CONVENTIONAL ROOM EFFECTIVENESS TEST USING RAYSAFE IN RADIOLOGY UNIT SITI RAHMAH ISLAMIC HOSPITAL PADANG

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ABSTRACT

The more the number of patients, the greater the number the examination was carried out in the radiology room at the Siti Islamic Hospital Rahmah. This research aims to determine the effectiveness and level of security in conventional spaces Radiology Unit of Siti Rahmah Islamic Hospital against radiation with use raysafe unfors. This research was conducted by sticking raysafe unfors from the inside and the outside on walls, doors and Pb glass in a conventional room in the Hospital Radiology Unit Islam Siti Rahmah with the type of quantitative research. The results of the measurement of the largest dose rate were found at the inner 3A point, which was 10.5198 mGy/h. While the results of the measurement of the smallest dose rate are at the outer 7B point, which is -0.0001 mGy/h. The dose before penetrating the material (D0) measured in a conventional room ranged from 10.5198 –1.3228 mGy/h. The dose value that varies at the measurement point is caused by the distance of the radiation source from the measurement point. Where in the conventional room (D0), the largest measured radiation dose is at point 3A 10.5198 mGy/h. This is because the measurement position is closest to the radiation source with a distance of 160 cm. Conventional space buildings are already effective against scattered radiation and safe as a radiation barrier with the effectiveness of values ranging from 99.9% to 100%. The results showed that the ability of walls, doors and Pb in a conventional room in the Radiology Unit of the Siti Rahmah Islamic Hospital absorb radiation.

Keyword : Effectiveness Test; Conventional Room; Unfors Raysafe.

BACKGROUND

Siti Rahmah Islamic Hospital is a health service center in the city of Padang which has a fairly complete radiology aircraft such as X-rays, ultrasound, MRI, CT-Scan, Panoramic and Mammography. The radiology room at the Siti Rahmah Islamic Hospital is commonly used for examination of the extremities, cranium, thorax, thoracolumbar, lumbosacral, abdomen, pelvis, and appendicogram. The more the number of patients, the more the number of examinations carried out in the radiology room at the Siti Rahmah Islamic Hospital.

The size of the conventional examination room according to the Regulation of the Head of the Nuclear Energy Supervisory Agency Number 8 of 2011 must be 4 m × 3 m × 2.8 m, the walls of the room are made of red brick with a thickness of 25 cm or equivalent to 2 mm of lead (Pb), the door of the room must be coated with lead with a certain thickness. The Radiology Unit has many rooms adjacent to conventional examination rooms including the control panel room, officer guard room, administration and patient waiting room so that the room must be safe from radiation.The use of radiation sources in various fields, especially in the world of health, continues to grow and increase from time to time. The utilization includes radiodiagnostic measures, radiotherapy, and nuclear medicine (Akhadi, 2000). These three services use radioactive sources which are very dangerous if not used in accordance with established safety standards. However, in terms of its benefits, it is very useful in the health sector, especially for diagnosing passive diseases. In the utilization of radiation sources, the human safety factor must be given top priority, so that its utilization will be more perfect if the loss factor that will arise can be reduced as low as possible or eliminated altogether (Akhadi, 2000). The radiation source room must be built according to radiology room building standards, which is to have an effective wall as a radiation barrier made of Pb and concrete, where these materials can weaken the intensity of radiation, the point is to minimize the dangers or effects of radiation that will arise (Sari, 2010).).

Siti Rahmah Islamic Hospital is a health service center in the city of Padang which has a large number of patients. The more the number of patients, the more the number of examinations carried out in the radiology room at the Siti Rahmah Islamic Hospital. In the West Sumatra region in recent years, earthquakes have often occurred which cause shifts in buildings, especially in special buildings such as the walls of conventional rooms at the Radiology Unit of the Siti Rahmah Islamic Hospital, this is indicated by the presence of cracks which if a leak occurs, the dose received by the community The surrounding area and radiation officers will increase, but this room has never been tested for the effectiveness or accuracy of the scattering radiation.

METHODE

This type of research is quantitative with an experimental method of measuring exposure to X-ray radiation doses around conventional rooms at the Radiology of Siti Rahmah Islamic Hospital using an unfors Raysafe measuring instrument. Measurements were made at 7 points by attaching Raysafe indoors and outdoors at each point. This research was conducted in July 2020 (Soekidjo, 2012). The research time was carried out for 1 day by attaching Raysafe at each predetermined point. After exposure, Raysafe will read the dose rate in mGy/h units. Before exposing the 7 points, the background value reading at the Radiology Unit of the Siti Rahmah Islamic Hospital is 0.000002 mGy/h. The tools and materials used in this study were Unfors raysef Xi and an X-ray plane.

RESULT AND DISCUSSION

Based on research that has been carried out in the conventional aircraft room at the radiology unit of the Siti Rahmah Islamic Hospital in July 2020 to determine the effectiveness of the conventional aircraft room in the Radiology Unit of the Siti Rahmah Islamic Hospital in resisting radiation generated by conventional X-ray aircraft. The measuring instrument used by Raysafe can be obtained about the Effectiveness of Conventional Aircraft Room at the Radiology Unit of the Siti Rahmah Islamic Hospital.

The research time was carried out for 1 day by attaching Raysafe at each predetermined point. After exposure, Raysafe will read the dose rate in mGy/h units. Before exposing the 7 points, the background value reading at the Radiology Unit of the Siti Rahmah Islamic Hospital is 0.000002 mGy/h. The results of the dose rate measurement are as follows:

1. At points 1A and 1B
   a. On the wall before passing through the radiation barrier (1A)
      Measurement Results – Background
      4.960 mGy/h – 0.0002 mGy/h = 4.9598 mGy/h
   b. On the wall after passing through the radiation barrier (1B)
      Measurement Results – Background
      0.0002 mGy/h – 0.0002 mGy/h = 0.0000 mGy/h
2. At points 2A and 2B
   a. On the wall before passing through the radiation barrier (2A)
      Measurement Results – Background
      2.273 mGy/h – 0.0002 mGy/h = 2.2728 mGy/h
   b. On the wall after passing through the radiation barrier (2B)
      Measurement Results – Background
      0.0000 mGy/h – 0.0002 mGy/h = -0.0002 mGy/h
3. At points 3A and 3B
   a. On the wall before passing through the radiation barrier (3A)
      Measurement Results – Background
      10.52 mGy/h – 0.0002 mGy/h = 10.5198 mGy/h
   b. On the wall after passing through the radiation barrier (3B)
      Measurement Results – Background
      0.0002 mGy/h – 0.0002 mGy/h = 0.0000 mGy/h
4. At points 4A and 4B
   a. On the wall before passing through the radiation barrier (4A)
      Measurement Results – Background
      3.283 mGy/h – 0.0002 mGy/h = 3.2828 mGy/h
   b. On the wall after passing through the radiation barrier (4B)
      Measurement Results – Background
      0.0000 mGy/h – 0.0002 mGy/h = -0.0002 mGy/h

5. At points 5A and 5B
   a. At the patient entrance before passing through the radiation barrier (5A)
      Measurement Results – Background
      2.117 mGy/h – 0.0002 mGy/h = 2.1168 mGy/h
   b. At the patient entrance after passing through the radiation barrier (5B)
      Measurement Results – Background
      0.0000 mGy/h – 0.0002 mGy/h = -0.0002 mGy/h
6. At points 6A and 6B
   a. On the Pb Glass before passing through the radiation barrier (6A)
      Measurement Results – Background
      1.804 mGy/h – 0.0002 mGy/h = 1.8038 mGy/h
   b. On the Pb Glass after passing through the radiation barrier (6B)
      Measurement Results – Background
      0.0000 mGy/h – 0.0002 mGy/h = -0.0002 mGy/h
7. At points 7A and 7B
   a. On the control panel door before passing through the radiation barrier (6A)
      Measurement Results – Background
      1.323 mGy/h – 0.0002 mGy/h = 1.3228 mGy/h
   b. On the control panel door after passing through the radiation barrier (6B)
      Measurement Results – Background
      0.0001 mGy/h – 0.0002 mGy/h = -0.0001 mGy/h

Table 1. The results of the measurement of the absorbed dose rate at each observation point in the Radiology Unit of the Siti Rahmah Islamic Hospital

Location of Raysafe	Absorbed dose rate mGy/h	Background	Effective absorbed dose rate mGy/h
Point 1A	4,960	0,0002	4,9598
Point 1B	0,0002	0,0002	0,0000
Point 2A	2,273	0,0002	2.2728
Point 2B	0,0000	0,0002	-0,0002
Point 3A	10,52	0,0002	10,5198
Point 3B	0,0002	0,0002	0,0000
Point 4A	3,283	0,0002	3,2828
Point 4B	0,0000	0,0002	-0,0002
Point 5A	2,117	0,0002	2,1168
Point 5B	0,0000	0,0002	-0,0002
Point 6A	1,804	0,0002	1,8038
Point 6B	0,0000	0,0002	-0,0002
Point 7A	1,323	0,0002	1,3228
Point 7B	0,0001	0,0002	-0,0001

Room Effectiveness Calculation

Effectiveness is a shield used to reduce the intensity of electromagnetic radiation to half or more of the original intensity of electromagnetic radiation. From the data obtained, according to Akhadi (2000), to test the effectiveness of the radiation barrier in an examination room, it can be determined by the following formula:
Effectiveness =(D0-D)/D0 x 100 Equation......(1)

Description :
D0 = rate of radiation dose before passing through radiation barrier
D = radiation dose rate after passing through the radiation barrier
To test the effectiveness of the conventional room at the Radiology Unit of the Siti Rahmah Islamic Hospital as follows:

A. Point 1
Effectiveness =(D0-D)/D0 x 100%
=(4.9598 - 0.0000)/4.9598 × 100%
=100%

B. Point 2
Effectiveness =(D0-D)/D0 x 100%
=(2.2728 - 0.0002)/2.2728 × 100%
=100%

C. Point 3
Effectiveness =(D0-D)/D0 x 100%
=(10.5198- 0.0000)/10.5198 × 100%
=100%

D. Point 4
Effectiveness =(D0-D)/D0 x 100%
=(3.2828 - 0.0002)/3.2828 × 100%
=100%

E. 5 point
Effectiveness =(D0-D)/D0 x 100%
=(2.1168 - 0.0002)/2,1168 × 100%
=100%

F. Point 6
Effectiveness =(D0-D)/D0 x 100%
=(1.8038 - 0.0002)/1.8038 × 100%
=100%

G. Point 7
Effectiveness =(D0-D)/D0 x 100%
=(1.3228 - 0.0001)/1.3228 × 100%
=100%

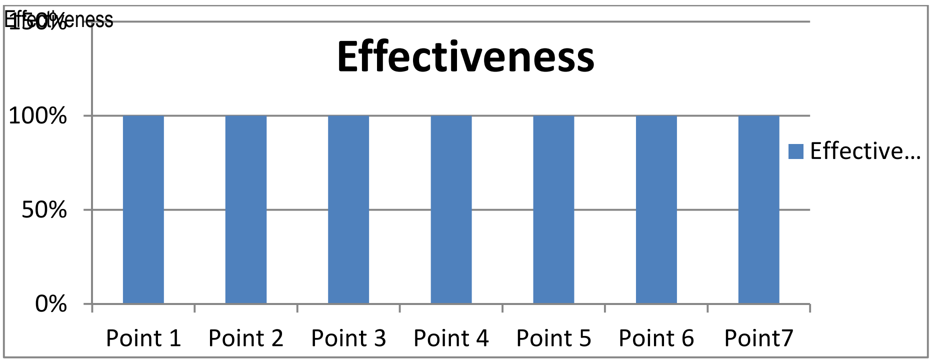
Table 2. The results of measuring the absorbed dose rate on each side of the conventional aircraft room at the Radiology Unit of the Siti Rahmah Islamic Hospital

Location of Raysafe	Dose rate beforeD0 (mGy/h)	Dose rate after D (mGy/h)	Absorbed dose rate (D0-D)
Point 1	4,9598	0,0000	4,9598
Point 2	2,2728	-0,0002	2,273
Point 3	10,5198	0,0000	10,5198
Point 4	3,2828	-0,0002	3,2828
Point 5	2,1168	-0,0002	2,1168
Point 6	1,8038	-0,0002	1,8038
Point 7	1,3228	-0,0001	1,3228

The results of measuring the effectiveness of conventional aircraft rooms at the Siti Rahmah Islamic Hospital Unit can be seen in table 4 below:

Table 3. Results of measuring the effectiveness of conventional aircraft rooms in the Siti Rahmah Islamic Hospital Unit.

Location of Raysafe	D0	D	Effectiveness	Description
Point 1	4,9598	0,0000	100%	Effective
Point 2	2,2728	-0,0002	100%	Effective
Point 3	10,5198	0,0000	100%	Effective
Point 4	3,2828	0,0002	99,9%	Effective
Point 5	2,1168	-0,0002	99,9%	Effective
Point 6	1,8038	-0,0002	100%	Effective
Point 7	1,3228	0,0001	100%	Effective



From the table above, the effectiveness of conventional room buildings has been effective as a radiation barrier, the TVT concept is an effective radiation barrier that is able to reduce the intensity of electromagnetic radiation to 1/10 of the original intensity (Akhadi, 2000). Table 4 shows that the results of the largest dose rate measurement are at the inner 3A point, which is 10.5198 mGy/h. While the results of the measurement of the smallest dose rate are at the outer 7B point, which is -0.0001 mGy/h. The dose before penetrating the material (D0) measured in a conventional room ranged from 10.5198 –1.3228 mGy/h. The dose value that varies at the measurement point is caused by the distance of the radiation source from the measurement point. Where in the conventional room (D0), the largest measured radiation dose is at point 3A 10.5198 mGy/h. This is because the measurement position is closest to the radiation source with a distance of 160 cm.

Then the closer the distance of the radiation source and the measurement point, the greater the dose value and vice versa. The dose after penetrating the material (D) measured in a conventional chamber is in the range of 0.0000 – -0.0001 mGy/h. The dose value that varies at the measurement point is due to the distance factor from the measurement point. Where in the conventional outdoor area (D) the smallest measured area is at point 7B -

0.0001 mGy/h. This is because the measurement position is farthest from the radiation source with a distance of 455 cm. The farther away the measurement point is, the smaller the dose value.

Measurement of radiation dose in conventional aircraft rooms at Siti Rahmah Islamic Hospital is influenced by several factors, one of which is the distance and thickness of the radiation shield, where the farther the radiation source is to the measurement point, the smaller the radiation dose and the closer the radiation source is to the measurement point. then the measured radiation dose will be greater, while for radiation shielding the thicker the shield used, the higher the absorbed dose will be, and vice versa if the radiation shield is thinner, the absorbed radiation will be smaller (Permenkes, 2008).

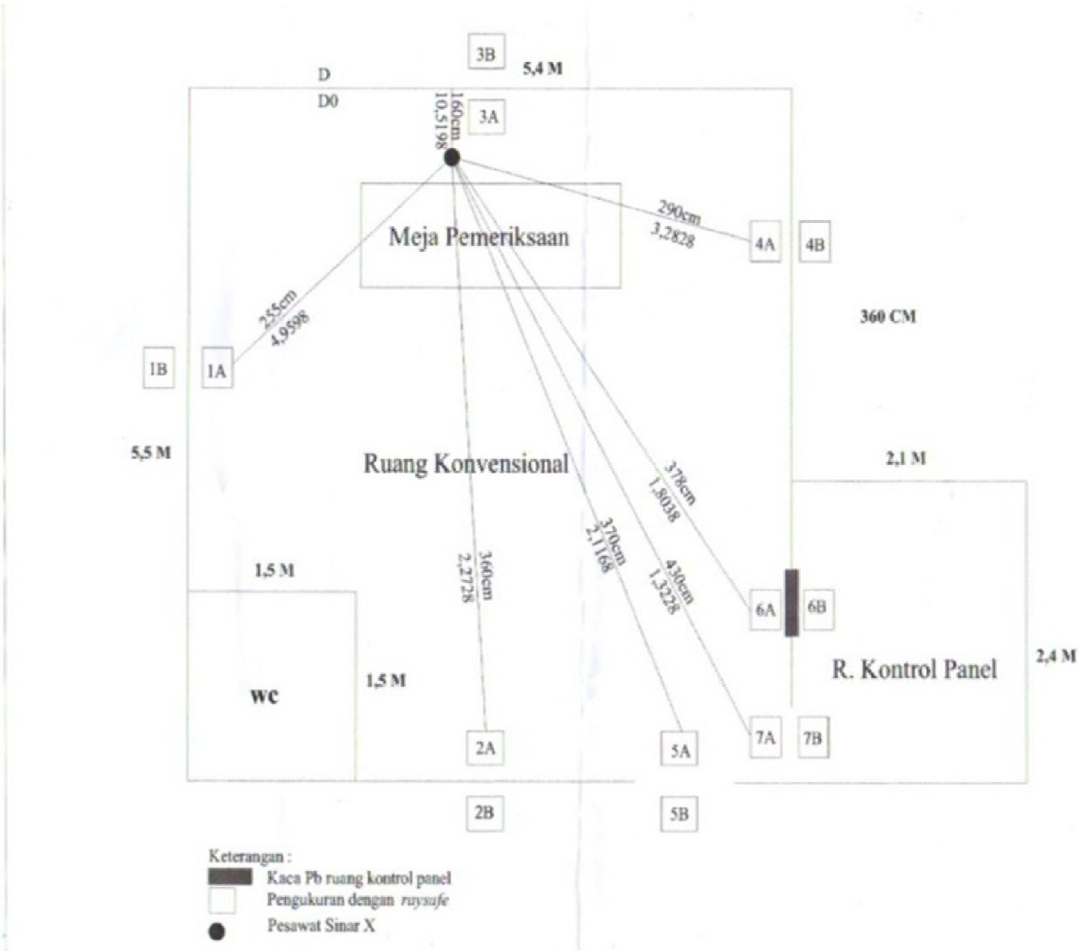


Figure 1. Schematic of the distance between Raysafe points

Based on research that has been carried out by researchers who are also collaborating with Fluke Biomedical at the Siti Rahmah Islamic Hospital Unit on the Conventional Room Effectiveness test against radiation doses, the results are 100% effective on the left wall, 100% administration wall, 100% mammography wall, and control wall. 100% panel, 100% patient door, 100% Pb Glass and 100% control panel door.

From these results, the effectiveness of the conventional room building has been effective as a radiation barrier because according to Akhadi (2000) the concept of TVT is an effective radiation barrier which is able to reduce the intensity of electromagnetic radiation to 1/10 of the original intensity. According to Rudi, et al (2012) concluded that the closer the measurement point is to the radiation source, the larger the radiation dose received, to prevent radiation reception, it is done by keeping a safe distance from the radiation source.

CONCLUSIONS AND SUGGESTIONS

Based on the results of research on the Conventional Room Effectiveness Test at the Siti Rahmah Islamic Hospital Unit using the Raysafe tool, the following conclusions can be drawn: Radiology conventional examination room at Siti Rahmah Islamic Hospital is able to absorb scattered radiation and is effective as a radiation barrier with 100% effectiveness, The walls of the Radiology Conventional Examination Room at the Siti Rahmah Islamic Hospital are able to absorb scattered radiation and are effective as a radiation barrier with 100% effectiveness, The PB glass and the door in the control panel room are able to absorb scattered radiation with 100% effectiveness, and the door in the examination room is able to absorb scattered radiation effectively as a radiation barrier with 100% effectiveness.

The conventional room at the Radiology Unit of the Siti Rahmah Islamic Hospital has been said to be effective and in accordance with the Conventional room building standards set by the head of BAPETEN Regulation No. 8 of 2011, but it is better to repair the cracks on the side of the wall of the room and the officers hope to be careful in working with radiation sources.

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