

CCP-TP-198

Revision 2

CCP HE-RTR Operating Procedure

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PRINTED NAME

APPROVED FOR USE

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	02/11/2011	Initial Issue
1	03/01/2011	Revised to incorporate recommendations documented in MA-CCP-0003-11.
2	03/14/2011	Revised to incorporate changes identified during the CH2M Hill Plateau Remediation Company (CHPRC) Level 3 Readiness Assessment.

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1.0 PURPOSE

The purpose of this procedure is to provide instructions for start-up, operation, and shut-down of the High Energy Real-Time Radiography (HE-RTR) system.

1.1 Scope

The scope of this procedure is limited to start-up, operation, and shut-down of HE-RTR. Maintenance activities are outside the scope of this procedure.

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- CCP-QP-002, *CCP Training and Qualification Plan*

Referenced Documents

- CCP-PO-005, *CCP Conduct of Operations*
- CCP-QP-008, *CCP Records Management*

2.2 Training Requirements

2.2.1 Personnel performing this procedure shall be identified as a qualified operator on the list of qualified individuals (LOQI).

2.2.2 Qualified personnel will understand their responsibilities prior to performing work.

2.3 Equipment List

2.3.1 HE-RTR System, consisting of the following major components:

- LINATRON X-ray source
- X-ray Detector
- Manipulator (Cart, X-ray source, Detector)

2.4 Precautions and Limitations

2.4.1 **IF** during the course of performing this procedure a change occurs that causes deviation from the normal process, **AND** this condition can **NOT** be corrected as directed by this procedure, **THEN** Real-Time Radiography (RTR) Operators shall IMMEDIATELY suspend work and notify the Vendor Project Manager (VPM).

2.4.2 If the Area Radiation Monitor alarm sounds

- [A] OPEN the Linac Main Disconnect in the Control Room if it can be done safely.
- [B] NOTIFY the VPM.

- 2.4.3 Employees may use copies of this procedure printed from the controlled document file; however, employees are responsible for ensuring that the correct revision of this procedure is used.
- 2.4.4 The personal protective equipment (PPE) for normal operations outside the Control Room is leather gloves, safety toe shoes, and safety glasses when handling containers. Additional PPE may be specified by Host Site management or in a site-specific Work Permit. Personnel will don the required or specified PPE before starting RTR operations.
- 2.4.5 The HE-RTR system generates high-energy x-rays (up to six Million electron Volts [MeV]). Personnel will avoid radiation exposure by observing all warning devices and personnel barriers. A safety interlock circuit will inhibit x-ray generation when the x-ray enclosure door is opened.
- 2.4.6 Workers who will be working in a radiological area must have read and signed the applicable radiation work permit (RWP).
- 2.4.7 RTR Operators will perform a walk down to visually ensure the x-ray Vault is clear of personnel and the RTR Operators will close the enclosure doors prior to the start-up of the x-ray system.
- 2.4.8 **DO NOT** attempt to OPEN the x-ray enclosure door when the x-ray system is in operation. Doing so will potentially expose affected personnel to dangerous levels of radiation and will automatically trigger an Emergency-Stop event which can be damaging to the equipment.
- 2.4.9 **DO NOT** leave the system operating unattended at anytime.
- 2.4.10 **IF** the six-month Radiation Survey has expired,
THEN DO NOT proceed with the RTR operations until Radiation Services personnel perform and document all required inspections **AND** certify the RTR system is operational within allowable limits.
- 2.4.11 **IF** the quarterly inspection on the Area Radiation Monitor has expired,
THEN DO NOT proceed with the RTR operations until Radiation Services personnel perform and document all required inspections **AND** certify the RTR system is operational within allowable limits.

2.4.12 **IF** the six-month interlock check has expired,
THEN DO NOT proceed with the RTR operations until the required
interlock check is complete **AND** the results are satisfactory.

2.5 Prerequisite Actions

2.5.1 None

3.0 RESPONSIBILITIES

3.1 RTR Operator

3.1.1 Operates the RTR system.

3.1.2 Maintains the Nondestructive Examination (NDE) Operational Logbook (OLB) in accordance with CCP-PO-005, *Conduct of Operations*.

3.2 Vendor Project Manager (VPM)

3.2.1 Ensures Central Characterization Project (CCP) personnel comply with environmental safety, security requirements, and CCP safety requirements.

3.2.2 Monitors the Qualifications of RTR Operators to ensure that only qualified people operate the equipment.

4.0 PROCEDURE

4.1 HE-RTR Equipment Startup

- 4.1.1 Obtain the system POWER key and LINAC ENABLE key.
- 4.1.2 Turn the system POWER key on the Operator Control Console (Figure 1, System Control Console) to "RUN" position and release if necessary.
- 4.1.3 Obtain an approved blank copy of Attachment 1, "NDE Daily Pre-operational Checklist" and perform the first three items to verify six-month Radiation Survey, the six-month interlock check and quarterly source check documents are current.
- 4.1.4 Open the Vault Door
- 4.1.5 Coordinate daily operation of the Area Radiation Monitor (ARM) with the Radiological Control Technician (RCT).
- 4.1.6 Inspect the equipment, warning devices, interlocks and emergency stop switches using Attachment 1 to inspect the equipment, warning devices, interlocks, and emergency stop switches, as required.
- 4.1.7 **IF** any item on the Attachment 1 is not satisfactory, **THEN DO NOT** proceed with RTR operations. Ensure the system is in a SAFE configuration and notify VPM.
- 4.1.8 Ensure no one is inside x-ray enclosure by direct observation and being the last person to leave the x-ray enclosure.
- 4.1.9 Close the Vault Door by pressing the "DOOR CLOSE" button at the shielded door.
- 4.1.10 Place the completed Attachment 1 in a holding file.

Figure 1. System Control Console



4.1.11 Turn the system POWER key on the System Control Console (Figure 1) to “RUN” position and release if necessary.

4.1.12 Turn the switch on LINAC Temperature Control Unit (TCU) to “ON.”

4.1.13 Ensure the ventilation fan is on and functioning.

4.1.14 Press the “RESET” Button on the LINAC Modulator.

4.1.15 On LINAC control console touch-screen display, press the button “Startup,” then press the button “Power Is Off.” Display should change to “POWER Is On.”

[A] Record the time of LINAC “POWER ON” in the NDE OLB.

4.1.16 Start the imaging computer.

4.1.17 Start the control/archive computer.

4.1.18 After both computers are ready, start Vi3 software on the imaging computer.

NOTE

If Vi3 detects that all motion axes are not homed at startup, the Vi3 display screen will prompt the operator to begin a homing sequence.

- 4.1.19 **IF** prompted by Vi3 software to perform a “Composite Home,” **THEN** click “YES” **AND** ensure that all axes move to Home position.
-

NOTE

Homing is verified in Vi3 RT Series software by noting that the position for each axis is set to 0 inches after the axis is moved to a programmed limit. The homed individual axis may be used by clicking (H) and “OK.” The homed axis is also colored BLUE on the display.

4.2 LINAC Warm Up

WARNING

During the daily checkout, if the LINATRON-M does not function as expected, or if unusual sounds or odors are present, the main circuit breaker (CB1) on the modulator front panel must be turned to the OFF position.

NOTE

The LINATRON-M progresses through several operational states during power up. Each of these states (except emergency off) is named in the Status screen in the Main control screen. These states are:

- Emergency off
- Standby
- Power On
- Prewarn
- Ready
- X-rays on

The Power On state was attained in step 4.1.15. Warm-up sequence is automatic and should take 7 minutes if no error messages need to be cleared.

- 4.2.1 Observe the LINAC screen for system status messages.

- 4.2.2 **IF** the Interlocks or Faults screen buttons are flashing red, **THEN** touch the flashing button for a detailed report.
- 4.2.3 Clear any faults or interlocks that are preventing the warm-up completion.

NOTE

Once all faults and/or interlocks are cleared, the warm-up sequence will resume automatically.

- 4.2.4 Record the time Warm-up is complete in the NDE OLB.

NOTE

At the completion of Warm-up, the only interlock preventing Pre-warm operation is the Enable/Disable key switch on the LINAC control console. When this key is turned to ENABLE, the 20 second pre-warning period begins.

4.3 Detector Calibration

- 4.3.1 **IF** calibration of the flat panel image detector is indicated, **THEN** ensure that the x-ray Vault is NOT occupied **AND** that the access doors are closed.
- 4.3.2 Click on the “calibrate” button in Vi3 to calibrate the detector.
- 4.3.3 A window will open with the message, “Welcome to the Detector Calibration Wizard.” Click the “Next” button at the bottom of the window.
- 4.3.4 Ensure x-ray generation has been off for at least 10 minutes. Click “Next” button at the bottom of the window.
- 4.3.5 At the LINAC control, insert the ENABLE key and turn it to “ENABLE.”

NOTE

An audible warning will sound and the beacon will flash amber for 20 seconds.

- 4.3.6 Turn on the LINAC by pressing “BEAM ON.”
- 4.3.7 Click “Next” button at the bottom of the Vi3 window.
- 4.3.8 Click the “Next” button at the bottom of the window as there are no adjustments to be made.

4.3.9 Click the “Next” button at the bottom of the window to begin automatic detector calibration.

4.3.10 **WHEN** the message “Detector calibration is complete!” appears on the screen,
THEN click “Close” button.

4.3.11 Press “BEAM OFF” button at the LINAC control.

4.3.12 Turn the ENABLE key to DISABLE.

4.3.13 Remove and secure the ENABLE key.

4.4 System Operation

4.4.1 Ensure the cart is in the load position.

4.4.2 Once the cart is in loading/unloading area, turn LOCK/UNLOCK switch (Item number 12 in Figure 1) to LOCK position.

4.4.3 Ensure the area is clear, **AND**, if necessary, press the “DOOR OPEN” console button (Item number 2 in Figure 1).

4.4.4 Verify Radiation Monitor is **NOT** alarming (indicates that the LINAC is de-energized).

NOTE

The RTR Operator will be in the field area during all unloading and loading events with the key in his control in full view.

4.4.5 Ensure the container to be examined is loaded onto the cart turntable.

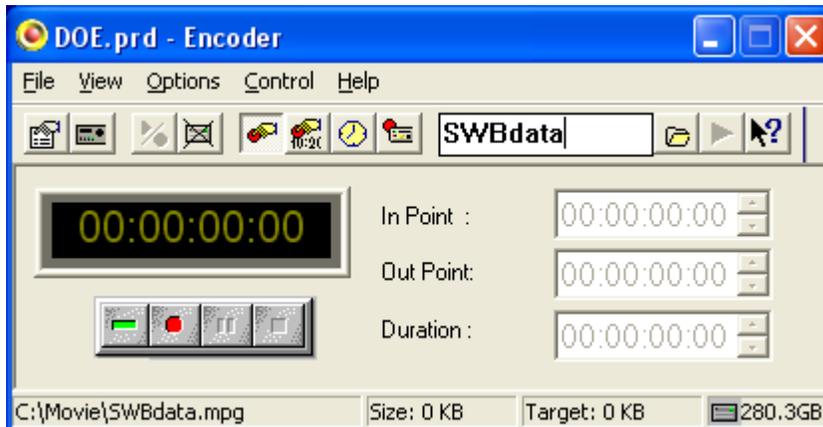
4.4.6 **WHEN** the area is clear,
THEN press the “DOOR CLOSE” button at the shielded door.

4.4.7 Press the “INSPECTION” console button (Item number 6 in Figure 1).

[A] Ensure the cart is in front of the detector using the joystick (Item number 4 in Figure 1) **OR** entering position coordinates into the motion control software if necessary.

- 4.4.8 **IF** using MPEG composer, start MPEG ENCODER ICON control/archive on the computer, **THEN** enter Container Identification data in the form of an alphanumeric filename for the movie file at the location where “SWBdata” is written in Figure 2, MPEG Encoder, below.

Figure 2. MPEG Encoder



- 4.4.9 At the LINAC control, insert the ENABLE key and turn it to “ENABLE.”
- 4.4.10 After the prewarning time, turn on the LINAC by pressing “BEAM ON.”
- 4.4.11 Click on the ‘Grab – F3’ button in Vi3 to enable live display of images from the detector.
- 4.4.12 Click on the auto-contrast button to enable window-leveling. Window-leveling is performed by drawing a rectangle while holding the mouse down around the area of the image to be improved.
- 4.4.13 **IF** recording video, **THEN** click on the F2 key on the keyboard to display the image in full screen mode.

NOTE

The F2 key toggles between the regular Vi3 window (with toolbars) and the full-screen.

- 4.4.14 **IF** recording video, **THEN** click the GREEN button in MPEG Composer to initialize the recording.

4.4.15 **IF** recording video,
THEN click the RED record button in MPEG Composer to start recording.

4.4.16 GO TO CCP-TP-053, *CCP Standard Real-Time Radiography (RTR) Inspection Procedure*, and manipulate the display image using the joysticks (Item number 7 in Figure 1 and Item number 8 in Figure 1) to examine 100% of the contents of the container.

NOTE

At the console, additional controls may assist in achieving the required examination: "SOURCE/DETECTOR" (Item number 10 in Figure 1) and "LOCK/UNLOCK" (Item number 12 in Figure 1) may be used to attain oblique viewing angles.

4.4.17 **WHEN** done,
THEN stop recording by clicking on the rectangular stop button on the MPEG Composer software.

4.4.18 Stop x-ray by pressing the 'BEAM OFF' button on the LINAC control console and turning the ENABLE key to "DISABLE."

4.4.19 Remove and secure the ENABLE key.

4.4.20 Press the "LOAD/UNLOAD" button (item number 5 on Figure 1)

[A] Ensure the cart is at the load/unload position using the joystick (item number 4 in Figure 1) **OR** entering position coordinates into the motion control software if necessary.

NOTE

The RTR Operator will be in the field area during all unloading and loading events with the key in his control in full view.

4.4.21 Ensure the area is clear, AND press the "DOOR OPEN" console button (Item number 2 in Figure 1).

4.4.22 Ensure the container is unloaded from the cart turntable.

4.4.23 **IF** another container is to be examined,
THEN repeat Section 4.4.3;
ELSE proceed to Section 4.5.

4.5 HE-RTR Shut-Down

- 4.5.1 Ensure NO personnel are present inside the Vault **AND** close the shielded door by pressing the “DOOR CLOSE” button at the shielded door.
- 4.5.2 Make required copies of the video data files.
- 4.5.3 Close down computers in accordance with controlling procedures, work instructions, or protocols.

WARNING

Even after you have pressed “Power is ON” and the LINAC system appears to have powered down, some parts of the system are still powered and can cause serious injury or death if touched.

- 4.5.4 At the LINAC control, touch “Power is ON” button on the Main control screen to return the LINATRON to the standby state.
- 4.5.5 Turn the operator console key switch to “OFF.”
- 4.5.6 Remove and secure both keys.
- 4.5.7 Turn the switch on the TCU to “OFF.”
- 4.5.8 Ensure the ventilation fan is turned off.
- 4.5.9 Complete entries to the NDE OLB, including Shut-Down time.
- 4.5.10 Secure the HE-RTR system.

5.0 RECORDS

- 5.1 The records generated during the performance of this procedure are identified as quality assurance (QA) records and are maintained as QA records in accordance with CCP-QP-008, *CCP Records Management*. The records are the following:

5.2.1 QA/Lifetime

[A] NDE OLBs

5.2.2 QA/Nonlifetime

[A] NDE Daily Pre-Operational Checklist

Attachment 1 – NDE Daily Pre-Operational Checklist

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HE-RTR Number: _____ Location: _____ Date: ___/___/___

Maintain the LINAC ENABLE key in possession at all times. System POWER key must be ON to open doors and verify E-stops and warning lamps.

Check the following items for satisfactory status:

IF found to be satisfactory,
THEN initial the box.

IF the item is NOT satisfactory,
THEN mark X in the box and explain in the comments section.

- Six-month Radiation Survey is current. Survey Date: _____
- Six-month Interlock Check is current. Check Date: _____
- Quarterly Area Radiation Monitor (ARM) source check is current.
Check Date: _____
- Signs and postings outside exposure room: High Rad sign located under the red beacon light above the roll-up door.
- General Housekeeping: No trash, no unsecured equipment or tools, no excessive dirt nor debris.
- Signs and postings inside exposure room
 - E-Stop sign located near the E-Stop on the left wall inside the Vault.
 - Pull cord signs (first attachment) are located near the middle of each of the pull cords.
- Transport cart and tracks: No visible damage, no fluid leaks, no foreign material.
- Detector panel and lift: No visible damage, no fluid leaks, no foreign material.
- LINAC and lift: No visible damage, no fluid leaks, no foreign material.

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

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HE-RTR Number: _____ Location: _____ Date: ___/___/___

NOTE

Warning lamps are tested using a switch (Item 11 in Figure 1) at the operator console. Item 11 in Figure 1 is titled Warning Lamps check.

Warning Lamps: Red lamp inside exposure room, red beacon over shield door.

NOTE

Pre-warning alarms are tested using a switch inside the exposure room.

Pre-warning alarms: Amber lamp inside exposure room, audible alarm inside control room.

NOTE

There are five pull cord E-stops inside the exposure room, in addition to a Red mushroom button inside the exposure room door, and another Red mushroom button at the System control console. Operating any one of these E-stops will drop out System power and turn on an indicator lamp at the actuated E-stop. That E-stop must be reset before power can be restarted at the System control console. A different E-stop switch should be tested every day.

E-stop circuit Actuator tested: _____

Exposure room is clear of all personnel.

Verify Vault Door Interlock. Visually inspect for signs of damage or wear; verify engagement on door closing.

