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CCP-TP-074

Revision 1

CCP
Large Container Non-Destructive Examination (LCNDE) Operating Procedure

EFFECTIVE DATE: 10/07/2010

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RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	09/07/2010	Initial Issue.
1	10/07/2010	Corrected Radiation Generating Device (RGD) issues.

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1.0 PURPOSE

The purpose of this procedure is to provide instructions for safe start up, operation, and shut-down of the Large Container Non-Destructive Examination (LCNDE) system, at the Savannah River Site (SRS).

1.1 Scope

This procedure applies to LCNDE activities performed by qualified Real-Time Radiography (RTR) Operators. Waste characterization activities for the purposes of Waste Isolation Pilot Plant (WIPP) certification are outside the scope of this procedure. Maintenance activities are also outside the scope of this procedure.

2.0 REQUIREMENTS

2.1 References

2.1.1 Referenced Documents

- CCP-PO-005, *CCP Conduct of Operations*
- CCP-QP-008, *CCP Records Management*
- CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*
- CCP-TP-053, *CCP Standard Real-Time Radiography (RTR) Inspection Procedure*
- CCP-TP-066, *CCP Radiography Screening Procedure for Prohibited Items*

2.2 Training Requirements

2.2.1 Personnel performing this procedure will be trained, qualified, and placed on the Central Characterization Project (CCP) List of Qualified Individuals (LOQI) for radiography operations.

2.3 Equipment List

- Image Test pattern gauge
- X-Ray Control Panel Key
- Locks and key to Low Activity Waste Vault (LAWV) Cell gates
- Radiation survey meter

2.4 Software

2.4.1 None

2.5 Precautions and Limitations

2.5.1 The personal protective equipment (PPE) for normal operations is leather gloves, safety shoes, and safety glasses (when handling containers). Ear plugs are required when forklifts are moving containers in the LAWV Cell 2. Additional PPE may be specified by a Host site Radiological Control Technician (RCT) or in a site-specific Radiation Work Permit (RWP).

2.5.2 The LCNDE system generates X-rays up to three million electron volts. An interlock system will de-energize X-ray generation when any LAWV Cell 1 and Cell 2 gate or door is opened.

2.5.3 Keys to the LCNDE system and LAWV Cell 1 and Cell 2 access gates must remain under the control of the RTR operator at all times, when the system is operating.

2.5.4 The PaR robotic system is subject to moving without warning. Blue lights on the light towers will illuminate when the system is “armed”, and capable of being moved.

2.5.5 The LCNDE is equipped with visible and audible warning signals, which activate for 30 seconds prior to initiation of the X-ray beam. A yellow light on the light tower and an alarm horn indicate that the 30-second “Pre-Warn” cycle has been initiated. A red light indicates that the X-ray beam is on. If these signals activate at any time during LAWV Cell 1 and Cell 2 entry (other than testing), immediately press the nearest Emergency Stop (E-Stop) button. This will stop any movement of the robotic system, and shut down the X-ray system.

2.5.6 Following X-ray operation, any re-entry into LAWV Cell 1 and Cell 2 requires Radiological Protection Department (RPD) to use a suitable, calibrated radiation detection instrument to verify that the X-ray tube has been fully de-energized.

2.5.7 In the event an in-cell E-Stop button is actuated in a true emergency situation (X-ray operation with personnel in the cell), the system shall be secured pending an investigation by facility management.

2.5.8 X-ray system trips resulting from an internal (Varian) system fault may be reset, and operation resumed. These may occur during changes in the trigger rate, or during extended periods of operation. Two repeated occurrences should be investigated by the RTR Lead Operator (LO), as needed.

2.5.9 Loss of X-ray beam resulting from interlock system actuation must be investigated by the RTR operator. Spurious trips of the system during operation are rare, and the operator must be assured that no attempt to enter the cell has been made.

2.5.10 Interlock system actuation resulting from exceeding the set point of the in-cell radiation monitors must be investigated by RPD. If high radiation is the result of beam scatter, it may be necessary to change the orientation of the container or reduce the dose rate (trigger rate) to complete the examination.

2.5.11 Abnormal or unexpected movement of the PaR system may be stopped using the E-Stop button on the CIMROC cabinet or on the teach pendant. These buttons ONLY stop the PaR system movement, and will **NOT** shut down the X-ray system. Use of the E-Stop on the Operator Console will stop the PaR system, and shut down the X-ray system.

2.5.12 In the event an E-Stop condition or "perimeter interlock" fault preventing startup or operation of the X-ray system cannot be cleared, yet the display on the Interlock Touch Screen is normal, it may be necessary to cycle the power to the interlock cabinet. This is performed by turning off circuit #13 /15 in E661006-ELLV-PNL-002 for approximately 10 seconds, then turning it back on. The X-ray modulator will need to be restarted following this action.

2.5.13 RTR Operators will ensure electrical panels and junction boxes are closed; prior to start-up of the LCNDE system.

2.5.14 RTR Operators will ensure that LAWV Cell 1 and Cell 2 are clear of personnel, doors and gates are closed and locked. To facilitate this, a Closed-Circuit Television (CCTV) system has been installed.

2.6 Prerequisite Actions

2.6.1 Conduct a safety walk-down of the equipment, **AND** record results in the Nondestructive Examination (NDE) Operational Logbook at the beginning of each shift.

2.6.2 Verify the radiation leak check compliance label (OSR4-958, *RGD Inspection and Survey Due Date Label*), located on the X-Ray Control Panel, is current.

[A] **IF** the radiation leak check has expired, or hardware or software adjustments/modifications have been performed, **THEN DO NOT** proceed with RTR operations until Radiation Protection Services personnel and Radiation Generating Device (RGD) Custodian perform and document a radiation leak check and certify the LCNDE system is operating within allowable limits.

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3.0 RESPONSIBILITIES

3.1 RTR Operator

3.1.1 Completes Attachment 1, NDE Daily Pre-Operational Checklist.

3.1.2 Operates the LCNDE system.

3.1.3 Maintains the NDE Operational Logbook.

3.2 RTR Lead Operator (LO)

3.2.1 Ensures the technical quality in all aspects of the RTR examination process.

3.2.2 Provides supervision for the overall operation of the LCNDE system and is, at a minimum, a qualified RTR Operator.

3.2.3 Notifies SRS RGD custodian of qualified NDE operators.

3.3 Radiological Control Technician (RCT)

3.3.1 Prepares Radiological Work Permits (RWPs) for LAWV entry and LCNDE operation, **AND** performs a periodic RGD X-ray vault radiation protection and contamination surveys of the LCNDE system.

3.4 Vendor Project Manager (VPM)

3.4.1 Ensures CCP personnel comply with environmental safety, security requirements, and CCP safety requirements.

3.5 Facility Records Custodian

3.5.1 Receives, processes and transmits completed Attachment 1, NDE Daily Pre-Operational Checklist, in accordance with CCP-QP-008, *CCP Records Management.*

4.0 PROCEDURE

NOTE

If a system fault/error occurs during system startup, the operator, based on training and RTR LO guidance should take non-repair actions (i.e., no hardware or software adjustments/modifications) to reset the system. If the fault/error cannot be corrected, the Vendor Project Manager (VPM), or RTR LO should be notified and the system shutdown per Section 4.3.

4.1 System Startup

4.1.1 **VERIFY** the system status file in Shift Manager Trailer 704-37E contains a LAWV Cell 2 NDE System Electrical Alignment Checklist.

4.1.2 **VERIFY** coolant level in the surge tank for the NDE Temperature Control Unit (TCU) is between the inlet and outlet ports,
IF NOT,
THEN ENSURE Maintenance fills before proceeding.

4.1.3 **ENERGIZE** the NDE TCU in LAWV Cell 2, by turning knob to ON position.

4.1.4 Ensure that the PaR robotic system is clear of any obstructions or foreign material which could interfere with movement.

NOTE

The pressure regulator in the supply line to the Linear Detector Array (LDA) should be set to 30 pounds per square inch (PSI) when air is flowing. It will indicate slightly higher in a no-flow condition. Air only flows when the LDA internal temperature exceeds 95 degrees Fahrenheit (F).

4.1.5 **VERIFY** that air compressor PA CMP 001 receiver tank is pressurized to approximately 150 PSI.

4.1.6 **ENSURE** that the operator console E-Stop button is **NOT** depressed,
THEN ENERGIZE the Varian Medical System M3 Linatron® X-Ray Source in accordance with the following:

[A] **PRESS** the Reset Button in the Modulator Trailer

[B] **ENSURE** the red “Power is On” is displayed on the Main Control Screen and that the system is “Warmup” status.

4.1.7 **ENSURE** surveillance cameras are powered ON, **AND** video monitor displays an image from LAWV Cell 2 cameras.

NOTE

If a system fault/error occurs during system startup, the operator, based on training and LO guidance should take non-repair actions (i.e. no hardware or software adjustments/modifications) to reset the system. If the fault/error **CANNOT** be corrected, contact the VPM or LO and proceed to Section 4.3, Normal System Shutdown.

WARNING

VERY HIGH RADIATION conditions exist in the LAWV Cell 2 when operating that can result in lethal doses to personnel from unauthorized entry. Functioning alarms are needed to provide a 30 second warning to personnel of VERY HIGH RADIATION hazard. Interlocks provide for automatic shutdown of the VERY HIGH RADIATION when perimeter doors and gates are opened.

4.1.8 **COMPLETE** Attachment 1, NDE Daily Pre-Operational Checklist.

4.1.9 **ENERGIZE** the PaR Robotic System using the CIMROC 5/21 Controller Switch on the front panel of the CIMROC cabinet.

4.1.10 **LOGIN** to PaR, Area Detector Array (ADA), and LDA computers as necessary, **AND ALLOW** the PaR software to finish loading before proceeding to the next step.

4.1.11 **PRESS** the BLUE E-Stop “Reset” button on the PaR system CIMROC cabinet, **AND VERIFY** that the E-Stop clears on the PaR computer display.

4.1.12 **START** Computer Tomography (CT) Flash Linear Scanning System (LSS) program and Shutter Control program on the LDA computer, and CT Flash Data Acquisition system (DAQ) program on the ADA computer.

4.1.13 **ENSURE** that there are no E-Stop conditions present on the Interlock Display Panel or on the PaR computer screen, **AND RESOLVE** any discrepancies prior to proceeding.

4.1.14 **ENSURE** that the Varian X-ray system has completed the warm-up period, and that all interlocks (except key fault) are satisfied on the Main Control Screen.

4.2 Operation

NOTE

If a system fault/error occurs during operations, the operator, based on training and LO guidance should take non-repair actions (i.e., no hardware or software adjustments/modifications) to reset the system. If the fault/error cannot be corrected, the VPM, or LO should be notified and the system shutdown per Section 4.3.

4.2.1 **ENSURE** the trigger rate is set to external.

4.2.2 **ENSURE** that the PaR motion control system is armed as indicated by the green “ARM POWER” light on the PaR computer screen.

[A] **IF** the PaR motion control system is **NOT** armed, **THEN PRESS** the BLUE E-Stop “Reset” button on the CIMROC cabinet, **AND/OR USE** the “Re-initialize Hardware” function on the LDA screen to re-initialize the system.

NOTE

At this point, the operator should observe the trigger rate setting.

4.2.3 **POSITION** the camera to the “ADA/Container preset.”

4.2.4 **ENSURE** the X-Ray Control Panel Key Switch is in the ENABLE position.

4.2.5 **VERIFY** that the Red Warning Lights are illuminated when X-rays are generated for the first time of the day and record status in the NDE Operation Logbook.

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WARNING

The LCNDE system is classified as a shielded installation in which the X-ray Generating Device (XGD) and all objects exposed are within a permanent enclosure within which no person is permitted to remain during irradiation. Operating this equipment improperly can produce a lethal dose of radiation in a short period of time. Exposure to this radiation can cause serious injury or death.

4.2.6 **IF** LDA is desired,
THEN:

[A] **ENSURE** the linear slide is at position 10 on the PaR monitor.

[B] **INITIATE** LDA scan using on-screen controls, **AND ENSURE** LDA scan is complete.

CAUTION

During container movement for real-time ADA inspection, the position of the container relative to the ADA and LDA detectors must be carefully observed using the cameras to prevent contact.

4.2.7 **IF** ADA is desired,
THEN:

[A] **INITIATE** ADA scan using on-screen controls, **AND MANIPULATE** container, source, and detector positions as required to perform a detailed inspection of items in the container in accordance with the applicable procedure.

4.2.8 **WHEN** the inspection is complete,
THEN:

[A] **PRESS** the X-ray “Beam Off” button

[B] **TURN** the X-Ray Control Panel Key Switch to the BEAM DISABLE position

WARNING

De-energizing of the LCNDE system and removal of the key prevents un-authorized operation that could result in lethal doses of VERY HIGH RADIATION to personnel in LAWV Cell 1 and Cell 2.

[C] **REMOVE** the key.

4.2.9 **ENSURE** the container is at a near-normal position (approximately 0 degrees tilt, 0 degrees rotation).

CAUTION

The container table must be positioned properly prior to issuing a command to return it to the loading position. The system will automatically restore tilt and rotation positions causing unexpected motion if the starting position is too far from the normal state.

4.2.10 **RETURN** the container to the desired loading position,
THEN USE the “Close Motion Control” function on the LDA screen to disarm the PaR system.

WARNING

The X-Ray Control Panel key must remain in the control of the RTR operator at all times, and must be removed from the key switch before any personnel enter LAWV Cell 1 or Cell 2 to perform the survey.

4.2.11 **IF** no further inspection of the container is required,
THEN PERFORM a radiation survey of LAWV Cell 2, and notify SRS for container movement.

4.2.12 **IF** the X-ray unit needs to be shut down due to extended break (not for end of the day),
THEN:

[A] **PRESS** the E-Stop button on the operating console to shut down the X-ray system.

[B] **SHUTDOWN** the PaR computer completely.

[C] **TURN** the CIMROC 5/21 Controller Switch to the OFF position on the front panel of the CIMROC cabinet.

4.2.13 **IF** the X-ray unit has been shut down due to extended break,
THEN:

[A] **ENERGIZE** the Varian Medical System M3 Linatron X-Ray Source.

[B] **ENSURE** the RED “Power Is On” is displayed on the Main Control Screen, and that the system is in the “Warmup” status.

[C] **ENERGIZE** the PaR Robotic System using the CIMROC 5/21 Controller Switch on the front panel of the CIMROC cabinet.

[D] **LOGIN** to PaR.

4.2.14 **IF** X-raying another container and container loading movements are complete,
THEN:

[A] **PERFORM** a final and detailed physical sweep to ensure no one is in LAWV Cell 1 and Cell 2.

[B] **VERIFY** door 818 (Cell 2 NE) and door 819 (Cell 2 SE) are inaccessible from Cell 3.

[C] **ENSURE** access gates/doors are closed and gates 817, 828, 829, 906, 907, and 909 are locked.

[D] **RETURN** to section 4.2.2, **AND PROCEED**.

4.2.15 **IF** X-raying is complete,
THEN PROCEED to Section 4.3, Normal System Shutdown.

WARNING

VERY HIGH RADIATION doses to personnel can result if the LCNDE system is not completely de-energized before returning the LAWV Cell 1 and Cell 2 to normal operations.

4.3 Normal System Shutdown

NOTE

When power is shut down to the computers and/or the LDA detector, it may be necessary to reload the operating parameters for the LDA, and perform a calibration. Refer, as necessary, to the operating manuals for detailed instructions.

4.3.1 Upon completion of daily examination operations, SHUTDOWN the system as follows:

[A] **ENSURE** that the key is removed from the X-Ray Control Panel Key Switch.

[B] **PRESS** the E-Stop button on the operating console to shut down the X-ray system.

[C] **CLOSE** any open programs on the LDA and ADA computers, **AND DO NOT TURN OFF** the LDA and ADA computers.

[D] **SHUTDOWN** the PaR computer completely.

[E] **TURN** the CIMROC 5/21 Controller Switch to the OFF position on the front panel of the CIMROC cabinet.

[F] **TURN** knob to the **OFF** position for the NDE Temperature Control Unit in LAWV Cell 2.

[G] **REMOVE** locks from LAWV Cell 1 and Cell 2.

4.3.2 RTR Operator forwards completed Attachment 1 to the Facility Records Custodian.

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4.4 Facility Records Custodian

4.4.1 Receive, process, and transmit completed Attachment 1, NDE Daily Pre-Operational Checklist, in accordance with CCP-QP-008.

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5.0 RECORDS

5.1 The NDE Operational Logbook generated during the performance of this procedure are identified as quality assurance (QA) records in CCP-PO-005, *CCP Conduct of Operations,* and maintained as QA records in accordance with CCP-QP-008.

5.2 The following record generated by this procedure is a QA record and will be maintained in accordance with the CCP-QP-008.

QA/Nonpermanent

5.2.1 NDE Daily Pre-Operational Checklist

Attachment 1 – NDE Daily Pre-Operational Checklist

Date Performed _____ Page 1 of 4

NOTE

Table 1 can be completed in any order.

X-ray operation is **NOT** permitted if more than one light tower in LAWV Cell 1 or Cell 2 is **NOT** functioning correctly.

1. RTR Operator: Test each warning light and audible alarm in Table 1 using the key switch and test buttons on the LAWV Cell 2 Interlock Panel. An assistant may be used for completion of the test.

2. Record P (PASS) or F (FAIL) in Table 1 and initial completion.

Table 1
WARNING LIGHTS/HORNS
(P=Pass F=Fail)

Light Tower (LT)	Horn Test (P or F)	Blue Light Test (P or F)	Yellow Light Test (P or F)	Red Light Test (P or F)	Initial
LT-1 918 Cell 2 NE Wall					
LT-2 919 Cell 2 SE Wall					
LT-6 920 Cell 2 N wall					
LT-5 921 Cell 2 NW Wall					
LT-4 922 Cell 2 SW Wall					
LT-3 923 Cell 2 Main Gate					
LT-7 924 Cell 1 NE Wall					
LT-8 925 Cell 1 SE wall					
LT-9 926 Cell 1 Main Gate					

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Attachment 1 – NDE Daily Pre-Operational Checklist (Continued)

Date Performed _____ Page 2 of 4

3. **ENSURE** LAWV Cell 1 access gates 906, 907, and 909 are closed and locked.

4. **ENSURE** RPD has performed the daily operability checks on the radiation monitors installed in LAWV Cell 1 and Cell 2.

5. **ENSURE** that a physical sweep of LAWV Cell 1 and Cell 2 is performed by the RTR Operator or other individual designated by the operator prior to operation of the X-ray system to ensure no person remains in the exposure area during the irradiation. This sweep is to give the operator control of the cell. A final sweep is performed later in the procedure.

6. **VERIFY** door 818 (LAWV Cell 2 NE) and door 819 (Cell 2 SE) are inaccessible from Cell 3.

7. **ENSURE** all LAWV Cell 2 access gates / doors are CLOSED.

8. **ENSURE** the X-Ray Control Panel Key Switch is in the ENABLE position.

9. **VERIFY** the pre-warn audible alarm sounds and yellow warning lights (minimum of two in each cell) turn on during the 30-second pre-warn period.

10. **VERIFY** when the pre-warn alarm stops that the “Beam On” light is off and the “READY” status is displayed on the Main Control Screen.

11. **OPEN** an access gate from Table 2, **AND VERIFY** the “READY” status displayed on the main control screen changed to “Warmup.”

12. **IF** in LAWV Cell 2,
    THEN EXIT LAWV Cell 2.

13. **PRESS** “BEAM ON” pushbutton.

14. **VERIFY** “BEAM ON” pushbutton light remains OFF and “Warmup” is displayed on the Main Control Screen, **AND INITIAL** for the applicable gate in Table 2.

15. **TURN** the X-Ray Control Panel Key Switch to the BEAM DISABLE position.

Attachment 1 – NDE Daily Pre-Operational Checklist (Continued)

Date Performed _____ Page 3 of 4

16. **REPEAT** Steps 7 thru 15 for each gate listed in Table 2 until Table 2 has been completed.

TABLE 2 **GATE CHECK**	
Access Gate	Initial
Gate 817 (walk-in) Cell 2	
Gate 828 (Double Gate) Cell 2	
Gate 829 (Double Gate) Cell 2	

17. **PRESS** one of the E-STOP BUTTONS in LAWV Cell 1 or Cell 2.

    [A] **USE** a random E-STOP BUTTON each day.

    [B] **RECORD** the E-STOP ID # ____

18. **VERIFY** the Varian Medical System M3 Linatron X-Ray Source is de-energized **AND**

    RESET the E-Stop. Initial: _____ Date: _____

19. **PERFORM** the following:

    [A] **REMOVE** and MAINTAIN the X-ray key from operator console.

    [B] **ENERGIZE** the Varian Medical System M3 Linatron X-Ray Source.

    [C] **ENSURE** the red “Power Is On” is displayed on the Main Control Screen, and that the system is in the “Warmup” status.

    [D] **PERFORM** a final and detailed physical sweep to ensure no person is in LAWV Cell 1 or Cell 2.

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Attachment 1 – NDE Daily Pre-Operational Checklist (Continued)

Date Performed _____ Page 4 of 4

NOTE

The RTR operator or designated personnel will maintain the gate keys at all times.

20. **ENSURE** access gates / doors are closed and gates 817, 828, 829, 906, 907, and 909 are locked.

Completed By Operator:

Print Name	*Signature*	*Date*	*Time*