National School of Healthcare Science

NHS Health Education England

Competency: Perform routine quality assurance measurements on a radionuclide calibrator

---

Trainee: Trainee

Module: Imaging including Ionising Radiation

Competency:
B3.7 Perform routine quality assurance measurements on a radionuclide calibrator.

Date of Review: 31/07/2012

Evidence:
On 18/7/12, I carried out radionuclide dose calibrator QA with ASSESSOR. The procedures used for this work, along with a description of the work and the results is attached.

On 27/7/12, I carried out linearity checks on a radionuclide dose calibrator, also with ASSESSOR. My description of this work, including results, is attached.

Files: (two procedure documents and two results documents attached)

Reviewer: Assessor

Feedback:
31/07/2012 TRAINEE has successfully completed calibrator QA (daily, monthly, and linearity). We have also discussed the NPL good practice guide which explains the various QA tests.

Outcome: Satisfactory

Quality assurance measurements for radionuclide calibrators

On the 18 July 2012 I took part, with ASSESSOR, in quality assurance (QA) measurements for each of the two radionuclide calibrators currently in use in the Nuclear Medicine and PET sections of the HOSPITAL. These are a CRC-15 BETA model and an ARC 120 model, both manufactured by Capintec.

Daily QA

We began by completing the daily QA checks for each radionuclide calibrator. This procedure is described in WORK INSTRUCTION.

Model	Date	Zero (mV/MBq)	Background (MBq)	System (V)	Data
CRC-15 BETA	18/7/12	-0.05	0.010	159.2	OK
ARC 120	18/7/12	0.000	0.001	153.1	N/A

Model	Actual (MBq)	Expected (MBq)	Deviation	Signature
CRC-15 BETA	6.97	6.82	2.2	TRAINEE
ARC 120	7.08	6.82	3.8	TRAINEE

WORK INSTRUCTION lists tolerances on these parameters for the ARC 120 model. The measurements taken today are well within these limits.

Parameter	Measured Values for ARC 120	Tolerance limits	In tolerance?
Zero (mV/MBq)	0.000	0.000±0.002	Yes
Background (MBq)	0.001	0.000±0.005	Yes
Voltage (V)	153.1	140-155V	Yes

Monthly QA

This procedure is described in WORK INSTRUCTION, and begins with ensuring that daily QA checks have been carried out. Then, checks are carried out on precision and relative response of the calibrators.

Precision checks

The aim of these checks is to check, by repeated measurement of a single source, that “the random uncertainty of a single measurement is primarily determined by the random nature of radioactive decay. A larger than expected value indicates the possible presence of another random source of uncertainty”.

The source used for these tests was a caesium-137 source, reference date 01/01/2009, activity 7.396MBq, source number 1356-10-7.

Model	Readings										Mean	St. Dev.	Precision (%)	Limit	Within limit?
	1	2	3	4	5	6	7	8	9	10					
CRC-15 BETA	6.97	6.95	6.97	6.97	6.97	6.95	6.97	6.98	6.96	6.96	6.965	0.0097	0.14	1%	Yes
ARC 120	7.1	7.09	7.08	7.08	7.07	7.08	7.09	7.08	7.09	7.08	7.084	0.0084	0.12	1%	Yes

The measurement precision is calculated as the standard deviation divided by the mean, as a percentage. This should be within 1%, as was the case for both calibrators.

Relative response checks

The aim of these tests was to check that the calibrators' settings for particular radionuclides have not changed. As these measurements are currently not taken monthly, the values recorded here will be used for comparison in coming months.

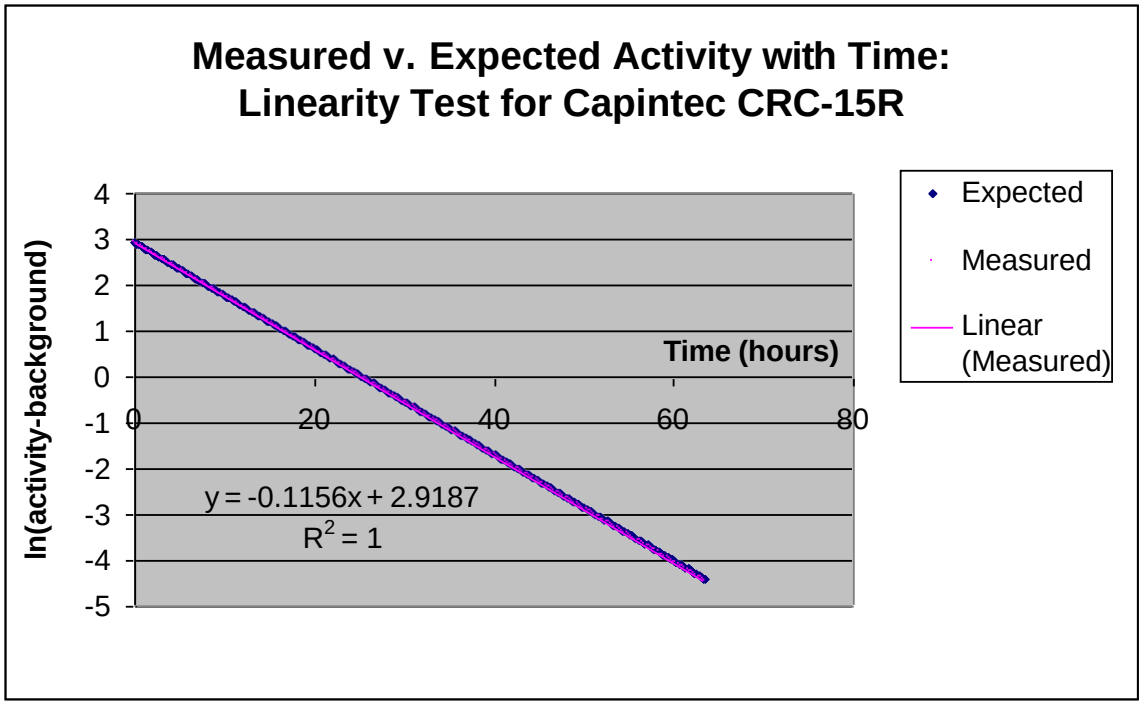
	CRC-15 BETA (MBq)	ARC 120 (MBq)	% Difference
Cs-137	6.965	7.084	1.7
Tc-99m	12.7	12.96	2.0
I-131	8.9	8.75	1.7
I-123	5.84	6.1	4.5
F-18	3.96	-	

WORK INSTRUCTION recommends that results for field instruments agree to within 2%. This was the case for all measurements except the I-123. This may be because the ARC-120 calibrator is fairly old, and requires a calibration soon. When the two caesium measurements are corrected for decay since the reference date, they agree with the source activity to within 2.2% and 3.9% for the CRC-15 BETA and the ARC 120, respectively. Again, this suggests that the ARC 120 calibrator may require a recalibration.

Linearity checks on radionuclide dose calibrator capintec CRC-15R

On the 27/7/12 I took part in linearity tests for the dose calibrator Capintec CRC-15R, with ASSESSOR. These tests are part of regular quality assurance tests for dose calibrators, and follow the method described in the National Physical Laboratory Good Practice Guidelines No. 93, "Protocol for Establishing and Maintaining the Calibration of Medical Radionuclide Calibrators and their Quality Control".

We used a technetium-99m source (18.52GBq at 15:27, 27/7/12), the Capintec CRC-15R dose calibrator and a laptop with data-logging software. The software was set up to record the activity every 15 minutes over a weekend, i.e. 255 data points. These were exported into an Excel spreadsheet, and the results plotted with time:



A linear fit was added to the natural logarithms of the activities measured. The gradient of this line was found to be -0.1156hr^{-1}, compared with an expected value of -0.1154 hr^{-1}, from the NPL guidelines (and equal to ln2 divided by the half-life of technetium). This is a difference of 0.17%, slightly above the limit of 0.1% recommended by the NPL. The fact that the R^2 value was given by Excel as 1 indicates that the data follows a linear fit extremely well. The NPL also recommends that there be no more than 5% difference between measured activities and those expected if there is perfectly linear behaviour with exponential decay with a half-life of 6.007 hours.