The Calibration Control of Capintec Dose Calibrator CRC-7BT Using ^{137}Cs Method

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Abstract. *To maintain accuracy and traceability of measurement results of activity measurement Capintec Dose Calibrator CRC-7BT the radionuclides specialy of short half life such as ^{99m}Tc, ^{131}I, ^{18}F, and others. Laboratory Standardization PTKMR-BATAN develop a calibration control method tapped characteristics ^{137}Cs measurements on all cal settings measurement and produce calibration function equation $Y = 20.74\ X^{0,93}$ with R^2=0.998. With this equation the activity values obtained ^{99m}Tc , ^{131}I , ^{18}F in the calculation , is used as a reference value to obtain the calibration factor value of ^{99m}Tc, ^{131}I and ^{18}F activity by comparing the calculation values with the output activity of the measuring devices. Differences in measurement results using the calibration correction factors between the calibration control method and calibration factor data of Capintec Dose Calibrator CRC-7BT in 2011 was still below 5 %, still within tolerance. It shows the performance of Capintec Dose Calibrator CRC-7BT belong Laboratory Standardization is still good and the Calibration data Factor in 2011 can still be used. In order for the performance of Capintec Dose Calibrator CRC-7BT always observed the calibration control method must be performed periodically.*

Keywords : ^{137}Cs , Cal Settings , Dose Calibrator , Calibration Control

Introduction

To maintain the accuracy of the measurement results and traceability of activity measuring devices Capintec Dose Calibrator CRC-7BT, this tool must always be calibrated periodically. There are two methods of calibration commonly used to calibrate the measuring devices of this activity, using standards traceable sources and use standard measuring devices. Calibration of measuring activity using standard source is usually done for the measurement button sources with a length half- life while the sources have a short half life as ^{99m}Tc, ^{131}I, ^{18}F and other measuring devices is usually done with a standard activity. Calibration of measuring these activities should be carried out periodically by the competent authorities or institutions.

To maintain the stability of the performance of the measuring devices which has been calibrated, the stability of the performance of this measure needs to be checked periodically. For this purpose Standardization Laboratory PTKMR-BATAN developed a method for checking stability using response ^{137}Cs activity measurements on each cal setting of radionuclides contained in the meter activity Capintec Dose Calibrator CRC-7BT. This method is used as a calibration control until the measuring device is recalibrated with the activity of a standard source or a standard measuring device, in particular for cal setting measurement sources of a short half life.

Materials and Methods

Activity measuring device capintec Dose Calibrator CRC-7 BT is a radiation measuring instrument used to measure gamma-emitting radioactive. This tool is a measuring device that works based prinsif radiation ionization, which is one type of detector gas field.

Ionization detector consists of two insulated electrodes, the anode and cathode which are in the gas medium. Gas which is used as a medium is a gas from the group of noble gases, such as helium (He) or argon (Ar). Ionization detector is generally cylindrical tube wall in the form of the metal as a cathode and an anode wire inside the tube as (Kowalski et al., 1987; NCRP Report, 1987). Scheme ionization detectors can be seen on Fig.1.

Radiation enters the detector will ionize the gas and generate positive ions and negative ions, the amount of ions generated from this interaction is proportional to the radiation energy and power gas ionization. The ions produced will contribute to the formation of an electrical pulse or electrical current and to be processed by the next circuit which Pre-Amp, Amplifier and Counter become impormasi readable (Pusdiklat-BATAN, 2006). Pulses of electricity that comes from the interaction of certain radioactive amplifier is usually set in the form of windows that allow resfon tool shown directly in terms of activity and patented in the form of buttons or variable cal measurement settings with names of specific radioactive or radioactive type specific. Cal setting is defined with a variable number of 0-999. There is a button and a variable number on the possible cal settings activity of certain radionuclides can be measured with a practical, fast and accurate.

The designation of variable call settings for specific radionuclides indicated that a response or respond differently to radiation energy that belongs radionuclides. These characteristics can be used to control the performance of the Capintec Dose Calibrator CRC-7BT whether calibration is done

with this instrument can still be used or not until the tool is recalibrated, especially for radionuclide has a short half-life as ^{99m}Tc, ^{131}I, ^{18}F and radionuclides have time other short fold.

Research and Methods

The calibration method between can be done only for Dose Calibrator which has had variable cal setting for certain types radionulida system the dose calibrator. In general illustration of this radiation enumerator system as seen on Fig. 2.

Radiation measurements performed using radionuclide ^{137}Cs source with mCi 0.11480 activity on December 19, 2013. Sources of ^{137}Cs is measured in all cal settings owned Capintec Dose Calibrator CRC-7BT. The purpose of the measurement of the activity of ^{137}Cs in all variables this cal setting is to get the different responses of activity on each of each cal setting so that it can be used to control the performance of the system Dose Calibrator whether the measurement values, especially for sources of a short half-life still meets the value of traceability (Nazaroh et.al.,2015)to do recalibration back. The calibration data Capintec Dose Calibrator CRC-7BT The year 2011 belonged to the Laboratory Standardi-zation PTKMR-BATAN For radionuclide ^{99m}Tc, ^{131}I, ^{18}F as shown in Table 1.

Results and Discussion

From the measurement results ^{137}Cs with variations cal setting of various radionuclides such as display measurement data obtained in Table 2.

Measuring the data obtained from measurements on each cassette is plotted on the graph so obtained calibration function, as seen in Fig. 2 and the equation obtained is :

$$Y = 20{,}74X^{-0{,}93} \quad \text{..... (1)}$$

Where : Y : Aktivitas
X : Cal sett
with $R^2 = 0{,}998$

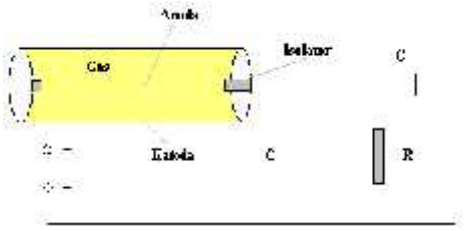

Fig.1. Schematic ionization detector

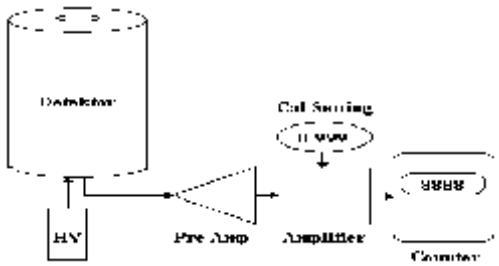

Fig.2. Illustration of radiation enumerator system Capintec Dose Calibrator CRC-7BT

Table 1. Calibration data of Capintec Dose Calibrator CRC-7BT belongs Standardization Laboratory PTKMR BATAN in 2011.

No.	Radionuclide	Cal Setting	Calibration
1.	^{99m}Tc	96	1,020
2.	^{131}I	201	1,000
3.	^{18}F	443	1,002

Table 2. Measuring data ^{137}Cs from various cal settings of Capintec Dose Calibrator CRC-7BT.

No.	Radionuclide	Cal Setting	Activity (mCi)
1	^{241}Am	74	0,35279 ± 0,00075
2	^{99m}Tc	96	0,28827 ± 0,00044
3	^{57}Co	112	0,25407 ± 0,00059
4	^{57}Ga	113	0,25200 ± 0,00063
5	^{201}Tl	160	0,18587 ± 0,00034
6	^{99}Mo	161	0,18433 ± 0,00060
7	^{133}Xe	194	0,15660 ± 0,00049
8	^{131}I	201	0,15133 ± 0,00047
9	^{153}Sm	203	0,14993 ± 0,00025
10	^{137}Cs	271	0,11480 ± 0,00040
11	^{123}I	286	0,10920 ± 0,00040
12	^{111}Ln	313	0,10050 ± 0,00050
13	^{18}F	443	0,07200 ± 0,00000
14	^{125}I	533	0,06000 ± 0,00000
15	^{133}Ba	555	0,05767 ± 0,00047
16	^{226}Ra	790	0,04000 ± 0,00000
17	^{60}Co	990	0,03193 ± 0,00025

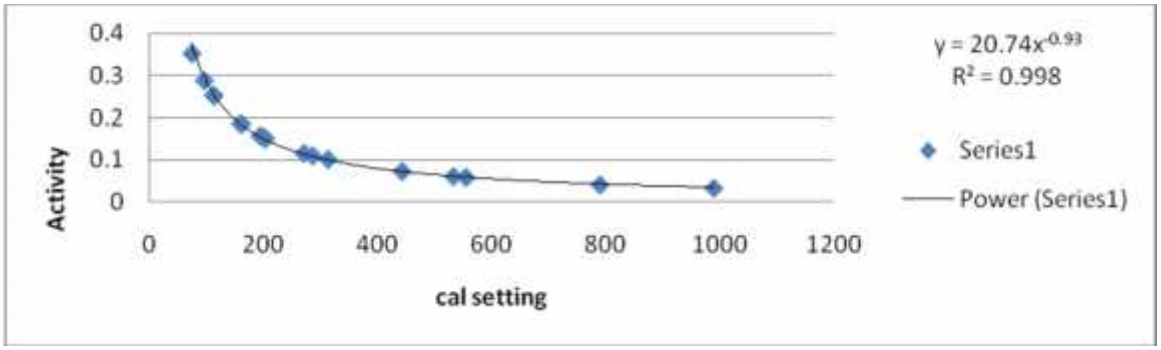

Fig. 3. Graphic output ^{137}Cs activity Capintec Dose Calibrator CRC-7BT on any cal setting.

Table 3. The calculation results of activity and calibration factor for ^{99m}Tc, ^{131}I, ^{18}F.

No.	Radionuclide	Cal Setting	A. Measuring (mCi)	A. Calculation (mCi)	Calibration Factor
1	^{99m}Tc	96	0,28827	0,29737	1,032
2	^{131}I	201	0,15133	0,14957	0,988
3	^{18}F	443	0,07200	0,07172	0,996

Table 4. The difference in measurement results using FK data 2011 with FK calibration control of Capintec Dose Calibrator CRC-7BT

No.	Radionuclide	Cal Setting	Data FK 2011	FK Calibration Control	Measurement Result Difference
1	^{99}mTc	96	1,020	1,032	1,2 %
2	^{131}I	201	1,000	0,988	0,2 %
3	^{18}F	443	1,002	0,996	0,6 %

With calibration function equation obtained, by calculating the value of ^{137}Cs activity response for three positions radionuclides cal sett obtained as shown in Table 3. Activity value obtained from the calculation in

$$FK = A_s/A_u \quad \text{.....} \quad (2)$$

Where FK : Calibration factor
A_s : Value activity of calculation
A_u : Value show activity measuring

By using equations 1 and 2 activity values obtained calculation factor and calibration of radionuclide ^{99m}Tc, ^{131}I, ^{18}F like to see in Table 3. While the resulting differences for activity measurements ^{99m}Tc, ^{131}I, ^{18}F uses data Calibration Factor 2011 and calibration control method in this study are in Table 4.

Differences in measurement results are still below 5%, still within tolerance allowed Each activity must have an accuracy of <5% 9 (Soejoko, 2002). It shows the performance of Capintec Dose Calibrator CRC-7BT as a gauge to determine the activity of the radionuclide in the field of nuclear medicine belonging to the Laboratory Standardization is still good and the data Calibration Factor 2011 can still be used. Ensuring traceability and observed for the performance of this measure, should be regularly once a month, the calibrating control method is carried out until a pre-determined recalibration.

Conclusion

To maintain the accuracy of the measurement results and traceability of measuring devices activity Capintec Dose Calibrator CRC-7BT. Standardization Laboratory PTKMR-BATAN make calibration control method using the output characteristics of ^{137}Cs activity in any setting cal measurement and calibration function produces the equation Y=20,74X-0.93 with R^2=0.998. With this equation obtained activity value ^{99m}Tc, ^{131}I, ^{18}F in the calculation, this value is used as a reference to obtain the value factor Calibration of ^{99m}Tc, ^{131}I and ^{18}F by comparing the value of the activity calculation by the output activity of the measuring devices, the value factor Calibration as shown in Table 3, and have different measurement results with the data calibration factor Capintec Dose Calibrator CRC-7BT in 2011 as in Table 4.

Differences in measurement results are still below 5%, still within tolerance allowed. It shows the performance of Capintec Dose Calibrator CRC-7BT belonging Laboratory Standardization is still good and this study is used as the reference values used to find the value of calibration factor at each particular measurement cal sett for radionuclide ^{99m}Tc, ^{131}I, ^{18}F.

the data calibration factor of 2011 still can be used. In order performance Capintec Dose Calibrator CRC-7BT always monitored control method is periodic calibration should be performed.

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