-230

[] Internal [] Sponsor [X] External Date Received 3-17-92

CHECKLIST FOR INFORMATION RELEASE REQUEST SIGNATORIES

This checklist provides the responsibilities of each reviewer. It is meant to be used as a checklist and requires no signatures. The list is not all-inclusive but covers the key areas needing review. Areas needing further review or other areas needing review should be indicated under comments.

AUTHOR/REQUESTOR

- [X] The project or program manager concurs with the issuance of this report.
- [] The reference citations are necessary, correct and appropriate for the intended audience and will be publicly available at the time the document is published.
- [] If a journal article, the reference style agrees with guidance from the client or journal publisher.
- [] Contributions from authors of other organizations indicated in the comment section of this form.
- [] The document is responsive to the client's scope of work.
- [X] The client approved this for release.
- [] The document reports or reflects quality technical work.
- [] The scientific methodology used is logical and reasonable.
- [] The inferences and conclusions are soundly based.

RESPONSIBLE MANAGER

Indicated at the bottom of the comment section of this form that General Counsel's office should review this document with particular attention to:

- [] an invention (reported or unreported)
- [] new software developed at WHC
- [] sensitive subject matter (policies, issues, concerns)
- [] copyrighted information
- [] trademark information
- [] proprietary information.

If the funding for the program represented by the document is from the Assistant Secretary for Nuclear Energy (NE), and public clearance or limited clearance for foreign exchange (sponsor-limited) is requested, the following information is required:

- [] Information generation dates
- [] Prior dissemination to DOE contractors
- [] Prior dissemination under international agreements
- [] Substantive value for international exchange
- [] Justification for release of information.

AUTHORIZED DERIVATIVE CLASSIFIER

Document reviewed for (and indicated on the front of the form) the presence of the following:

- [] Classified information
- [] Unclassified Controlled Nuclear Information (UCNI)
- [X] Unclassified Information.

JSEllerton

GENERAL COUNSEL REVIEWER

Document reviewed for (and indicated on the front of the form) the presence of the following:

- [] previously reported or as yet unreported patentable subject matter
- [] copyrighted material
- [] trademarks
- [] proprietary information
- [] product comparisons
- [] inventions
- [] new software developments
- [] Technical information meets environmental compliance.

COMMUNICATIONS DEPARTMENT REVIEWER

- [] This document contains no unresolved company policy issue.
- [] WHC logotype is used correctly.

WHC AND DOE TECHNICAL PROGRAM REVIEWER

Document reviewed for (and indicated on the front of the form) the presence of the following:

- [] Applied Technology Information
- [] Limited Disclosure Information (foreign exchange)
- [] Distribution list discussed with the client
- [] Others who should review this document before release indicated in the comment section of this form.

PUBLICATIONS SERVICES REVIEWER

- [] The structure of the document is appropriate for the subject matter.
- [] The overall format is appropriate for the client.
- [] Basic editorial concerns are addressed.
- [] Nomenclature and symbols used are consistent with accepted standards.

INFORMATION RELEASE ADMINISTRATION

- [] All reviews are complete and this publication or presentation is approved for release (after resolution of mandatory comments).

RHO-MA-230
ID Number

Lead Author	Phone	MSIN	Other Author(s) or Requestor
	2-0409	B2-19	Melinda J. Brown
Project or Program	**Lead Org Code**		**Sponsor Agency (DOE, DOT, NRC, USGS, etc.)**
Environmental Division	81140		DOE
Editor	**Phone**	**MSIN**	**DOE/HQ Program (DP, EH, EM, NE, etc.)**
None			EM

Mandatory Comments*	Reviewer Name & Signature	Date	Resolution	Date
Remarks:				
Information Requested				
by the WDOH				
NOTE: HISTORICAL DOCUMENT NO LONGER IN USE AT TANK FARMS				

*Only mandatory comments are to be documented. All other comments should be made on a copy of the information submitted for review and returned to the author.

Legends/Notices/Markings

	Affix Yes	Affix No	Remove Yes	Remove No
Applied Technology	[ ]	[ ]	[ ]	[ ]
Business-Sensitive Information	[ ]	[ ]	[ ]	[ ]
Computer Software Notice	[ ]	[ ]	[ ]	[ ]
Copyright License Notice	[ ]	[ ]	[ ]	[ ]
Export Controlled Information	[ ]	[ ]	[ ]	[ ]
Legal Disclaimer	~~[ ]~~	[ ]	[ ]	~~[ ]~~
Limited Disclosure	[ ]	[ ]	[ ]	[ ]
Patent Status	[ ]	[ ]	[ ]	[ ]
Predecisional Information	[ ]	[ ]	[ ]	[ ]

	Affix Yes	Affix No	Remove Yes	Remove No
Programmatic Notice	[ ]	[ ]	[ ]	[ ]
Proprietary Information	[ ]	[ ]	[ ]	[ ]
Purpose and Use	[ ]	[ ]	[ ]	[ ]
Thesis/Dissertation	[ ]	[ ]	[ ]	[ ]
Trademark Disclaimer	[ ]	[ ]	[ ]	[ ]
Unclassified Controlled Nuclear Information/Official Use Only	[ ]	[ ]	[ ]	[ ]

N/A
Responsible Manager (Printed/Signature)