1.0 PURPOSE:

The eXplore Locus SP MicroCT scanner is used in conjunction with the MS console to scan, acquire, and reconstruct specimens for in-depth three-dimensional analysis. A series of two-dimensional projections captured during the acquisition process are reconstructed into a single three-dimensional volume by the MS console using GE eXplore software.

2.0 SCOPE:

This document outlines a typical scanning procedure that is only applicable for scans performed by the MS scanner. The laboratory area where the scans are performed will vary between a Containment Level 1 or Containment Level 2 laboratory depending on the specimen being scanned. Analysis methods and techniques on full-resolution reconstructed regions of interest will not be outlined.

3.0 RESPONSIBILITIES:

- Users that have received training from qualified individuals may operate the scanner and are responsible for performing image acquisition, adjustment and reconstruction.
- If necessary, trained personnel execute procedures related to animal preparation and decontamination of the area in compliance with local policies from *The University of Western Ontario Council for Animal Care (UCAC)*.

4.0 DEFINITIONS:

Acquisition – The process of acquiring CT images. i.e. scanning.

ADU – Arbitrary Digital Units. These units need to be calibrated to have physical meaning.

Center of Rotation – The vertical axis of the reconstructed three-dimensional volume.

Operator – A trained individual qualified to work with the scanner.

Reconstruction – The process of converting many single projections taken during the same scan into a single three-dimensional volume.

MS console – The computer located beside the MS scanner that acquires and reconstructs the scanned images. The MS scanner is directly connected to this console.

MS scanner – Locus SP MicroCT Scanner.

ROI – Region of Interest

Specimen – The object that is being imaged.

5.0 REFERENCES:

GE Healthcare eXplore Locus User Manual

6.0 EQUIPMENT:

eXplore Locus SP MicroCT Scanner
MS Console

7.0 PROCEDURES:

All references to programs related to GE software can be found under the following directory: Start → Program Files → GE Medical Systems → eXplore utilities.

7.0.1 PRELIMINARY PROCEDURE

1. Decide what protocol will be used for scanning the specimen.
2. Refer to the SOP that complies with the specimen being scanned for preparation and handling procedures.

Object	**SOP**
Living rat/mouse	Animal Handling for MicroCT
Non-living rat/mouse	Non-living rat/mouse
Rat/mouse ligament	Rat/mouse ligament
Phantom	Phantom

7.0.2 SYSTEM WARMUP

A green light at the side of the CT scanner (next to the power cables) indicates that the scanner is ON and a system warmup will not necessary.

1. If the CT scanner is OFF, turn the key located on the machine counter-clockwise. If the key is not in the machine, contact a facilitator for the key.
2. Log onto the MS console.
3. A warmup process should automatically start. This process will take about 10 minutes. If the warmup process does not start:
   a. Run **Warmup App**.
   b. Click **Idle**.
   c. Wait for a popup window to appear that says “X-rays are now warmed up”. Click on **Scan Control** to continue with scanning.

7.0.3 CHANGING THE DATA DIRECTORY

1. Goto **Start → Settings → Control Panel** and run **GEMS eXplore System Controls**.
2. Type in the new working directory. The drive can only be switched between D: and R:.

7.0.1 SCANNING

1. Run **eXplore Scan Control**.
2. Choose **Scan New Subject** or **Add to Existing Subject**. Record the scan number that is shown, the number becomes the directory whereby the acquired images will be allocated.
3. Enter a descriptive name for the scan and click **Accept**.
4. Select the scanning protocol.

5. Click **Fluoro** to view the position of the specimen. it may take a few minutes.
6. Move the acquired bed view to centralize the ROI.
7. Close the window to proceed.
8. Click **Start Scan** to begin scanning. This may take 10-15 minutes depending on the number of frames being acquired as well as other protocol parameters.

7.0.2 RECONSTRUCTION

After images have been acquired from the MS scanner, the array of two-dimensional projections needs to be combined into a three-dimensional volume. The following processes are done with the eXplore Reconstruction Utility.

A. LOAD AND CORRECT SCAN IMAGES*.*

1. Run **eXplore Reconstruction Interface**.
2. Click **Load Scan** and load the log file of the scan. This log file will be found under the directory that corresponds to the scan number.
   NOTE: All log files are named *evolver.log* by default.
3. Click **Correct**.

B. RECONSTRUCT A REGION OF INTEREST

*This is done using **eXplore Reconstruction Interface**.*

1. Check the **Mini Volume** checkbox.
2. Click **Thumbnail**.
2. Click **Recon**. eXplore MicroView is launched automatically once a reconstruction is complete.
3. Press ‘Ctrl+7’ to designate the intersection of the three planes as the first corner.
4. Move the three planes to define the second corner.
5. Press ‘Ctrl+8’ to designate the intersection of the three planes as the second corner.
6. Press ‘S’ to save the region coordinates.
7. Press **Load Crop** to load the saved coordinates.
8. Uncheck the **Mini-Volume** checkbox.
9. Press **Full Res** Click **Recon**.

C. OBTAIN CALIBRATION VALUES

*This is done using **eXplore Reconstruction Interface**.*

1. Click **Advanced**.
2. Select **Reconstruction**.
3. Select **32-bit slice**.
4. Click **Recon**. eXplore MicroView is launched automatically once a reconstruction is complete.
5. Press ‘7’ and ‘8’ to select a rectangular region of *air* in the volume. Press ‘M’ to display the average ADU value of the selected region. Record the value.
6. Repeat step 5 to obtain the ADU values for *water* and *bone*.
7. Click **Advanced**.

8. Select **Reconstruction**.
9. Enter the recorded ADU values for air, water, and bone into the calibration textfields.
10. Click **OK**.

D. ADJUST THE CENTER OF ROTATION

*This is done using **eXplore Reconstruction Interface**.*

1. Click **Full Res**.
2. Click **Advanced**. Select **Short Scan**.
3. Set the **Z-Size** value to 1.
4. Click **Recon**. Hit **enter** if you are satisfied with the default name for the volume. This will generate a 2D slice.
5. Notice the direction of any wisps on the image. If the wisps are to the left, the Center of Rotation value will need to be increased. If the wisps are to the right, the Center of Rotation value will need to be decreased. If the wisps appear to be in both directions, refer to *section 7.7.2 CENTER OF ROTATION OFFSET*.
6. Click **Advanced**.
7. Select **Reconstruction**.
8. Change the Center of Rotation value. Click **OK**.
9. Repeat steps 4-8 until the Center of Rotation is well adjusted.
10. Uncheck **Short Scan**.
11. Click **Load Crop** to retrieve the saved coordinates of the ROI.

E. QUEUING RECONSTRUCTION JOBS

*It is sometimes useful to queue reconstruction jobs to save time for an operator. This is done within **eXplore Reconstruction Interface**.*

1. Click **Append** to place a reconstruction job into the *job queue*. Additional jobs can be queued by clicking **Append**.
2. Click **Job Manager** to view the job queue.

7.0.3 SYSTEM SHUTDOWN

This procedure should only be performed on rare occasions, such as a scheduled power outage.

1. Shutdown the MS console.
2. Turn the key in the MS scanner clockwise. You should now be able to take the key out. The green light by the power cables will be off.

7.3 RISKS TO PERSONNEL AND PRECAUTIONS FOR RISK REDUCTION:

7.3.1 Because the MS scanner uses X-rays, avoid tampering with it. ?!?

7.7 CONTINGENCIES:

7.7.1 SLOW RECONSTRUCTIONS

If the reconstruction process is taking longer than anticipated, it may be because a local DOS box method is being used to perform the reconstruction computations. To resolve this contingency, under the eXplore Reconstruction Interface:

a. Click **Advanced**.
b. Select the **Network** tab.
c. Select a reconstruction server from the list.
d. Uncheck **Use local DOS box method**.
e. Click **Accept**.

7.7.2 CENTER OF ROTATION OFFSET

Occasionally the wisps will point in two opposing directions in the same image. Adjusting the value of the center of rotation will not remedy this problem. The source of this problem is from the reconstruction software. The advised solution would be to adjust the center of rotation for the desired area of interest.

8.0 REPORTING AND DOCUMENTATION:

During each scan, acquisition and reconstruction procedure, record the following information:

9.0 REVIEWS AND REVISIONS:

This procedure shall be reviewed for compliance and effectiveness and revised as necessary.