



3D Well Counter Correction

Prerequisites


Table 1. Personnel requirements


Required persons	Preliminary requirements	Procedure	Finalization
1	minutes	minutes	minutes

Table 2. Tools and test equipment

Item	Quantity	Effectivity	Part number	Manufacturer
DQA Annulus Phantom	1	-	-	-
Flood Phantom	1	-	-	-
Phantom Holder assembly	1	-	5479999	-

Table 3. Safety





CAUTION

EXPOSURE TO RADIATION.

This procedure uses radioisotopes.

Follow facility guidelines to handle and dispose of radioactive substances.

Overview

Normalization involves measuring the differences in individual crystal efficiencies to obtain correction factors which are applied to each emission scan. Normalization scans are carried out using a centered DQA Annulus phantom landmarked on the scribed line closest to the phantom holder..

The Well Counter Correction (WCC) uses a water-filled flood phantom and a known quantity of radioisotope to correlate the measured numerical value in each image pixel to a specific activity measured in physical units (activity per volume). Images in physical units are required to calculate SUVs. WCC also maintains a good match of sensitivity between the imaging system and dose calibrator.

Last Revised:	27 September 2018
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1 3D Normalization: Position and Scan the DQA Annulus Phantom

Follow this procedure to mount, position and scan the DQA annulus phantom. Follow facility guidelines to transport and handle the radioactive phantom. If possible, avoid holding the phantom from the sides; always use the handle and the round opening on its end-caps.

Procedure

1. Click the **Exam Rx** icon on the scan monitor.
2. Click **New Patient** on the display monitor.
3. Type **PETWCC3D** into the **Patient Name** and **Patient ID** data fields.
4. Click **Enter PET Tracer Info** and **record** the information from the phantom label.
 - Type the phantom volume (nominal **1250** mL) into the **Tracer volume** field.
 - Type the date and total activity into the **Pre-Injection Assay** data field.
 - Do not update the **Injection time** and **Post-Injection Assay** data fields.

NOTE:

Some DQA Annulus Phantoms are either missing the volume value or the value listed is in “liters” instead of “ml”. Enter the nominal phantom volume value of **1250** ml into the Tracer Volume Field.

5. Click **Accept** to close the tracer panel.
6. Click the **GE** tab on the protocol selector.
7. When looking at the Anatomical Adult (under the **GE** tab), place the cursor directly under the toes and click. The **Miscellaneous** protocol selections should display.
8. Click the **Normalization 68Ge Annulus** protocol. Do NOT change the default parameters.
9. Retrieve the phantom holder. Mount the holder to the end of the table. Ensure the phantom holder clips to the cradle securely.



EXPOSURE TO RADIATION.

This procedure uses radioisotopes.

To minimize unnecessary exposure, maintain maximum distance from PET Annulus Phantom and minimize time spent holding phantom.

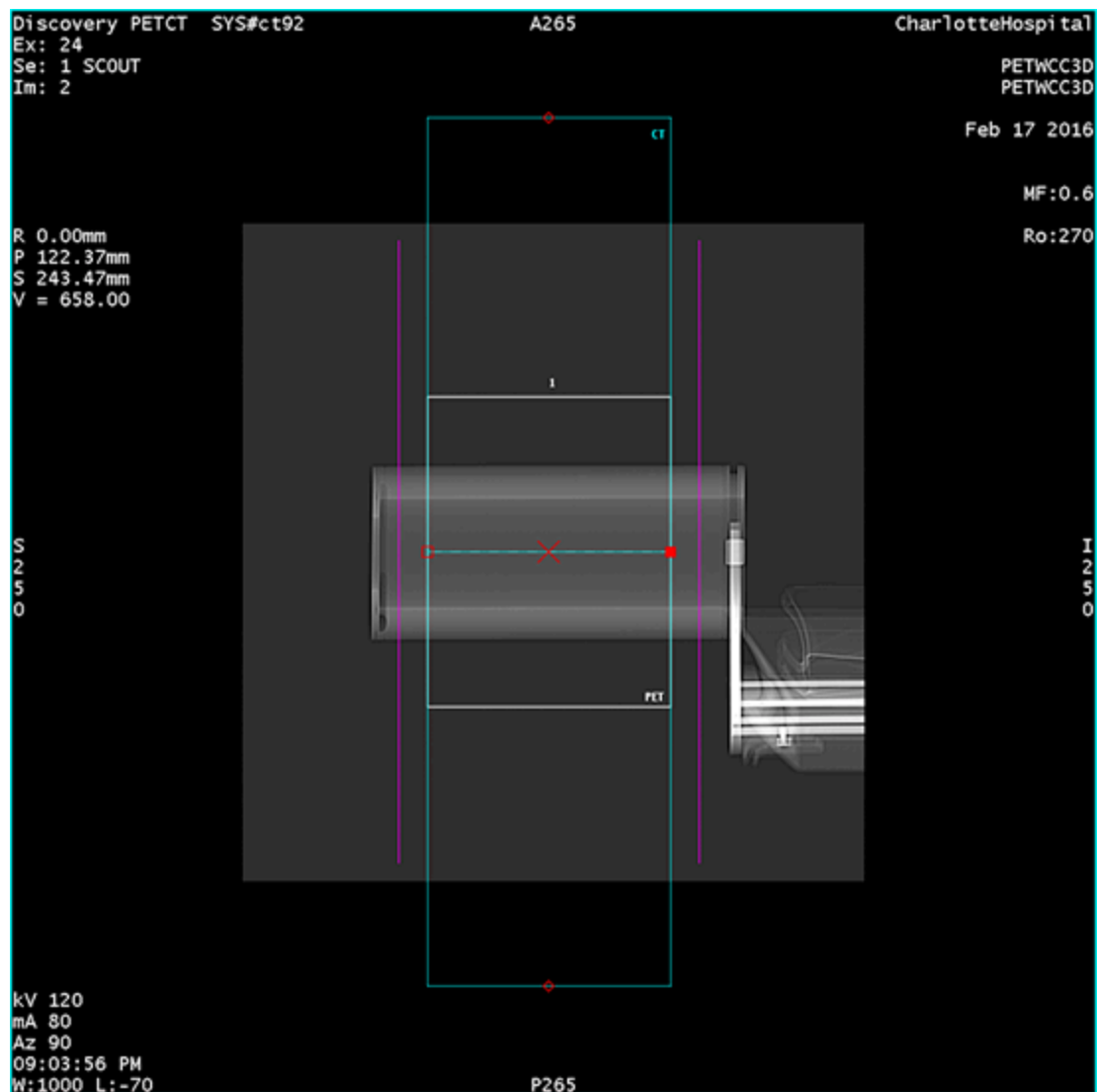
10. Retrieve the DQA annulus phantom. Mount the phantom on the phantom holder. Ensure the phantom is fully seated on the phantom holder.
11. Align the straight lines scribed along the length of the phantom with the horizontal and vertical lasers, and the mark scribed around the phantom closest to the phantom's holder with the axial laser, then press **Landmark**. See [Figure 1](#). The position settings loaded with the protocol will center the phantom in the FOV.

Figure 1. Align DQA (Annulus) Phantom on Phantom Holder



12. Make sure all personnel leave the scan room before you initiate the scan sequence.
13. Click **Confirm** to initiate the Scout scan sequence.
14. Press the **Move to Scan** button when it flashes.
15. Press the **Start Scan** button when it flashes. The X-Ray Exposure Indicator on the Acquisition Control illuminates (amber) during the X-ray exposure.
16. Click **Next Series**.
17. If necessary, click **Show Localizer** to display the 90 degree Scout image.

Figure 2. Graphic Rx Localizer



18. Refer to [Figure 2](#). If necessary, use the Graphic Rx Localizer to position the scan field over the center gray area of the phantom, away from the phantom edges.
19. Click **Confirm**.

NOTE:

The default acquisition time for Normalization is 2 hours and 30 minutes, but the actual acquisition time is shorter calculated on current count rate from the phantom and fix number of counts to acquire ("stop on counts"). Acquisition time will increase as the phantom ages.

20. Press **Move to Scan** when it flashes.
21. Press **Start Scan** when it flashes. The system acquires the CTAC.
22. Click **PET**.
23. Click **Confirm**.

NOTE:

The default acquisition time on the Normalization menu is listed as "2h:30m" and is a worse case value. The actual acquisition time is based on the activity of the Annulus phantom with the "Stop on Counts" selection turned on and can then be as short as 8 minutes with a new phantom. Acquisition time, however, will increase as the phantom ages.

24. Press **Move to Scan** when it flashes.

25. Press **Start Scan** when it flashes. The system acquires the CTAC required to correct for attenuation in the phantom during the reconstruction of the PET images.
26. Click **PET**.
27. Click **Confirm**.
28. Press **Move to Scan** when it flashes.
29. Press **Start Scan** when it flashes. Wait for scan to complete. Prospective reconstruction begins immediately on scan completion.
30. Click **End Exam**.
31. DO NOT delete or modify the image series created in this test (**Series 12**) until the next Normalization scan.
32. Remove the annulus phantom and store it in a shielded container.
33. Remove the phantom holder from the table cradle.

2 Well Counter Correction: Prepare and Scan the Water-Filled Flood Phantom

Follow this procedure to load a flood phantom so it has approximately 20 MBq (0.54 mCi) of F-18 at scan time for use in the 3D Well Counter Correction procedure. Remember to **record** the times and activity values when directed, so you can enter these values into the corresponding **Tracer Information** window fields.

2.1 Preliminary Phantom Preparation

Procedure

1. WCC requires a flood phantom. Remove all inserts from the PET Image Corrections Phantom.



GE FES SHOULD NOT HANDLE, INJECT OR MIX THE ISOTOPES NEEDED FOR WCC SCANS.

Work with the customer to fill the flood phantom with the appropriate amount of F-18 FCG.

2. Fill the phantom with clean water, leaving enough space to hold the injected activity.
3. Tilt and rotate the phantom to dislodge any air bubbles and move them to the fill hole. Air bubbles with a diameter of less than 10 mm will not disturb most tests.
4. Verify the time on the dose calibrator clock matches the time on the scanner.
5. If your facility uses a stirring bar and magnetic plate to mix phantoms, follow the manufacturer's instructions and facility guidelines to use them. If the stirring bar will remain in the phantom, make sure it is against one of the end walls of the phantom.

NOTE:

This procedure contains instructions to mix the phantom without using these tools.

2.2 Measure Tracer Activity and Inject the Phantom

Follow the procedure in this section to measure the amount of activity you injected into the phantom.

- The WCC calibration matches a known amount of activity concentration, calculated in this section, to the display image pixel value. Make sure you set the dose calibrator to the isotope you plan to assay. Make sure the scanner,

dose calibrator, and facility clocks are synchronized. A time difference of only two minutes introduces a bias of more than one percent for F-18 FDG.

- Refer to the following formula:

$$\frac{\text{Total Activity} - \text{Residual Activity}}{\text{Flood Phantom Volume}} = \text{MBq/ml in flood phantom}$$

Measure the total activity in the syringe, inject the activity into the phantom, then measure the residual activity in the syringe. Subtract the residual activity from the total activity, then divide this value by the total volume of the flood phantom. The resulting value equals the unit activity per milliliter in the phantom. (1 ml = 1 cc).

Procedure



EXPOSURE TO RADIATION.

This procedure uses radioisotopes.

Follow facility guidelines to handle and dispose of radioactive substances.

1. Draw the F-18 tracer into the syringe.
2. Measure and **record** the time and total activity of the isotope in the syringe. Use the patient dose calibrator (set to F-18) to measure total and residual activity.
3. **Record** the time, then inject the contents of the syringe into the phantom.
4. Rinse the syringe by drawing up some phantom water, and reinjecting it.
5. Return the used syringe to the patient dose calibrator.
6. Measure and **record** the time and residual activity in the syringe.
7. Fill the remaining air bubble with water and seal the phantom. Do not overfill the hole where the plug connects. If there is no bubble left in the phantom, the plug may create excessive pressure inside the phantom and develop a leak.
8. Thoroughly mix the contents of the phantom to evenly distribute the activity.
 - Use a stir rod.
 - or
 - Before filling the phantom completely, place it on a clean towel and gently roll it back and forth to mix. This method will not be effective with a full tank.
9. **Record** the total volume of the flood phantom.
 - The standard volume of the flood phantom normally equals 5,640 ml. For best results measure the actual volume of the flood phantom and **record** that value on a label, and place it somewhere on the phantom, for future reference.
 - The volume of the water is best measured by subtracting the weight of the empty phantom from the weight of the water-filled phantom. Leave a ~3 cc air bubble to allow expansion of cold water as it reaches room temperature.

10. Subtract the residual activity (measure and **record** the time and residual activity in the syringe) from the total activity (measure and **record** the time and total activity of the isotope in the syringe). Divide this value by the total volume of the phantom (**record** the total volume of the flood phantom) to obtain the unit activity/ml. **Record** the unit activity/ml.
11. Follow facility guidelines to label the phantom as radioactive.

2.3 Position and Scan the Flood Phantom

Follow this procedure to mount, position, and scan the flood phantom.

Procedure



EXPOSURE TO RADIATION.

This procedure uses radioisotopes.

Follow facility guidelines to transport and handle the radioactive flood phantom.

1. Click the **Exam Rx** icon on the scan monitor.
2. Click **New Patient** on the display monitor.
3. Enter *PETWCC3D* into the **Patient Name** and **Patient ID** field.

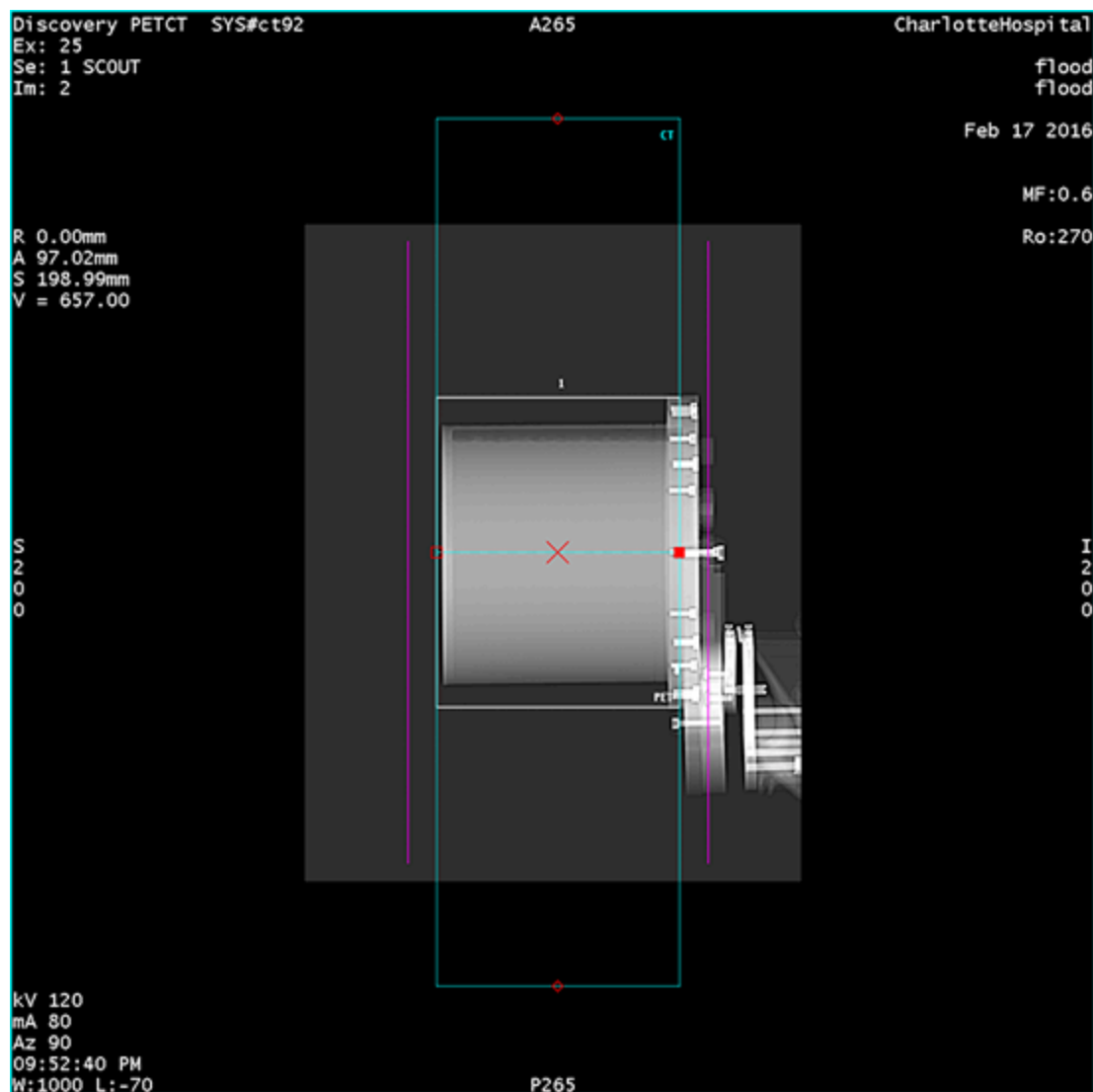
NOTE:

For the software to work, *PETWCC3D* must be entered in the Patient Name and Patient ID field for both protocols.

4. Click **Enter PET Tracer Info** and use the information you recorded during the previous section to fill in the data fields.
 - Enter the phantom volume (default 5640 ml) into the Tracer volume field. Do not enter the volume of the syringe into this field.
 - Enter the time and total activity into the **Pre-Injection Assay** field.
 - Enter the time and residual activity into the **Post-Injection Assay** field.
5. Click **Accept** to close the **Tracer Information** window.
6. Click the **GE** tab on the protocol selector.
7. When looking at the Anatomical Adult, place the cursor directly under the toes and click. The Miscellaneous protocol selections should display.
8. Click the **WCC FDG Flood** protocol. Do not change the default parameters.
9. Align the scribed mark on the phantom to the external lasers and press **External Landmark**. The phantom should be centered in the longitudinal direction.
10. Make sure all personnel leave the scan room before you initiate the scan sequence. Click **Confirm** to initiate the Scout scan sequence.
11. Press the **Move to Scan** button when it flashes.
12. Press the **Start Scan** button when it flashes. The X-Ray Exposure indicator on the Acquisition Control illuminates (amber) during the X-ray exposure.
13. Click **Next Series**.

14. If necessary, click **Show Localizer** to display the 90 degree scout image.
15. Use the Graphic Rx Localizer to position the scan field over the center gray area of the phantom, with the red cross-hair centered on the phantom.

Figure 3. Correctly Positioned Graphic Rx Localizer



16. Click **Confirm**.
17. Press **Move to Scan** when it flashes.
18. Press **Start Scan** when it flashes. The system acquires the CTAC required to correct for attenuation in the phantom during the reconstruction of the PET images.
19. Click **PET**.

NOTE:

If you used a isotope other than F-18, click **Nuclide**, select the correct tracer, then click **OK** to continue.

20. Click **Confirm**.
21. Press **Move to Scan** when it flashes.
22. Press **Start Scan** when it flashes. The selected protocol prescribes the prospective image reconstruction.
23. When the **System Messages** area displays the message "scan completed", click **End Exam**.

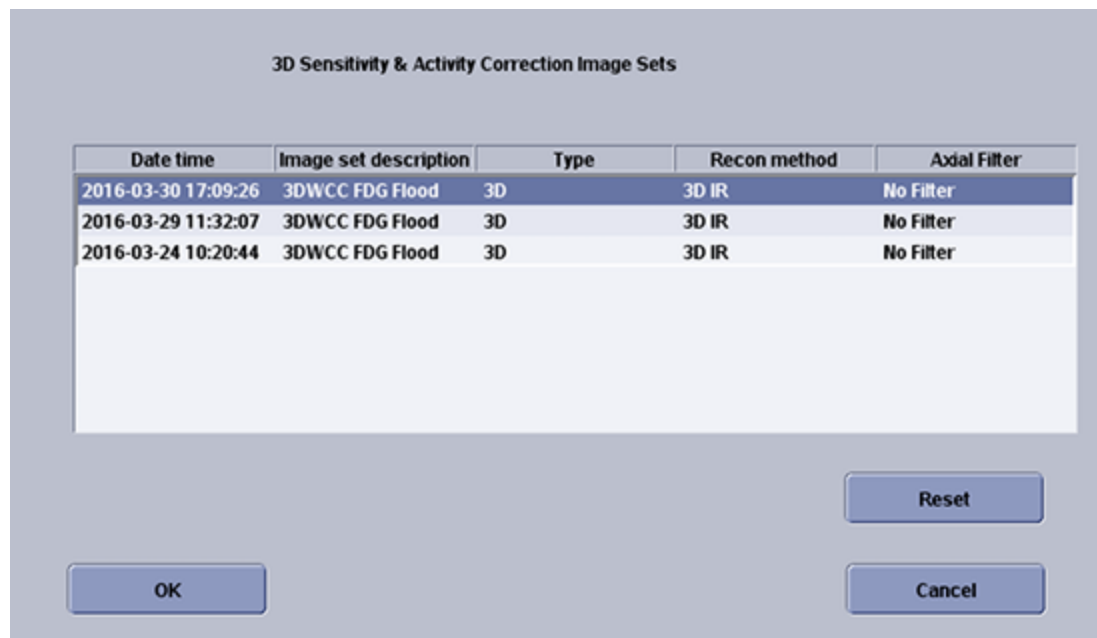
3 Generate the 3D Normalization and Well Counter Corrections

Follow this procedure to generate the 3D Normalization and Well Counter Corrections from the data acquired during the previous section.

Procedure

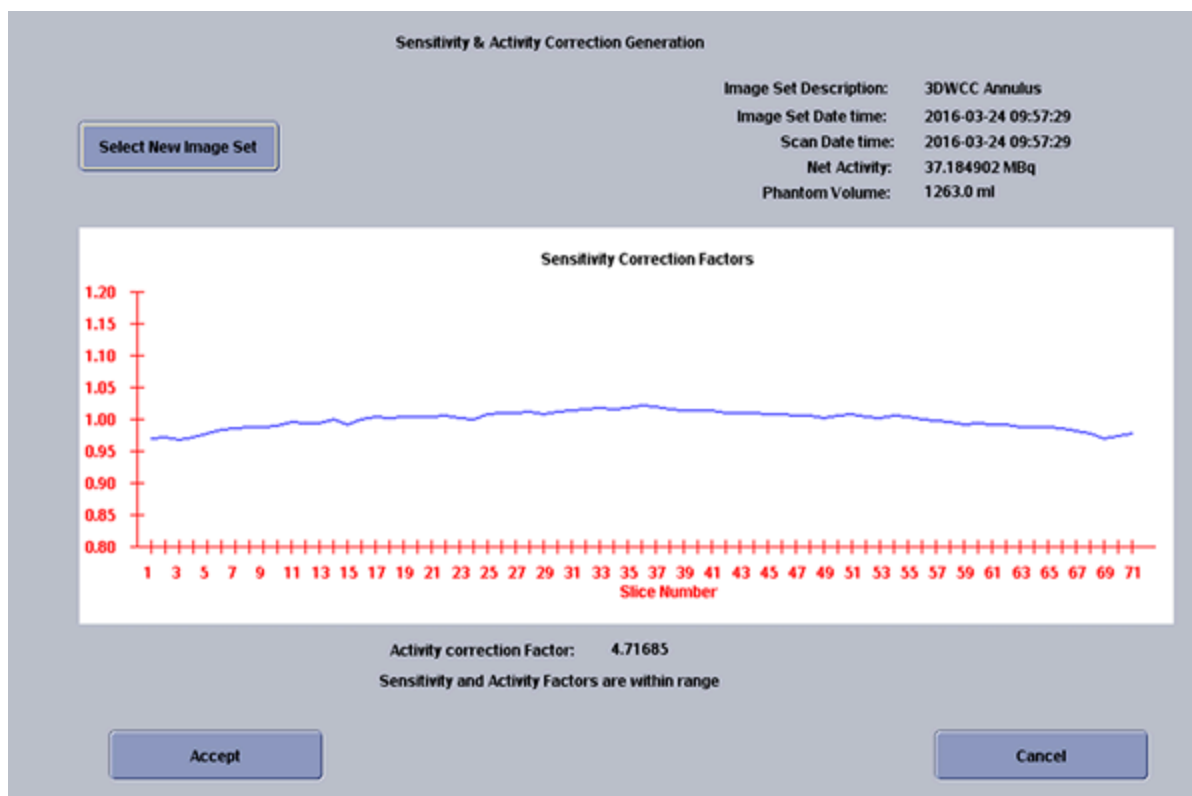
1. Click the **Service** icon on the scan monitor to open the service desktop.
2. Click the PET radio button to display the PET service desktop.
3. Click the **Image Quality** icon. If necessary, click the **Image Quality** folder to display its contents.
4. Click the **3D Normalization** folder to display its contents.
5. Click **3D WCC Calculation** to open the **3D Sensitivity & Activity Correction Image Sets** window.

Figure 4. 3D Sensitivity and Activity Correction Image Sets



6. Select the image set from the most recent WCC acquisition with description **3DWCC FDG Flood**.
7. Click **OK** to display a **Sensitivity & Activity Correction Generation** graph.

Figure 5. Sensitivity and Activity Correction Generation Graph



8. Click **Accept** to set the newly generated well counter as the system default, and open a WCC Description window with the default description displayed.

Optional: Enter a descriptive name for the correction into the field.

9. Click **Save** to open an alert window with the message, "WCC results stored in database."
10. Click **OK** to use this as the default correction for all scans.
11. Return to the PET Service Desktop **Image Quality** tab and click **Cal Manager** to open the PET Calibration Database similar to the one shown in [Figure 6](#).
 - a. Click the **Well Counter Calibration** and **Normalization** check boxes to display the corresponding database information.
 - b. Verify the most recently acquired Normalization and 3D WCC appear in the database, with the label, **true**, in the **Default** column.

Figure 6. PET Calibration Database Manager

☒ Normalization
 ☐ Blank Scan
 ☐ Geometric Correction
 ☒ Well Counter Calibration

☐ Energy
 ☐ Position Map
 ☐ Gain
 ☐ CTC Timing

Date/Time	Type	Default	Description
30 Mar 2016 16:52:25	3D Normalization	true	3DWCC Annulus
30 Mar 2016 17:32:38	3D WCC	true	3D WCC 30 March 2016 CR BAY94
29 Mar 2016 08:34:28	3D Normalization	false	3DWCC Annulus
28 Mar 2016 10:33:38	3D Normalization	false	3DWCC Annulus
24 Mar 2016 10:15:09	3D Normalization	false	3DWCC Annulus
18 Mar 2016 06:25:19	3D Normalization	false	3DWCC Annulus
29 Mar 2016 11:54:29	3D WCC	false	3D WCC FDG Mar29 Bay94Col4R Idr
28 Mar 2016 12:35:22	3D WCC	false	3D WCC 28 March 2016 LR Bay90
28 Mar 2016 12:00:36	3D WCC	false	3D WCC FDG Marc 28th 690 Bay96
24 Mar 2016 10:45:02	3D WCC	false	3D WCC 24 March 2016 K141
18 Mar 2016 08:49:25	3D WCC	false	3D WCC FDG Marc 18 Bay 94 Idr

Refresh
 More Info
 Export
 Import
 Reference List
 Set Default
 View Data
 Log
 Delete
 Close

12. Optional: To assign a different **Default**, click the corresponding file description, then click **Set Default** to change the corresponding default label to **true**, and move the file to the top of its category.
13. Click **Close** to exit the PET Calibration Database manager.
14. Remove flood the phantom from the table cradle.

4 Finalization

Finalization

No finalization steps.