This ECN releasing HNF-SD-W026-OTR-003, Rev. 1, voids and superseded revision 0 in its entirety.

14. Justification (mark one) 14b. Justification Details
Criteria Change ☐
Design Improvement ☐ This document is being revised to provide all documentation to support
Environmental ☐ the Drum Non-Destructive Examination System Operational Test Report.
Facility Deactivation ☐ USQ No:  WRP-99-112
As-Found ☐
Facilitate Const. ☐
Const. Error/Omission ☐
Design Error/Omission ☐

15. Distribution (include name, MSIN, and no. of copies)
See attached distribution sheet
## ENGINEERING CHANGE NOTICE

**ECN-651719**

### 16. Design Verification
- **Required:**
  - Yes
  - No

### 17. Cost Impact
- **Engineering**
  - Additional: $ N/A
  - Savings: $ N/A
- **Construction**
  - Additional: $ N/A
  - Savings: $ N/A

### 18. Schedule Impact (days)
- Improvement: N/A
- Delay: N/A

### 19. Change Impact Review
- Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

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<td>Stress/Design Report</td>
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### 20. Other Affected Documents
- **Note:** Documents listed below will not be revised by this ECN. Signatures below indicate that the signing organization has been notified of other affected documents listed below.

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**DEPARTMENT OF ENERGY**

Signature or a Control Number that tracks the Approval Signature

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**ADDITIONAL**

---
WRAP OPERATIONAL TEST REPORT
DRUM NON-DESTRUCTIVE EXAMINATION SYSTEM

KL Humphrys
Waste Management Federal Services of Hanford, Inc., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-96RL13200

EDT/ECN: ECN-651719 UC: 506
Org Code: 32600 Charge Code: AJ60
B&R Code: EW02J126 Total Pages: 63

Key Words: OTR, NDE, X-Ray, DNS

Abstract: This operational test report was performed to verify the WRAP Facility Drum Non-Destructive Examination systems operate in accordance with the system designs and specifications.

* Philips 450 KV X-Ray Machine is a registered trademark of Philips' Gloeilampenfabrieken, (Netherlands)
* PLC is a registered trademark of Allen Bradley Company, Milwaukee, WI.

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Approved for Public Release

A-6400-073 (01/97) GEF321
**Title:** Drum Non-Destructive Examination System Operational Test Report

**Change Control Record**

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The Drum Non-Destructive (NDE) System was operationally tested including the interfaces with the Plant Control System (PCS) and the Data Management System (DMS) computers on August 5, 1996. The Drum NDE system performed adequately. There were no test exceptions. The Drum NDE System was shown to satisfactorily receive drums from the Automated Guided Vehicle (AGV), x-ray drums, display x-ray images of the drums using both the real-time radiography and the linear diode array image chains, store x-ray images to both optical disks and video tapes, and discharge the drums to the AGV. The PCS was shown to close and open the vault doors. The DMS was shown to allow the radiographers to record the x-ray image storage locations as well as pertinent x-ray information. It is recommended that the DMS data fields be modified to accept time format used on video cassette recorders (i.e. 0:03.39). It is also recommended that the local controls for the NDE vaults be relocated outside the vaults. Climbing over the conveyors and lift table to gain access to the local controls is not safe.

The Drum NDE System was also operationally tested July 16 - 17, 1996, without the DMS computer. It is possible that the data recording function normally performed by the DMS could be accomplished “manually” using logbooks.

The Drum NDE System is not designed to be operated without the PCS, however. Modifications to the system need to be implemented if it is required that the Drum NDE System be run without the PCS. The interface with the AGV and the conveyors would have to be reworked so that the Operator would not have to enter the NDE vaults to load and unload the drums.

Cognizant Engineer: [Signature]
Date: 9/27/96

Lead Start-up Engineer: [Signature]
Date: 3/9/96

Engineering Manager: [Signature]
Date: 9/30/96
# WESTINGHOUSE HANFORD COMPANY

Project W-026, WRAP 1
Operational Test Report - Drum Non-Destructive Examination System

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<td>OPERATION OF THE DRUM NONDESTRUCTIVE EXAMINATION SYSTEM, REV. A-0, 8/22/96</td>
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1 INTRODUCTION

The Waste Receiving and Packaging Facility, Module 1 (WRAP 1), employs a Drum Non-Destructive Examination (NDE) System for imaging the contents of 55 gallon and 85 gallon radioactive waste drums. This Drum NDE System was designed and constructed by V.J. Technologies.

The Drum NDE System was operationally tested July 16 - 17, 1996, without access to the Data Management System (DMS) computer and again on August 5, 1996, with the DMS computer. The first test was considered the "manual mode." The second was considered the "automatic mode." At all times the Drum NDE System functioned adequately.

The Test Director was Kathryn L. Humphrys, WHC WRAP 1 Engineering. The Drum NDE System was operated by Daniel A. Veselitza, V.J. Technologies, Inc. The tests were witnessed by John Keve, WHC Radiographer, Doug Dunlap, WHC Start-up Engineering, and Keith Ealden, WHC Start-up Engineering.

2 DESCRIPTION OF TEST, TEST METHOD AND TEST EQUIPMENT

Test drums containing a lines paired per millimeter gage and a #7 American Society of Mechanical Engineers penetrameter were used to "cold run" the Drum NDE System. The gage and the penetrameter were used to test image quality and image resolution. The real-time x-ray images obtained from the image intensifier were recorded on video tape, recorded to optical disk, printed on the thermal paper, and these image locations were recorded on a DMS "NDE data record." The digital images obtained from the linear diode array were recorded to optical disk, printed on thermal paper, and these image locations were recorded on a DMS "NDE data record."

Drafts of Plant Operating Procedures, WRP1-OP-0904, "Operating and Emergency Procedure for the Philips 450 kV X-Ray Machine," and WRP1-OP-0908, "Operation of the Drum NDE System," were followed throughout the test and "redlined" where appropriate. These procedures were corrected and released as revision A-0. Copies of the released documents, dated August 22, 1996, are included in this report.

There were no test exceptions nor deficiencies.

3 TEST RESULTS

The Drum NDE System was proven to be adequate when the PCS is operational. The DMS was proven to be adequate for storing the location of x-ray images as well as pertinent x-ray information.
When the PCS is not available, the only way to control the Drum NDE System conveyors is to climb into the vault and retrieve the local control pendant from the Programmed Logic Controller (PLC) cabinet. There is an industrial safety concern when personnel must climb over conveyors to access equipment. If radioactive waste drums are in the vaults, there would also be a radiation exposure concern for personnel climbing into and out of the vaults. It is not safe.

4 CONCLUSION AND RECOMMENDATIONS

It was concluded that the Drum NDE System is operationally ready for service.

It is recommended that the local controls for the NDE vaults be relocated outside the vaults. Climbing over the conveyors and lift table to gain access to the local controls is not safe.

It is also recommended that the DMS data fields be modified to accept time format used on video cassette recorders (i.e. 0:03.39). As it is currently configured, the "video start" data field will not recognize leading zeros and will not recognize the colon nor the decimal characters.
WESTINGHOUSE HANFORD COMPANY
Project W-026, WRAP 1
Operational Test - Drum NDE System

"MANUAL" OPERATIONS
OPERATIONAL TEST 7/16/96 - 7/17/96

"AUTOMATIC" OPERATIONS
OPERATIONAL TEST 08/05/96

APPROVAL DESIGNATOR  ESQ  

PROCEDURE APPROVAL BY TEST REVIEW BOARD (TRB)

Kathryn L. Humphrys  7/16/96  Kathryn L. Humphrys  7/16/96
TRB Startup Chairman Date WRAP 1 Cog. Engineer Date

Jay O'Neill  7/16/96  Kevin T. Kelly  7/16/96
Start-Up Engineer Date WRAP 1 Industrial Safety Date

Lead Start-Up Engineer  7/16/96  O. F. Vance  7/16/96
Date WRAP 1 Quality Assurance Date

WRAP 1 Engineering Manager  7/16/96  WRAP 1 Operations Manager  7/16/96
Date Date
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ATTACHMENT 3.1 Operational Test Exception Log
ATTACHMENT 3.2 Test Exception Report
ATTACHMENT 3.3 Signature Record
ATTACHMENT 5.1 Drum NDE System Operational Test
ATTACHMENT 5.3 WRPI-OP-0908, "Operation of the Drum NDE System."
1.0 PURPOSE

This procedure has been prepared to verify that the Drum Nondestructive Examination (NDE) System operates in accordance with system design and specifications. Refer to the Project W-026 Construction Specification Section 13532 and Test Specification 13532.

2.0 INFORMATION

2.1 SCOPE

This procedure will demonstrate the operation of the Drum NDE System and its interface with the Data Management System (DMS) and Plant Control System (PCS) Computers.

2.2 TERMS AND DEFINITIONS

2.2.1 DMS - Data Management System
2.2.2 NDE - Nondestructive Examination
2.2.3 OT - Operational Test
2.2.4 PCS - Plant Control System
2.2.5 TD - Test Director
2.2.6 TE - Test Engineer
2.2.7 TRB - Test Review Board

2.3 RESPONSIBILITIES

2.3.1 Test Director (TD) responsibilities:

- Provides the support equipment necessary requested in Operational Test (OT) Sections 4.0 and 5.0.
- Records OT equipment status and data.
- Test scheduling/rescheduling as required.
- Recording Data Exceptions and support OT notes as required on the OT Test Exception Log (Attachment 3.1) and Test Exception Report (Attachment 3.2).
2.3.2 Test Engineer (TE) responsibilities:
- Providing technical support during testing.
- Providing programming support during testing.
- Conducts pre-job planning meetings - as necessary.
- Conducts pre-job system walkdown - as necessary.
- Verify power supply system functions correctly.

2.3.3 Maintenance Craft personnel responsibilities:
- Providing assistance during OT activities.

2.3.4 NDE Radiographer responsibilities:
- Performing manipulations on Systems and Test Equipment.
- Starting, stopping and operating equipment related to OT.
- Controlling and monitoring parameters from Control Panels and Control Room.
2.4 CHANGE CONTROL

Test procedure administrative or editorial changes required during testing may be accommodated as redline exceptions in the test report, if these changes do not affect operating facility function, performance or safety that could compromise or influence OT data results. The OT changes to acceptance criteria, requirement changes, or changes to Caution, Danger, Special Precautions - or any other safety items and environmental instructions in the OT shall be prepared as attached supporting documents, which must be revised using Engineering Change Notice Procedures or the Test Exceptions Log and Report (Attachments 3.1 and 3.2).

2.5 REFERENCES

2.5.1 HSRCM-1, Hanford Site Radiological Control Manual

2.5.2 Project W-026 Construction Specification Section 13532, "Drum Nondestructive Examination System"

2.5.3 Project W-026 Test Specification 13532, "Drum Nondestructive Examination System"

2.5.4 WRP1-OP-0904, "Operating and Emergency Procedures for the Philips 450 kV X-Ray Machine"

2.5.5 WRP1-OP-0908, "Operation of the Drum Nondestructive Examination System"

2.5.6 WHC-CM-5-36, Solid Waste Disposal Internal Requirements

2.6 SAFETY

The Drum NDE vaults are a restricted access area. The radiation level inside the vaults during NDE Operations is capable of causing death or serious injury.

The Drum NDE vaults are therefore monitored by in-vault television cameras. The vaults are posted inside with "Radiation Generating Device: High Intensity Radiation When Red Light Is On" signs. Personnel are not allowed inside the vaults during operations.
2.7 RADIATION/CONTAMINATION CONTROL

The Drum NDE vaults shield personnel from the radiation levels achieved within. The radiation levels 5 centimeters from any accessible point on the exterior of the vaults is less than 0.5 milliREM/hour.

The drums used in OT activities do not contain radioactive waste. No radioactive contamination concerns are expected during OT activities.

2.8 QUALITY ASSURANCE

No Quality Assurance witness, holdpoints or verifications are required in this OT procedure.

2.9 GENERAL INFORMATION

General Information pertaining to the WRAP 1 Drum NDE X-ray machine can be found in the WRP1-OP-0904, "Operating and Emergency Procedure for the Philips 450 kV X-Ray Machine." Attachment 5.2
2.10 LIMITS AND PRECAUTIONS

2.10.1 If during performance of this procedure, any of the following conditions are found, immediately notify the assigned TD and TE:

- Any equipment malfunction which could prevent fulfillment of its functional requirements.
- Personnel error or procedural inadequacy which could prevent fulfillment concerning OT procedural requirements.

Then the TD and TE shall stop work and place equipment in a safe condition. The decision to continue with unaffected portions of the OT will be based on the significance of the malfunction, error or inadequacy.

2.10.2 Contact TD and TE for additional instructions if changing plant conditions affect work or delays in work extending beyond the assigned work shift.

2.10.3 If any waste is generated during performance of this OT, consult Environmental Compliance Officer for specific instructions to ensure compliance with WHC and DOE environmental standards, as applicable, for correct disposal.

2.10.4 The TD has overall control concerning testing process and change record authorization for this OT. The TD is responsible for conducting the test, data collection, and ensuring compliance with all OT requirements.

2.10.5 All test data readings are to be taken and recorded for each location where the capability exists (i.e. Drum vault A and Drum vault B).

3.0 RECORDS

This Drum NDE System OT with all completed attachments will be filed as a permanent test record. Records are handled, stored and retained in accordance with the requirements listed in WHC-CM-5-36, Section 3-5, paragraph 9.0.
4.0 PREREQUISITES

NOTE: Prerequisite actions may be performed in any order.

4.1 Perform a pretest briefing for all testing personnel involved in performing the OT.

4.2 Perform a walkdown inspection of the Drum NDE System.

4.3 The official OT document and any other OT photocopies that will be used during testing have been verified to be the latest approved OT document revision.

4.4 The TE has determined appropriate interface support from other departments/organizations (Projects, ICF Kaiser Hanford Company - Construction Forces, etc.) and that the necessary support personnel/equipment is available.

4.5 Training and qualifications for personnel involved in the OT performance have been documented and reviewed.

4.6 All open Acceptance Test Procedure Exceptions, Field Test Procedure Exceptions, Engineering Change Notices and punchlist items have been evaluated and verified to not affect the OT performance.
4.7 All personnel who will be involved with this OT procedure have provided the required signature verification information on the Signature Record of Understanding OT Duties (attachment 3.3).

Test Director  ___________________________ Date 7/16/96

4.8 All equipment necessary to support this OT are available:

- Test Drums (two)
- Lines paired per millimeter gage
- Penetrameter, American Society of Mechanical Engineers #7

Test Director  ___________________________ Date 7/16/96

5.0 PROCEDURES

5.1 Drum NDE System testing activities shall be performed using Attachment 5.1, "Drum NDE System Operational Test."

5.2 X-ray Machine operating procedure activities shall be performed using Attachment 5.2, WRP1-OP-0904, "Operating and Emergency Procedure for the Philips 450 kV X-Ray Machine."

5.3 Drum NDE System operating procedure activities shall be performed using Attachment 5.3, WRP1-OP-0908, "Operation of the Drum NDE System.

6.0 ACCEPTANCE CRITERIA

The acceptance criteria is system performance within the stated design requirements. Refer to the Project W-026 Construction Specification Section 13532 and Test Specification 13532.
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**ATTACHMENT 3.3**

Signature Record

Drum Nondestructive Examination System Operational Test

**SIGNATURE RECORD:** By signing below, I attest that I am aware of and understand my duties and responsibilities as described in the OT and as assigned by the TS or TE.

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<td>TEST DIRECTOR, ENG. ENGINEER</td>
<td>WHC, WRAP 1 ENG.</td>
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<tr>
<td>DAV</td>
<td></td>
<td>DANIEL A. YESCITA</td>
<td>TEST ENGINEER, MAINTENANCE &amp; ELEC.</td>
<td>V.I. TECHNICAL INS.</td>
</tr>
<tr>
<td>JKK</td>
<td></td>
<td>JOHN K. KEVE</td>
<td>NDE Radiographer</td>
<td>WHC, NDE Radiographer</td>
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<tr>
<td>DL</td>
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ATTACHMENT 5.1

Drum Nondestructive Examination System Operational Test

1.0 INITIAL CONDITIONS

1.1 The PCS System is operational and can be accessed from both Drum NDE control consoles, for automatic operations.
1.2 The DMS is operational and can be accessed from both Drum NDE control consoles, for automatic operations.
1.3 Physical Composition Data has been input into the DMS for the two (2) NDE Test Drums, for automatic operations.
1.4 One of the two (2) NDE Test Drums has been loaded into the Drum NDE vault A and the other has been loaded into Drum NDE vault B.

Test Director: Date: 7/16/76

2.0 OPERATIONAL TEST

2.1 Start-up the PCS Terminal and the X-ray Machine using WRP1-OP-0904 (attachment 5.2) and WRP1-OP-0908 (attachment 5.3).

2.2 Perform the Daily Resolution Measurements using WRP1-OP-0908.

2.2.1 Verify that the Linear Diode Array resolution is acceptable.
2.2.2 Verify that the Real-Time Radiography resolution is acceptable.

2.4 Perform NDE Operations using WRP1-OP-0908.

2.4.1 Record x-ray images to optical disk and VCR tape for each of the two (2) NDE Test Drums.
2.4.2 Print x-ray images for each of the two (2) NDE Test Drums.

2.4.3 Record the NDE data for the two (2) NDE Test Drums into the DMS computer.

2.5 Shut-down the X-ray Machine and the PCS Terminal using WRP1-OP-0908 and WRP1-OP-0904.
ATTACHMENT 5.1

Drum Nondestructive Examination System Operational Test

2.6 Start-up the PCS Terminal and retrieve the DMS data for each of the two (2) NDE Test Drums.

2.6.1 View the x-ray images stored on optical disk.

2.6.2 View the x-ray images stored on VCR tape.

2.6.3 Print x-ray images for each of the two (2) NDE Test Drums.

Test Director: [Signature] Date: 07/16/96
S/U Signature: [Signature] Date: 07/16/96
COG Signature: [Signature] Date: 07/16/96

3.0 The Drum NDE OT is considered closed.

S/U Signature: [Signature] Date: 07/16/96
COG Signature: [Signature] Date: 08/05/96

THE DMS WAS NOT AVAILABLE ON 7/16/96 - 7/17/96 WHEN THE "MANUAL MODE" OF THIS OTP WAS PERFORMED. THE DMS WAS OPERATIONAL ON 8/5/96 WHEN THE "AUTOMATIC MODE" WAS PERFORMED.

[Signature] 8/5/96
WRAP 1 PLANT OPERATING PROCEDURE

SYSTEM: NDE-NDA

OPERATING AND EMERGENCY PROCEDURE FOR THE PHILIPS 450 kV X-RAY MACHINE

ALL CHANGES MARKED ON THIS PROCEDURE WERE ENTERED IN 1996 DURING THE PERFORMANCE OF THE OPERATING TEST. THESE CHANGES WERE INITIATED AND DATED IN 1997 TO MEET PUBLISHING STANDARDS.

I. SYSTEM DESCRIPTION

The Drum and Box NDE systems use penetrating radiation (X-rays) to examine the contents of waste drums and boxes. Three Philips 450 kV industrial x-ray machines are employed. One in each of the two Drum NDE systems and one in the Box NDE system. Each Philips 450 kV industrial X-ray machine consists of a control console, a 450 kV dual focus (1.0 mm and 4.5 mm) X-ray tube, two gas filled high voltage generators (transformers), and oil-to-air cooler.

Each x-ray system is housed in a shielded vault with integral safety interlocks for the protection of personnel. Each fail-safe interlock system consists of the following:

1. The vault door is interlocked with the X-ray control console's safety circuit and also with the X-ray generators primary current circuit to prevent X-ray production when the door is not closed or when the door is opened during irradiation.

2. When the X-ray machine is energized there is a 20-second delay before the production of X-rays. This delay is called the pre-warning time.

3. During the pre-warning time, yellow lights are activated inside of the vault and on opposite corners of the roof outside of the vault.

4. During the pre-warning time an audible alarm inside of the vault will be activated.

5. A flashing red light is activated inside of the vault during irradiation. As well as flashing red lights on opposite corners of the roof outside of vault.

6. A steady state "X-RAY ON" lighted sign is located at the entrance to the vault.

7. The interlock fail-safe system will prevent X-rays from being produced by the X-ray machine if any of the above lights are burned out. The flashing red light inside the vault, and/or the blinking X-ray indicator light located on the X-ray console are burned out.

8. An emergency crash button is located inside of the vault which will disable the X-ray machine at anytime.

9. A vault door opening switch is located inside of the vault.
II. REFERENCE DOCUMENTS

HSRCM-1, Hanford Site Radiological Control Manual
WHC-CM-5-34, Solid Waste Disposal Operations Administration
WHC-CM-5-36, SWD Internal Requirements
WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria
WHC-CM-4-39, Qualification and Certification of Nondestructive Examination Personnel
WHC-IP-1242, WRAP 1 RGD Radiation Protection Program

III. PRESTART CONDITIONS

Personnel performing this procedure shall be qualified and certified in accordance with WHC-CM-5-34, Section 1.8, "Training Plan", WHC-CM-4-39, Qualification and Certification of Nondestructive Examination Personnel, WHC-IP-1242, WRAP 1 RGD Radiation Protection Program, and on-the-job training.

It is also important the X-ray equipment be operated in accordance with established ALARA principles and practices.

IV. SAFETY

Although the Duty Operations Supervisor (DOS) has the primary responsibility for the safety of the WRAP 1 Facility, the radiographer has the responsibility to ensure the safety of personnel associated with Radiation Generating Device (RGD) operation. Only personnel who have a valid RGD certification and a current RGD performance appraisal are allowed to independently operate the RGD. In order to gain the experience necessary to become a qualified RGD operator, trainees may operate the RGD under the direct supervision of a certified RGD operator.

The drum and box X-ray vaults are a restricted access area. The drum vaults are monitored by in-vault television cameras, while the box vaults has a closed circuit television (CCTV) at the entrance to the vault. The vaults are posted inside with "Radiation Generating Device: High Intensity Radiation When Red Light Is On" signs.

When access to the vault interior is necessary the vault electrical system shall be "Locked and Tagged" out-of-service. The DOS shall also control the X-ray machine and console keys.
V. TOOLS AND SUPPLIES

None

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<th>Description</th>
<th>PAGE</th>
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<tbody>
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<td>B.</td>
<td>MANUAL OPERATION</td>
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<td>C.</td>
<td>EMERGENCY RESPONSE</td>
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<td>RECORD 3.</td>
<td>3-MONTH RGD INSPECTION/MAINTENANCE PROGRAM</td>
<td>12</td>
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</table>
VII. PROCEDURE

NOTE 1 - Automatic actions conducted by the Plant Control System are indicated by (PCS) in the far left column.

NOTE 2 - Administrative hold steps are identified by letters in parentheses at the left margin of the procedure step. The direction given in the procedure step must be satisfied before work continues.

(M) - Operations management shall approve continued operation

(R) - Radiological Control (RC) shall complete surveys or agree to permit continued operation.

A. WARMUP

1. FILL OUT the RGD Operational/Daily Log (Record 1). If the RGD operator encounters any safety related operational or interlock problems the RGD shall not be operated. The DOS, NDE Radiation Safety Officer, and the Manager of Nondestructive Examination (RGD Manager) shall be immediately notified.

2. FILL OUT the RGD Maintenance Log, if appropriate (Record 2).

3. VERIFY the 3-month equipment inspection has been completed within the past three months. (Record 3).

4. VERIFY the 6-month interlock and radiation survey is current and located at the appropriate X-ray console.

5. REQUEST, if required, from the DOS to have someone energize the main electrical power at panel PPO9-101 breaker; #13 for drum system A, #19 for drum system B, and #14 for the box system.

6. ENERGIZE the NDE control room console with the main control panel key switch.

NOTE - An emergency stop button is also located on this panel.

7. CLOSE the X-ray tube shutters and the image intensifier (II) shutters to protect the II and linear diode array from receiving unnecessary radiation. As the X-ray intensity increases, watch the II television monitor for signs of unnecessary radiation exposure.

8. VERIFY the X-ray vault is not occupied by using the appropriate CCTV.
9. **ACTIVATE** the mains switch on the control panel by turning the key to the right to the vertical position "-".

**NOTE** - The vertical key position is a "standby" position that allows tube cooling and removal of the key. The white mains lamp will illuminate, and the kV, mA, and time indicator lights will indicate "0000".

10. **SET** the mains switch to the high voltage position by turning the key to the right to the horizontal position.

Select the appropriate warm-up program from the following table and enter it by using the key pad.

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<tr>
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<td>3 - 14 Days</td>
<td>102</td>
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<tr>
<td>More than 14 days or new tubes</td>
<td>103</td>
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11. **VERIFY** the X-ray vault door is in the closed position and all safety interlocks are satisfied by observing the green interlock light on the X-ray control console.

12. **ENERGIZE** the high voltage by depressing the black "ON" button.

This will start the 20-second pre-warning time. During the pre-warning time flashing yellow lights inside of the vault and on the vault's roof will activate. An audible alarm inside the vault will also sound during the 20-second pre-warning time. The blue pre-warning lamp on the X-ray control panel will illuminate at seventeen seconds into the 20-second pre-warning time. On completion of the pre-warning time; the X-ray high voltage will be energized, the blue pre-warning lamp will extinguish, and the audible alarm will silence, at which time the flashing red warning lamp on the X-ray console will start flashing along with the red lights mounted inside the vault and on the vault's roof. **Exterior "X-Ray" on light will also illuminate**.
UPON COMPLETION of the warm-up cycle the high voltage is switched off automatically and the keypad indicator will be "000".

The X-ray system is now ready for normal manual operation.

B. MANUAL OPERATION

1. SET the keypad indicator to the manual mode by entering "000" on the keypad.

2. SELECT the desired kV, mA, time (normally set to infinity), and focal spot size prior to energizing the X-ray machine's high voltage.

3. VERIFY the X-ray vault is not occupied by using the appropriate CCTV.

4. VERIFY the X-ray vault door is in the closed position and all safety interlocks are satisfied by observing the green interlock light on the X-ray control console.

5. OPERATE THE SYSTEM TO EXAMINE ITEMS AS REQUIRED.

   ENERGIZE the X-ray machine by depressing the high voltage "ON" button (black button). The X-ray machine will energize after a 20-second pre-warning to the values set in step 2.

6. DE-ENERGIZE the X-ray machine by depressing the high voltage "OFF" button (red button) on the X-ray control console.

CAUTION

NEVER USE THE MAIN CONTROL PANEL KEY SWITCH OR THE X-RAY "MAINS" SWITCH TO STOP THE EXPOSURE. USE THE HIGH VOLTAGE "OFF" BUTTON (RED BUTTON) ON THE X-RAY CONTROL CONSOLE. AFTER EACH EXPOSURE, THE RED WARNING LIGHTS WILL EXTINGUISH.

C. SHUTDOWN

LEAVE the X-ray control key in the vertical or horizontal position for 3 to 5 minutes after the last exposure to ensure adequate X-ray tube head cooling before turning the X-ray mains switch to the "OFF" position.

COMPLETE the RGD Operational/Daily Log. (Record 1.)
EMERGENCY RESPONSE

This establishes the response to emergency situations which could occur during RGD operations at the WRAP 1 Facility.

For the WRAP 1 RGD's an emergency situation is one where there is a loss of control over the RGD, or an actual or suspected radiation overexposure to personnel. Because it is impossible to foresee all potential accident scenarios, it is imperative that if an emergency situation arises that not only is this procedure followed, but that common sense and good judgement be exercised.

The radiographer has the necessary training and experience to recognize when an emergency situations exists and it is the radiographer's responsibility to ensure the safety of all personnel. It is also important that the radiographer recognize that an emergency situation exists before any personnel overexposures occur. Once an emergency condition is identified the DOS will be immediately notified by the radiographer.

1. SAFETY INTERLOCK FAILURE

A safety interlock failure is not an emergency situation if it is discovered prior to RGD operation. However, the RGD shall not be operated if any of the warning lights or interlock switches are not working properly. If the safety interlock failure is discovered after RGD operation the DOS, the Manager of NDE and the WRAP 1 Radiological Control Manager shall be notified.

2. PERSONNEL OVEREXPOSURE

Immediately notify the DOS, the Manager of NDE and WRAP 1 Radiological Control Manager if you discover that you or someone else has or may have a potential overexposure to radiation from the RGD.

3. UNAUTHORIZED ENTRY INTO THE X-RAY VAULT

Unauthorized entry into the X-ray vault is a serious offense. The RIC shall take the individual's name and payroll number and report it to the DOS, the Manager of NDE, and the WRAP 1 Radiological Control Manager. The RIC shall try to establish and document where the individual went and how long they were within the X-ray vault.
VIII. RECORDS

1. RGD OPERATIONAL/DAILY LOG ........................ 9
2. RGD MAINTENANCE LOG .............................. 10
3. 3-MONTH RGD INSPECTION/MAINTENANCE PROGRAM ................... 11

IX. AUTHORIZATIONS/TECHNICAL BASIS

HSRCM-1, Hanford Site Radiological Control Manual

21 CFR 1020.40, Cabinet X-ray Systems

ANSI N43.3-1993, For General Radiation Safety - Installations Using Non-Medical X-Ray And Sealed Gamma-Ray Sources, Energies Up To 10 MeV

WAC 246-243, Radiation Protection - Industrial Radiography
### ATTACHMENT 1. EMERGENCY NOTIFICATION LIST

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<td>M. K. Hackworth</td>
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<td>(541)567-9429</td>
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<td>JC Krogness</td>
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# RGD MAINTENANCE LOG

**Maintenance Performed on RGD**

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**Periodic Reviews:**

1. **WRAP 1 NDE Cog. Eng.**
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2. **NDE RGD Safety Officer**
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3-MONTH RGD INSPECTION/MAINTENANCE PROGRAM

X-RAY MACHINE IDENTIFICATION

RGD Operator

Today's Date MM/YY ____ + 3 Months = Expiration Date MM/YY ____

1. Visually examine high voltage cable insulation for damage.

2. Visually examine high voltage transformers for leakage or damage.

3. Visually examine x-ray cooling unit and hoses for leaks or damage.

4. Visually examine all interlocks and warning lights for damage.

5. All controls on x-ray control console are operational.

6. See maintenance log for repaired items.

Comments:

Periodic Reviews:

WRAP 1 NDE Cog. Eng. ___________________________ Date __________

NDE RGD Safety Officer ___________________________ Date __________

ATTACHMENT 5.2
I. SYSTEM DESCRIPTION

The Drum Nondestructive Examination (NDE) system uses penetrating radiation (X-rays) to examine the contents of waste drums for acceptance to WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria.

The system employs two different types of imaging technologies to view the drum contents: real-time radiography (RTR) and linear diode array (LOA). The RTR imaging chain uses an image intensifier to convert the X-rays to visible light which is viewed by a television camera and displayed on a television monitor. The LOA chain uses a solid state scintillator to convert the X-rays to light photons which are converted to digital signals and displayed on a high resolution computer monitor.

The system peripheral equipment include a closed-circuit television camera viewing the interior of the vault, an optical disk drive for storage of digital images, a video cassette recorder (VCR) with microphone for storage of video images with audio commentary, and a thermal printer for printing hardcopy images.

II. REFERENCE DOCUMENTS

HSRCM-1, Hanford Site Radiological Control Manual

WHC-CM-4-39, Qualification and Certification of Nondestructive Examination Personnel

WHC-CM-5-34, Solid Waste Disposal Operations Administration

WHC-CM-5-36, Solid Waste Disposal Internal Requirements

WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria

WHC-IP-1242, WRAP 1 RGD Radiation Protection Program

WRP1-OP-0904, Operating and Emergency Procedure for the Philips 450 kV X-ray Machine
WRAP 1 PLANT OPERATING PROCEDURE

III. PRESTART CONDITIONS

Personnel performing this procedure shall be qualified and certified in accordance with WHC-CM-5-34, Section 1.8; WHC-CM-4-39, Section 1.0, WHC-IP-1242 and on-the-job training.

A Field Training File will be maintained at the WRAP-1 facility which documents WRAP-1 facility specific training.

The X-ray machine shall be warmed up in accordance with WRP1-OP-0904.

It is also important that the X-ray equipment be operated in accordance with established ALARA principles and practices.

IV. SAFETY

The X-ray machine shall be operated in accordance with WRP1-OP-0904 to prevent injury to personnel and/or damage to the equipment.

V. TOOLS AND SUPPLIES

None

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VII. PROCEDURE

NOTE 1 - Automatic actions conducted by the Plant Control System are indicated by (PCS) in the far left column.

NOTE 2 - Administrative hold steps are identified by letters in parentheses at the left margin of the procedure step. The direction given in the procedure step must be satisfied before work continues.

(H) - Operations management shall approve continued operation

(R) - Radiological Control (RC) shall complete surveys or agree to permit continued operation.

A. START-UP OF THE PLANT CONTROL SYSTEM (PCS) TERMINAL

1. ENERGIZE the PCS terminal at either NDE control console.

2. LOGON the PCS using your username and password.

3. SELECT the Data Management System (DMS) icon from the Real Time Applications Platform (RTAP) screen

4. LOGON the DMS using your username and password.

5. SELECT the DMSS0201-NDE screen and indicate which Drum NDE vault you will operate: Vault A or Vault B.

B. START-UP OF THE X-RAY MACHINE

1. ENERGIZE the peripheral equipment.

2. ENERGIZE and warmup the X-ray machine in accordance with WRP1-OP-0904.

C. DAILY RTR RESOLUTION MEASUREMENT

1. VERIFY by the Closed-Circuit Television (CCTV) that the X-ray vault is clear of personnel.

2. CLOSE the door to the vault - USE "DOOR CLOSE " ENABLE" BUTTON.

3. PLACE the system into the RTR mode of operation on the main control console.

4. ENERGIZE the X-ray machine to produce radiation.
5. ADJUST the X-ray machine and the shutter controls to the proper levels to get a good image on the monitor.

6. ROTATE AND RAISE the drum until the proper Image Quality Indicator (IQI) is displayed on the RTR television monitor.

NOTE - The RTR system has two different types of IQI's placed inside of the qualification drum that may be used to qualify the imaging system for daily use. If the radiographic line-pairs per millimeter (lp/mm) gage is used, the system is acceptable if the 2.0 lp/mm or better is viewed on the RTR television monitor. If an American Society of Mechanical Engineers (ASME) #7 penetrator is used, the "2T" hole shall be visible on the RTR television monitor. The RTR resolution measurement will be performed at the RTR imaging chain's maximum enlargement.

7. TERMINATE X-ray generation.

D. DAILY LDA RESOLUTION MEASUREMENT

1. CHANGE the system's main control console from the RTR mode to the LDA mode of operation.

NOTE - It is recommended by the LDA manufacturer to leave the power supply and pre-amplifier on all the time to eliminate electronic drift of the LDA system during the warmup period.

2. ZERO the LDA.

3. ENERGIZE the X-ray machine to produce radiation.

4. RAISE the drum until it is between the X-ray source and the LDA.

5. ADJUST the X-ray machine and the LDA for the proper GAIN and OFFSET.

NOTE - This is accomplished by adjusting the X-ray machine's output and watching the signal on the oscilloscope to prevent the LDA from being saturated.

6. SCAN the drum.

NOTE - The LDA system's IQI is a 4lp/mm gage. The LDA system is acceptable if the 2.0 lp/mm or better is viewed on the television monitor. The hole is visible through the #7 stick.

7. TERMINATE X-ray generation.
8. INDICATE to the PCS that the examination is complete by depressing the "EXAM COMPLETE" button.

E. DRUM NDE OPERATIONS

1. VERIFY the X-ray vault's interior is clear of personnel with the CCTV AND THE DRUM IS INSIDE. XAH 6/30/99

2. CLOSE the door to the vault. BRING UP DMS NOW. XAH 6/30/99

3. PLACE the main control console to the LDA mode of operation. SELECT FROM THE LDA SCREEN THE EXTERNAL CONTROL MODE. XAH 6/30/99

4. ENERGIZE the X-ray machine to produce radiation.

5. RAISE the drum and adjust the output of the X-ray machine to the proper offset and gain on the LDA oscilloscope.

6. LOWER the drum to the start position. XAH 6/30/99

7. SCAN the drum in at least two directions (0 and 90 degrees as a minimum). XAH 6/30/99

8. IDENTIFY the physical components of the drum by referring to the DMS physical components record.

9. STORE the LDA images on the optical disk.

10. PLACE the main control console to the RTR mode.

   NOTE - If necessary, the RTR mode may be used to examine areas of the drum that was either not covered in the LDA examination (100% coverage), clarification of LDA images, penetrate high density areas, or for higher resolution of items within the waste matrix.

   WRITE DRUM # AND TIME/DATE ON RTR IMAGES. XAH 6/30/99

11. SCAN the drum as appropriate:

12. IDENTIFY any non-compliant items in the drum by referring to the lists in appendices A, B, and C.

13. STORE the RTR images on video tape or select individual frames to be digitized and placed on the optical disk.

14. TERMINATE X-ray generation.

15. PRINT hard copy prints as necessary. XAH 6/30/99
WRAP 1 PLANT OPERATING PROCEDURE

16. RECORD the results of the examination on the DMSS0201-NDE screen. Complete the following:

- The "Disk File" and "Disk No." (mandatory)  
  (07/17/96)  "TEST SIDE A"  
  BKH 6/30/99

- The "Tape No." and "Tape Start" (if applicable)  
  ("DISCARD")  (0:03:39)  
  BKH 6/30/99

- The "NDE comments block" with your estimation of the volume percentage of the physical components (mandatory), and with your identification of any non-compliant items from the lists in appendix A, B, and C (if applicable).

  NOTE - WRAP 1 Operations will complete the "Contents Verified?" and the "Compliant?" blocks based on your recorded "NDE Comments."

17. INDICATE to the PCS that the examination is complete by depressing the "EXAM COMPLETE" button on the control console.

F. SHUT-DOWN OF THE X-RAY MACHINE

1. COOL-DOWN and power off the X-ray machine in accordance with WRP1-OP-0904.

2. POWER OFF the peripheral equipment.

G. SHUT-DOWN OF THE PCS TERMINAL

1. LOGOFF the DMS.

2. LOGOFF the PCS.

3. POWER OFF the terminal.
APPENDIX A. TRANSURANIC WASTE NON-COMPLIANT ITEMS

1. Free Liquids. Free liquids are defined as any liquid that will pour or will exhibit a wave action when shaken.

2. Compressed Gases. Any cylinder with domed ends and valved penetrations must be assumed to be pressurized unless venting of the cylinder can be clearly identified. Examples of compressed gas containers are aerosol cans, gas cylinders, and fire extinguishers.

3. Explosives. The only explosives that have been identified by on-site Hanford Facilities are unfired gun cartridges.

4. Powders:
   a. Powders will be classified as either low density (radiographically a light area) or high density (radiographically a dark area).
   b. Low density powders are considered to be stabilizing or absorbing materials and are acceptable. Low density powders consist of absorbent materials and low density spheroids, and may be located in containers, bag folds, and/or the bottom of the drum.
   c. High density powders consist of heavy-metals like uranium and transuranic materials and may be located in containers and bag folds. When viewing high density materials with no indication of low density materials present, the material shall be considered unstabilized.

5. Ignitable, corrosive, and reactive material.

APPENDIX B. LOW LEVEL WASTE NON-COMPLIANT ITEMS

1. Free Liquids.

2. Explosives. Waste capable of detonation, of explosive decomposition, or of explosive reaction with water at normal pressures and temperatures.

3. Toxic gases. Waste capable of generating toxic gases, vapors, or fumes harmful to people.

4. Compressed gases. Waste packaged at a pressure in excess of 1.5 atmospheres.

5. Nonradionuclide pyrophoric materials.
APPENDIX C. MIXED WASTE NON-COMPLIANT ITEMS

1. Transformer with oil
2. Fluorescent light ballast
3. Electrolytic capacitors
4. Incandescent, fluorescent, sodium, and mercury bulbs
5. Lead in any form: lead based paint, lead paint on paint brushes, lead lined gloves, etc.
6. Oil
7. Batteries
8. Mercury (Thermometer and switches)
9. Grease and grease guns
WASTE RECEIVING AND PROCESSING (WRAP)  
PLANT OPERATING PROCEDURE  
SYSTEM: NONDESTRUCTIVE EXAMINATION - NONDESTRUCTIVE ASSAY  
OPERATING AND EMERGENCY PROCEDURE FOR THE  
PHILIPS 450 kV X-RAY MACHINE  

I. SYSTEM DESCRIPTION  

The drum and box NDE systems use penetrating radiation (X-rays) to examine the contents of waste drums and boxes. Three Philips 450 kV industrial x-ray machines are employed. One in each of the two drum NDE systems and one in the box NDE system. Each Philips 450 kV industrial X-ray machine consists of a control console, a 450 kV dual focus (1.0 mm and 4.5 mm) X-ray tube, two gas filled high voltage generators (transformers), and oil-to-air cooler.

Each x-ray system is housed in a shielded vault with integral safety interlocks for the protection of personnel. Each fail-safe interlock system consists of the following:

1. The vault door is interlocked with the X-ray control console's safety circuit and also with the X-ray generators primary current circuit to prevent X-ray production when the door is not closed or when the door is opened during irradiation.

2. When the X-ray machine is energized there is a 20-second delay before the production of X-rays. This delay is called the pre-warning time.

3. During the pre-warning time, flashing yellow lights are activated inside of the vault and on opposite corners of the roof outside of the vault.

4. During the pre-warning time an audible alarm inside of the vault will be activated.

5. A flashing red light is activated inside of the vault during irradiation as well as flashing red lights on opposite corners of the roof outside of the vault.

6. A steady state "X-RAY ON" lighted sign is located at the entrance to the vault.

7. The interlock fail-safe system will prevent X-rays from being produced by the X-ray machine if the flashing red light inside of the vault and/or the blinking X-ray indicator light located on the X-ray control console are burned out.
WRAP 1 PLANT OPERATING PROCEDURE

8. An emergency crash button located inside of the vault will disable the X-ray machine at any time.

9. A vault door opening switch is located inside of the vault.

II. REFERENCE DOCUMENTS

HSRCM-1, Hanford Site Radiological Control Manual

WHC-CM-5-34, Solid Waste Disposal Operations Administration

WHC-CM-5-36, SWD Internal Requirements

WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria

WHC-CM-4-39, Qualification and Certification of Nondestructive Examination Personnel

WHC-IP-1242, WRAP 1 RGD Radiation Protection Program

III. PRESTART CONDITIONS

Personnel performing this procedure shall be qualified and certified in accordance with WHC-CM-5-34, Section 1.8, "Training Plan", WHC-CM-4-39, Qualification and Certification of Nondestructive Examination Personnel, WHC-IP-1242, WRAP 1 RGD Radiation Protection Program, and on-the-job training.

It is also important the X-ray equipment be operated in accordance with established ALARA principles and practices.

IV. SAFETY

Although the Duty Operations Supervisor (DOS) has the primary responsibility for the safety of the WRAP 1 Facility, the radiographer has the responsibility to ensure the safety of personnel associated with Radiation Generating Device (RGD) operation. Only personnel who have a valid RGD certification and a current RGD performance appraisal are allowed to independently operate the RGD. In order to gain the experience necessary to become a qualified RGD operator, trainees may operate the RGD under the direct supervision of a certified RGD operator.

The drum and box X-ray vaults are a restricted access area. The drum vaults are monitored by in-vault television cameras, while the box vaults has a closed circuit television (CCTV) at the entrance to the vault. The vaults are posted inside with "Radiation Generating Device: High Intensity Radiation When Red Light Is On" signs.
When access to the vault interior is necessary the vault electrical system shall be "Locked and Tagged" out-of-service. The DOS shall also control the X-ray machine and console keys.

V. TOOLS AND SUPPLIES

None

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WRAP 1 PLANT OPERATING PROCEDURE

VII. PROCEDURE

NOTE 1 - Automatic actions conducted by the Plant Control System are indicated by (PCS) in the far left column.

NOTE 2 - Administrative hold steps are identified by letters in parentheses at the left margin of the procedure step. The direction given in the procedure step must be satisfied before work continues.

(M) - Operations management shall approve continued operation

(R) - Radiological Control (RC) shall complete surveys or agree to permit continued operation.

A. STARTUP

1. FILL OUT the RGD Operational/Daily Log (Record 1).
   
   If the RGD operator encounters any safety related operational or interlock problems the RGD shall not be operated. The DOS, NOE Radiation Safety Officer, and the Manager of Nondestructive Examination (RGD Manager) shall be immediately notified.

2. FILL OUT the RGD Maintenance Log, if appropriate (Record 2).

3. VERIFY the 3-month equipment inspection has been completed within the past three months. (Record 3).

4. VERIFY the 6-month interlock and radiation survey is current and located at the appropriate X-ray console.

5. REQUEST, if required, from the DOS to have someone energize the main electrical power at panel PP09-101 breaker; #13 for drum system A, #19 for drum system B, and #14 for the box system.

6. ENERGIZE the NDE control room console with the main control panel key switch.

   NOTE - An emergency stop button is also located on this panel.

7. CLOSE the X-ray tube shutters and the image intensifier (II) shutters to protect the II and linear diode array from receiving unnecessary radiation. As the X-ray intensity increases, watch the II television monitor for signs of unnecessary radiation exposure.

8. VERIFY the X-ray vault is not occupied by using the appropriate CCTV.
9. ACTIVATE the mains switch on the control panel by turning the key to the right to the vertical position "-".

**NOTE** - The vertical key position is a "standby" position that allows tube cooling and removal of the key. The white mains lamp will illuminate, and the kV, mA, and time indicator lights will indicate "0000".

10. SET the mains switch to the high voltage position by turning the key to the right to the horizontal position.

Select the appropriate warm-up program from the following table and enter it by using the key pad.

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<thead>
<tr>
<th>Period of Non-operation</th>
<th>Warm-up Program Number</th>
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<tr>
<td>1 - 3 Days</td>
<td>101</td>
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<tr>
<td>3 - 14 Days</td>
<td>102</td>
</tr>
<tr>
<td>More than 14 days or new tubes</td>
<td>103</td>
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</table>

11. VERIFY the X-ray vault door is in the closed position and all safety interlocks are satisfied by observing the green interlock light on the X-ray control console.

12. VERIFY the Image Intesifier image processor is viewing a live image.

13. ENERGIZE the high voltage by depressing the black "ON" button.

This will start the 20-second pre-warning time. During the pre-warning time flashing yellow lights inside of the vault and on the vault's roof will activate. An audible alarm inside the vault will also sound during the 20-second pre-warning time. The blue pre-warning lamp on the x-ray control panel will illuminate. On completion of the pre-warning time; the X-ray high voltage will be energized, the blue pre-warning lamp will extinguish, and the audible alarm will silence, at which time the flashing red warning lamp on the x-ray console will start flashing along with the red lights mounted inside the vault and on the vault's roof. Exterior "X-RAY ON" light will also illuminate.
WRAP 1 PLANT OPERATING PROCEDURE

14. UPON COMPLETION of the warm-up cycle the high voltage is switched off automatically and the keypad indicator will be "000".

The X-ray system is now ready for normal manual operation.

B. MANUAL OPERATION

1. SET the keypad indicator to the manual mode by entering "000" on the keypad.

2. SELECT the desired kV, mA, time (normally set to infinity), and focal spot size prior to energizing the X-ray machine's high voltage.

3. VERIFY the X-ray vault is not occupied by using the appropriate CCTV.

4. VERIFY the X-ray vault door is in the closed position and all safety interlocks are satisfied by observing the green interlock light on the X-ray control console.

5. OPERATE the system to examine items as required:
   a. ENERGIZE the X-ray machine by depressing the high voltage "ON" button (black button). The X-ray machine will energize after a 20-second pre-warning to the values set in step 2.
   b. DE-ENERGIZE the X-ray machine by depressing the high voltage "OFF" button (red button) on the X-ray control console.

CAUTION

NEVER USE THE MAIN CONTROL PANEL KEY SWITCH OR THE X-RAY "MAINS" SWITCH TO STOP THE EXPOSURE. USE THE HIGH VOLTAGE "OFF" BUTTON (RED BUTTON) ON THE X-RAY CONTROL CONSOLE. AFTER EACH EXPOSURE, THE RED WARNING LIGHTS WILL EXTINGUISH.

C. SHUTDOWN

1. LEAVE the X-ray control key in the vertical or horizontal position for 3 to 5 minutes after the last exposure to ensure adequate X-ray tube head cooling before turning the X-ray mains switch to the "OFF" position.

2. COMPLETE the RGD Operational/Daily Log. (Record 1.)
D. EMERGENCY RESPONSE

This establishes the response to emergency situations which could occur during RGD operations at the WRAP 1 Facility.

For the WRAP 1 RGD's an emergency situation is one where there is a loss of control over the RGD, or an actual or suspected radiation overexposure to personnel. Because it is impossible to foresee all potential accident scenarios, it is imperative that if an emergency situation arises that not only is this procedure followed, but that common sense and good judgement be exercised.

The radiographer has the necessary training and experience to recognize when an emergency situations exists and it is the radiographer's responsibility to ensure the safety of all personnel. It is also important that the radiographer recognize that an emergency situation exists before any personnel overexposures occur. Once an emergency condition is identified the DOS will be immediately notified by the radiographer.

1. SAFETY INTERLOCK FAILURE

A safety interlock failure is not an emergency situation if it is discovered prior to RGD operation. However, the RGD shall not be operated if any of the warning lights or interlock switches are not working properly. If the safety interlock failure is discovered after RGD operation the DOS, the Manager of NDE and the WRAP 1 Radiological Control Manager shall be notified.

2. PERSONNEL OVEREXPOSURE

Immediately notify the DOS, the Manager of NDE and WRAP 1 Radiological Control Manager if you discover that you or someone else has or may have a potential overexposure to radiation from the RGD.

3. UNAUTHORIZED ENTRY INTO THE X-RAY VAULT

Unauthorized entry into the X-ray vault is a serious offense. The RIC shall take the individual's name and payroll number and report it to the DOS, the Manager of NDE, and the WRAP 1 Radiological Control Manager. The RIC shall try to establish and document where the individual went and how long they were within the X-ray vault.
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IX. AUTHORIZATIONS/TECHNICAL BASIS

HSRCM-1, Hanford Site Radiological Control Manual

21 CFR 1020.40, Cabinet X-ray Systems

ANSI N43.3-1993, For General Radiation Safety – Installations Using Non-Medical X-Ray And Sealed Gamma-Ray Sources, Energies Up To 10 MeV

WAC 246-243, Radiation Protection – Industrial Radiography
ATTACHMENT 1. EMERGENCY NOTIFICATION LIST

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<tr>
<td>M. F. Hackworth</td>
<td>373-3861</td>
<td>(541) 567-9429</td>
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**WRAP 1 PLANT OPERATING PROCEDURE**

**RECORD 1. RGD OPERATIONAL/DAILY LOG**
RECORD 2. RGD MAINTENANCE LOG

RGD MAINTENANCE LOG

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RECORD 3. 3-MONTH RGD INSPECTION/MAINTENANCE PROGRAM

3-MONTH RGD INSPECTION/MAINTENANCE PROGRAM

X-RAY MACHINE IDENTIFICATION

RGD Operator

Today's Date MM/YY _____ + 3 Months = Expiration Date MM/YY _____

1. Visually examine high voltage cable insulation for damage.

2. Visually examine high voltage generators for leakage or damage.
   Record generator gage reading: + Generator _____
   - Generator _____

3. Visually examine x-ray cooling unit and hoses for leaks or damage.

4. Visually examine X-ray power supply and wiring for damage.

5. Visually examine all interlocks and warning lights for damage.

6. All controls on x-ray control console are operational.

7. See maintenance log for repaired items.
   Comments:

Periodic Reviews:

WRAP 1 NDE Cog. Eng. ___________________________ Date

NDE RGD Safety Officer ___________________________ Date

NEEDS
OK
REPAIR


OPERATION OF THE DRUM NONDESTRUCTIVE EXAMINATION SYSTEM

I. SYSTEM DESCRIPTION

The Drum Nondestructive Examination (NDE) system uses penetrating radiation (X-rays) to examine the contents of waste drums for acceptance to WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria.

The system employs two different types of imaging technologies to view the drum contents: real-time radiography (RTR) and linear diode array (LDA). The RTR imaging chain uses an image intensifier to convert the X-rays to visible light which is viewed by a television camera and displayed on a television monitor. The LDA chain uses a solid state scintillator to convert the X-rays to light photons which are converted to digital signals and displayed on a high resolution computer monitor.

The system peripheral equipment include a closed-circuit television camera viewing the interior of the vault, an optical disk drive for storage of digital images, a video cassette recorder (VCR) with microphone for storage of video images with audio commentary, and a thermal printer for printing hardcopy images.

II. REFERENCE DOCUMENTS

HSRCM-1, Hanford Site Radiological Control Manual

WHC-CM-4-39, Qualification and Certification of Nondestructive Examination Personnel

WHC-CM-5-34, Solid Waste Disposal Operations Administration

WHC-CM-5-36, Solid Waste Disposal Internal Requirements

WHC-EP-0063, Hanford Site Solid Waste Acceptance Criteria

WHC-IP-1242, WRAP 1 RGD Radiation Protection Program

WRP1-OP-0904, Operating and Emergency Procedure for the Philips 450 kV X-ray Machine
III. PRESTART CONDITIONS

Personnel performing this procedure shall be qualified and certified in accordance with WHC-CM-5-34, Section 1.8; WHC-CM-4-39, Section 1.0, WHC-IP-1242 and on-the-job training.

A Field Training File will be maintained at the WRAP-1 facility which documents WRAP-1 facility specific training.

The X-ray machine shall be warmed up in accordance with WRPI-OP-0904.

It is also important that the X-ray equipment be operated in accordance with established ALARA principles and practices.

IV. SAFETY

The X-ray machine shall be operated in accordance with WRPI-OP-0904 to prevent injury to personnel and/or damage to the equipment.

V. TOOLS AND SUPPLIES

None

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VII. PROCEDURE

NOTE 1 - Automatic actions conducted by the Plant Control System are indicated by (PCS) in the far left column.

NOTE 2 - Administrative hold steps are identified by letters in parentheses at the left margin of the procedure step. The direction given in the procedure step must be satisfied before work continues.

(M) - Operations management shall approve continued operation

(R) - Radiological Control (RC) shall complete surveys or agree to permit continued operation.

A. START-UP OF THE NDE CONSOLE

1. OBTAIN "Console" key from DOS.
2. ENERGIZE the NDE console by turning the key to "ON" position.
3. ENERGIZE the PCS terminal at either NDE control console.
4. LOGON the PCS using your username and password.
5. CHOOSE which drum NDE vault you will be operating (A or B) from the schematic screens.
6. At console 2, SET console switch to 104B.

B. START-UP OF THE X-RAY MACHINE

1. OBTAIN "X-ray" key from DOS.
2. START UP the X-ray system in accordance with WRP1-OP-0904.

C. DAILY RTR RESOLUTION MEASUREMENT

(PCS) Test drum is delivered to NDE vault. PCS terminal indicates "DRUM IN VAULT:XR OFF."

1. VERIFY by the Closed-Circuit Television (CCTV) that the X-ray vault is clear of personnel and that test drum is in NDE vault.
2. CLOSE the door to the vault using PCS screen door close "ENABLE" button.
3. ENERGIZE the X-ray machine to produce radiation.
PCS terminal indicates "EXAM IN PROGRESS."

4. ADJUST the X-ray machine and the shutter controls to the proper levels to get a good image on the monitor.

5. ROTATE AND RAISE the drum until the proper Image Quality Indicator (IQI) is displayed on the RTR television monitor.

NOTE - The RTR system has two different types of IQI's placed inside of the qualification drum that may be used to qualify the imaging system for daily use. If the radiographic line-pairs per millimeter (lp/mm) gage is used, the system is acceptable if the 2.0 lp/mm or better is viewed on the RTR television monitor. If an American Society of Mechanical Engineers (ASME) #7 penetrator is used, the "2T" hole shall be visible on the RTR television monitor. The RTR resolution measurement will be performed at the RTR imaging chain's maximum enlargement.

6. TERMINATE X-ray generation.

PCS terminal indicates "DRUM IN VAULT: XR OFF."

D. DAILY LDA RESOLUTION MEASUREMENT

1. CHANGE the system's main control console from the RTR mode to the LDA mode of operation.

NOTE 1 - It is recommended by the LDA manufacturer to leave the power supply and pre-amplifier on all the time to eliminate electronic drift of the LDA system during the warmup period.

NOTE 2 - Image Indicator shutters are CLOSED.

2. ZERO the LDA.

3. ENERGIZE the X-ray machine to produce radiation.

PCS terminal indicates "EXAM IN PROGRESS."

4. ADJUST the X-ray machine and the LDA for the proper GAIN and OFFSET.

NOTE - This is accomplished by adjusting the X-ray machine's output and watching the signal on the oscilloscope to prevent the LDA from being saturated.

5. TRIGGER gain control.
6. SCAN the drum.

*NOTE* - The LDA system's IQI is an ASTM F792 security stopwedge. The LDA system is acceptable if the #30 wire is visible through the #7 step when viewed on the television monitor.

7. TERMINATE X-ray generation.

*(PCS)* PCS terminal indicates "DRUM IN VAULT:XR OFF."

8. INDICATE to the PCS that the examination is complete by depressing the "EXAM COMPLETE" button.

*(PCS)* PCS terminal indicates "DROP OFF/COLLECT DRUM."

E. DRUM NDE OPERATIONS

*(PCS)* Waste drum is delivered to the NDE vault. PCS terminal indicates "DRUM IN VAULT:XR OFF."

---

**CAUTION**

WHEN NDE EXAMINATION CANNOT BE COMPLETED, THE "ABORT" BUTTON ON THE PCS CONSOLE IS DEPRESSED AND THE DUTY OPERATIONS SUPERVISOR NOTIFIED. PCS INDICATES "FAULT: EXAM ABORTED."

1. VERIFY the X-ray vault's interior is clear of personnel and the drum is inside using the CCTV.

2. CLOSE the door to the vault

3. SELECT the Data Management System (DMS) icon from the Real Time Applications Platform (RTAP) screen

4. LOGON the DMS using your username and password.

5. SELECT the DMSS0201-NDE screen and indicate which Drum NDE vault you are operating: Vault A or Vault B. REVIEW the DMS records for the drum, as desired.

6. SELECT from the LDA screen the External Control mode.

7. ENERGIZE the X-ray machine to produce radiation.

*(PCS)* PCS terminal indicates "EXAM IN PROGRESS."
8. RAISE the drum and adjust the output of the X-ray machine to the proper offset and gain on the LDA oscilloscope.

9. SCAN the drum.

10. IDENTIFY the physical components of the drum by referring to the DMS physical components record.

11. STORE the LDA image on the optical disk.

12. ROTATE the drum 90° and repeat Steps 9 through 11.

13. If necessary, PLACE the main control console into the RTR mode and VIEW the drum contents using the RTR mode.

   NOTE - If necessary, the RTR mode may be used to examine areas of the drum that was either not covered in the LDA examination (100% coverage), clarification of LDA images, penetrate high density areas, or for higher resolution of items within the waste matrix.

14. WRITE the drum number, time, and date on any RTR images created.

15. IDENTIFY any non-compliant items in the drum by referring to the lists in appendices A, B, and C.

16. STORE the RTR images on video tape or select individual frames to be digitized and placed on the optical disk.

17. TERMINATE X-ray generation.

(PCS) PCS terminal indicates "DRUM IN VAULT: XR OFF."

18. INDICATE to the PCS that the examination is complete by depressing the "EXAM COMPLETE" button on the control console.

(PCS) PCS terminal indicates "DROP OFF/COLLECT DRUM."

19. RECORD the results of the examination on the DMSS0201-NDE screen. Complete the following:

   - The "Disk File" and "Disk No." (mandatory)
   - The "Tape No." and "Tape Start" (if applicable)
   - The "NDE comments block" with your estimation of the volume percentage of the physical components (mandatory), and with your identification of any non-compliant items from the lists in appendix A, B, and C (if applicable).
NOTE - WRAP 1 Operations will complete the "Contents Verified?" and the "Compliant?" blocks based on your recorded "NDE Comments."

F. SHUT-DOWN OF THE X-RAY MACHINE

1. COOL-DOWN and power off the X-ray machine in accordance with WRP1-OP-0904.
2. RETURN key to DOS.

G. SHUT-DOWN OF THE NDE CONSOLE

1. LOGOFF the DMS.
2. LOGOFF the PCS.
3. POWER OFF the terminal.
4. POWER OFF the NDE console by turning key to "OFF" position.
5. RETURN key to DOS.
APPENDIX A. TRANSURANIC WASTE NON-COMPLIANT ITEMS

1. **Free Liquids.** Free liquids are defined as any liquid that will pour or will exhibit a wave action when shaken.

   *NOTE* - IF a drum is found to contain some potentially-flammable liquid, CONSULT the Duty Operations Supervisor (DOS). The DOS will determine if the drum is to be managed as flammable until further confirmation can be performed.

2. **Compressed Gases.** Any cylinder with domed ends and valved penetrations must be assumed to be pressurized unless venting of the cylinder can be clearly identified. Examples of compressed gas containers are aerosol cans, gas cylinders, and fire extinguishers.

3. **Explosives.** The only explosives that have been identified by on-site Hanford Facilities are unfired gun cartridges.

4. **Powders:**
   a. Powders will be classified as either low density (radiographically a light area) or high density (radiographically a dark area).
   b. Low density powders are considered to be stabilizing or absorbing materials and are acceptable. Low density powders consist of absorbent materials and low density spheroids, and may be located in containers, bag folds, and/or the bottom of the drum.
   c. High density powders consist of heavy-metals like uranium and transuranic materials and may be located in containers and bag folds. When viewing high density materials with no indication of low density materials present, the material shall be considered unstabilized.

5. **Ignitable, corrosive, and reactive material.**

6. **Nonradionuclide pyrophoric materials.**
APPENDIX B. LOW LEVEL WASTE NON-COMPLIANT ITEMS

1. **Free Liquids.**

2. **Explosives.** Waste capable of detonation, of explosive decomposition, or of explosive reaction with water at normal pressures and temperatures.

3. **Toxic gases.** Waste capable of generating toxic gases, vapors, or fumes harmful to people.

4. **Compressed gases.** Waste packaged at a pressure in excess of 1.5 atmospheres.

5. **Nonradionuclide pyrophoric materials.**
APPENDIX C. MIXED WASTE NON-COMPLIANT ITEMS

1. Transformer with oil
2. Fluorescent light ballast
3. Electrolytic capacitors
4. Incandescent, fluorescent, sodium, and mercury bulbs
5. Lead in any form: lead based paint, lead paint on paint brushes, lead lined gloves, etc.
6. Oil
7. Batteries
8. Mercury (Thermometer and switches)
9. Grease and grease guns
### DISTRIBUTION SHEET

**To**

**Distribution**

**From**

WRAP Engineering

**Page 1 of 1**

**Date** 06/10/99

**Project Title/Work Order**

WRAP OPERATIONAL TEST REPORT FOR DRUM NDE SYSTEM

**EDT No.** ECN-651719

**ECN No.** N/A

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