BACKGROUND RADIATION MEASUREMENTS IN THE CONTAMINATED AREA WITH DEPLETED URANIUM AT AL-NASIRIYAH STATION OF ELECTRICITY DISTRIBUTION

OSAMAH ABDULAMEER MEZHER

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I dedicate this work to my dear parents

Father and *Mother*

To those who loved them *My Wife* sincere and my dear *Daughters*

To my beloved *brothers* and *sister*

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ABSTRACT

Measurement of background radiation levels, in contaminated area with depleted uranium due to the use of depleted uranium shells through Gulf war in 1991 were carried out in this study. Gamma dose rates were measured using portable survey meter model, Ludlum 2241-2RK -USA. The measured gamma dose rates in study area were found in the range from 17.7 to 81.3 nGy h^{-1} with mean value 41.9 nGy h^{-1}. The area closed to control room has highest dose rate with mean dose rate 51.6 nGy h^{-1}. The activity concentration of ^{226}Ra, ^{232}Th and ^{40}K were determined using high purity germanium (HPGe) gamma spectrometer. The activity concentration were found in the range from 22.6±0.7 to 44±1 Bq kg^{-1} for ^{226}Ra, 16.2±0.9 to 32±2 Bq kg^{-1} for ^{232}Th and 163±2 to 673±8 Bq kg^{-1} for ^{40}K. The radiological hazard to humans due to the radioactivity arising from radionuclides in soils collected from the studied areas was assessed. The outdoor annual effective dose rate (AEDR) varied from 0.024 to 0.1 mSv, with a mean of 0.053 mSv. The radium equivalent activity (Ra_{eq}) varied from 58 ± 2 to 137 ± 10 Bq kg^{-1} with a mean value of 114 ± 5 Bq kg^{-1}. The values of the external hazard index (H_{ex}) for all soil samples varied from 0.15 to 0.37 with a mean value of 0.30. The results were compared and discuss with the world values recommended by UNSCEAR, 2000.

ABSTRAK

Pengukuran aras sinar latar bekang di kawasan yang dicemari oleh uranium tersusut akibat penggunaan peluru uranium tersusut dalam peperangan teluk pada tahun 1991 dilakukan dalam kajian ini. Kadar dos gama diukur dengan menggunakan meter mudah alih model Ludlum 2241-2RK –USA. Kadar dos gama yang diukur dalam kawasan kajian didapati bernilai dalam julat 17.7 hingga 81.3 nGy h^{-1} dan kadar dos min 41.9 nGy h^{-1}. Kawasan yang berdekatan dengan bilik kawalan mempunyai kadar dos tertinggi dengan nilai kadar dos min 51.6 nGy h^{-1}. Kepekatan aktiviti ^{226}Ra, ^{232}Th and ^{40}K telah ditentukan menggunakan Spektrometer Gama HiP Ge berpeleraian tinggi. Kepekatan aktiviti yang diperolehi adalah dalam julat 22.6±0.7 hingga 44±1 Bq kg^{-1} bagi ^{226}Ra, 16.2±0.9 hingga 32±2 Bq kg^{-1} bagi ^{232}Th dan 163±2 hingga 673±8 Bq kg^{-1} bagi ^{40}K. Bahaya radiologi terhadap manusia akibat kehadiran keradioaktifan daripada radionuklid dalam tanah yang diambil di kawasan kajian juga telah dianggarkan. Kadar dos berkesan tahunan luar bernilai antara 0.024 hingga 0.1 mSv, dengan nilai min 0.053 mSv. Aktiviti Setara Radium bernilai antara 58±2 hingga 137±10 Bq kg^{-1} dengan nilai min 114±5 Bq kg^{-1}. Nilai indeks bahaya luaran (H_{ex}) bagi semua sampel tanah bernilai antara 0.15 hingga 0.37 dengan nilai min 0.30. Hasil kajian dibincangkan dan dibandingkan dengan nilai dunia yang dicadangkan olah UNSCEAR, 2000.

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LIST OF SYMBOLS

A	-	Activity
cpm	-	Counts per minute
DU	-	Depleted Uranium
LCD	-	Liquid crystal display
N	-	Number of nuclear (atom)
$t_{½}$	-	half-life
NaI	-	Sodium Iodide
HPGe	-	High Purity Germanium
IAEA	-	International Atomic Energy Agency
UNSCEAR	-	United Nation Scientific Committee on the Effects of Atomic Radiation
USA	-	United States of America
α	-	Alpha particle
β	-	Beta particle
γ	-	Gamma radiation
λ	-	Decay constant

LIST OF UNITS

Bq	-	Becquerel
Ci	-	Curie
cm	-	centimetre
Gy	-	Gray
h	-	hour
KeV	-	Kilo electron Volt
kg	-	kilogram
m	-	Meter
MeV	-	Mega electron Volt
n	-	nano
rem	-	Roentgen equivalent man
s	-	Second
Sv	-	Sievert
µ	-	micron

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The sources of radiation are divided into two main sources. The natural sources produced by terrestrial background and from the sun or cosmic rays and man made sources produces by the human activity in different applications (Al-kinani, 1999; UNSCERA, 2008).

The term radiation usually refers to ionizing radiation in the IAEA publications. Ionizing radiations can be divided into high and low linear energy transfer radiations (as a guide to its relative biological effectiveness), or according to penetrating strength of radiation (as an indication of its ability to penetrate shielding or the human body) (IAEA, 2007). Radiation is the emission and spread of waves, movement of energy through vacuum or some medium which is also known as a torrent of particles, such as electrons, protons, neutrons, alpha particles or high-energy photons, or a combination of them (Mann et. al., 1991).

The excessive use of nuclear energy and radioactive materials in nuclear testing, wars and industry, draw the attention of many researchers to study the radioactive contamination which is of great importance in context of health and human life. Many researchers have conducted different investigations to evaluate the natural and artificial radionuclide in the environment (Mollah et. al., 1986).

The contamination of radioactive substances on surfaces or within solids, liquids or gases (including the human body) are unintended or undesirable or the process giving rise to their presence in such places (IAEA, 2007). The environmental radioactive contamination means the released of radionuclides to the environment from various sources, such as nuclear accidents, nuclear tests and military used of nuclear weapons (Mohamed F. M. et. al.,2010).

During the period of the Gulf War and the occupation of Iraq war, the depleted uranium (DU) was used in the war. The total number of rounds expended in the Gulf War are estimated to be about 860600 shot for a total weight of DU about 286 ton (IAEA, 2003). These rounds do not include the initial allocation of DU tank munitions expended by the US Marine Corps according to Dunningam and Bay.

Depleted uranium is one of the main industrial sources for environmental contamination. It is a toxic and radioactive substance which is a by-product resulting from the process of enriching uranium (IAEA, 2003).

Due to the firing of 321 tons of DU during the first Gulf War alone, the United Nations Environment Programme recommended to produce report post-conflict. Such as report post-conflict in Kuwait, which showed limited evidence of environmental pollution caused by DU with the exception, for example, an area near the tanks and damaged vehicles (Sidhu, 2010).

1.2 Objectives

1. Determination of gamma dose rate at the bombed side during Gulf War.
2. Determination of activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in the soil samples at the study area.
3. To estimate the radiation hazard, such as absorbed dose rate, radium equivalent activity, external hazard index and annual effective dose rate in the study area.
4. Determination of DU contents in soil samples at the study area.

1.3 Significance of Study

To measured the natural radiation and radioactivity concentration in the study area will contribute for baseline data in country. Moreover, the study can assess the corresponding radiological health hazard from the primordial radionuclides

1.4 Problem Statement

1. Iraq has many sites bombed with DU shells during the Gulf War and the occupation of Iraq war, and it is expected the areas has high background radiation from depleted uranium contamination.

2. Depleted uranium contains of more 99.28% ^{238}U (4.4 x 10^6 years) (IAEA, 2003), and it is needed to measured activity concentration of DU from first and second daughter of ^{238}U series.

1.5 Scope of Study

1. Samples were collected from the south of Iraq specifically in the city of Dhi-qar (Al-Nasiriyah Station of Electricity Distribution).

2. Gamma spectrometer type ORTEC with high purity germanium crystal with efficiency of 60% was used to determine the concentration of ^{226}Ra, ^{232}Th and ^{40}K in the samples.

3. Radiological health hazard such as radium equivalent activity, external hazard index and annual effective dose were assessed in this work.

4. Soil sample contaminated by depleted uranium (as a result of the U.S. military use of depleted uranium projectiles during the Gulf War) were collected at the study area

1.6 Organization of the dissertation

This thesis consists of five chapters. The first chapter includes introduction, objectives, significance of study, statement problem and scope of study. Chapter two is the literature review. Chapter three is research methodology, which illustrates the methods and equipments used in the experimental work. Chapter four discusses the results obtained from field measurement, analysis of soil samples, correlation coefficients and risk assessment on human. Finally chapter five presents the conclusion of the project and suggestions.

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