Environmental Pollution in five floors (5th to 9th) Resulting From the use of Depleted Uranium Weaponry in the AL-Tahreer Tower Building

Nabeel hashim Ameen, Mazen Abbas Al-ghirrawy, Hamza Hadi Kadhim

Ministry of science and Technology

Ph. 00964 7811332431

ABSTRACT

The goals of this study include measuring the increase in radioactivity and removal the contamination regions to protect the population and the environment resulting from bombing the AL-Tahreer Tower Building (the Turkish restaurant previously) by the depleted uranium bullets through direct measurement and sampling of soil from five floors (5th,6th,7th,8th,and 9th) of the building, which contains fourteen floors in addition to basement by using different types of portable monitoring equipments.

The results of radiological surveys by using the portable monitor (CAB) indicated the presence of contaminated soil reached to 55 c/sec, and small particles of depleted uranium shells has very high levels of contamination reached to 70 c /sec ,while the background level is (0.5c/sec) ,and the higher exposure rates is 55 μR/hr when the portable monitor (Ludlum) put on the contaminated regions approximately on distance 0.5 cm), where the natural background level is 9 μR/hr in the floors of the building.

The radiological analyses of the collected soil samples were done in the laboratory of the center of Radiological Researches in the Ministry of sciences and Technology by using gamma spectrometry (which contains High- purity Germanium Detector) with a efficiency of 40% and resolution 2 keV for Energy, 1.33Mev, collection, preparations and tests of soil samples were all done according to IAEA.The laboratory results indicated the presence of high concentrations of the isotopes Th-234 (1550.1) Bq/kg, and Pa-234m (1394.8) in the soil samples taken from the floors while the concentrations of Th-234 and Pa-234m in natural background levels are (nearly 40, nil) Bq/Kg respectively which is a clear indication of the presence of high concentrations an isotope of uranium - 238 as they are supposed to be in equilibrium radiation.

Keywords: radioactivity, AL-Tahreer Tower Building, contamination.

الخلاصة

إن خطة البحث شملت توصيف النشاط الإشعاعي لبناية برج التحرير(المطعم التركي سابقا) من خلال إجراء مسح إشعاعي لخمسة طوابق من البناية هي (الخامس ، السادس،السابع،الثامن،التاسع) والمتكونة من أربعة عشرا طابقا إضافة إلى السرداب وباستخدام أجهزة الكشف الإشعاعي المحمولة لغرض معرفة الزيادة الحاصلة في مستويات التعرض والتلوث الإشعاعي الناتجة من قصف بناية برج التحرير بإطلاقات اليورانيوم المستنفذ ،أظهرت نتائج المسوحات الإشعاعية التي أجريت باستخدام جهاز قياس معدل التلوث الإشعاعي CAB وجود تربة ملوثة يصل مستوى التلوث إلى 55 c/sec بالإضافة إلى وجود شظايا من إطلاقات اليورانيوم المستنفذ ذات مستويات تلوث عالية تصل إلى70 c/sec مقارنةً بمعدل الخلفية الإشعاعية (0.5 c/sec)، أما قراءات معدل الجرعة الإشعاعية للمناطق الملوثة باستخدام جهاز Ludlum فكانت 55 μR/hr عند وضع الكاشف على مسافة 0.5 cm تقريباً أما على مسافة 1 m فكانت 9 μR/hrوهي ضمن معدل الخلفية الإشعاعية الطبيعية.

كما وأخذت نماذج التربة وفق المعايير والمواصفات المعتمدة عالميا لهذا النوع من قياسات النشاط الإشعاعي،وتم قياسها باستخدام منظومة تحليل أطياف كاما والتي تتألف من عداد الجرمانيوم عالي النقاوة ذو كفاءة 40% وقدرة فصل 2 keV للطاقة 1.33 MeV،أظهرت نتائج الفحوصات المختبرية لنماذج التربة المأخوذة من مناطق قريبة من بناية برج التحرير والتي تعتبر كخلفية إشعاعية وجود نظير Th-234بنشاط إشعاعي قدره 40 Bq/kg وعدم وجود نشاط إشعاعي محسوس لنظير Pa-234m بينما أشارت نتائج نماذج التربة المأخوذة من طوابق البناية إلى وجود نشاط إشعاعي عالي لنظيري Th-234 و Pa-234m تصل إلى 1550.1 Bq/Kg و Bq/Kg1394.8 على التوالي والذي يعتبر مؤشر واضح على وجود نشاط إشعاعي عالي لنظير اليورانيوم- 238 لأنهما من المفروض أن يكونا في حالة توازن إشعاعي. وإن الهدف الأساسي من هذا البحث هو تقييم و معالجة التلوث الإشعاعي الناتج من قصف بناية برج التحرير بإطلاقات اليورانيوم المستنفذ لحماية السكان والبيئة من الآثار الضارة للأشعة المؤينة.

الكلمات المفتاحية: النشاط الاشعاعي، بناية برج التحرير، التلوث الاشعاعي.

INTRODUCTION

Uranium is found in trace amounts in all rocks and soil, in water and air, and in materials made from natural substances. It is a reactive metal, and, therefore, it is not present as free uranium in the environment. In addition to the uranium naturally found in minerals, the uranium metal and compounds produced by industrial activities can also be released back to the environment. Uranium can combine with other elements in the environment to form uranium compounds. The solubility of these uranium compounds varies greatly. Uranium in the environment is mainly found as a uranium oxide, typically as UO_2, which is an anoxic insoluble compound found in minerals and sometimes as UO_3, a moderately soluble compound found in surface waters. Soluble uranium compounds can combine with other chemical elements and compounds in the environment to form other uranium compounds. The chemical form of the uranium compounds determines how easily the compound can move through the environment, as well as how toxic it might be. Some forms of uranium oxides are very inert and may stay in the soil for thousands of years without moving downward into groundwater. The average concentration of natural uranium in soil is about 2 parts per million, which is equivalent to 2 grams of uranium in 1000 kg of soil [1].

DEPLETED URANIUM

Uranium is a radioactive chemical element in the periodic table, and is symbolized by the letter U. Atomic number is 92,and during the preparation of spent fuel for nuclear reactors ,processing and enrichment of Uranium is done to concentrate U-235 isotopes among other Uranium isotopes (U-230,U-234,U-238,U-235).the content ratios of these isotopes in the natural metal are 0.002% ,0.0058%,and 99.28% ,0.71% respectively [2] .Depleted Uranium (DU) is the highly toxic and radioactive byproduct of the Uranium enrichment process ,it is so called (Depleted) because the content of the fissionable U-235 isotope is reduced from 0.7% to 0.2% during the enrichment process. The depleted Uranium is roughly 60% as radioactive as naturally occurring uranium metal, The weapons that enter the depleted uranium in the manufacture of multiple terms in the form of alloy consisting of (99.27%) uranium Depleted and (0.75%), titanium (TI-TI9V), and other types consisting of (98%) uranium depleted (2%) Molbydiom (Mo). Different sizes and dimensions of missiles depending on the uses and the type of weapon, of radioactive depleted uranium,the effectiveness of alpha particles in depleted uranium, less than normal by about 43 % [3].

Depleted uranium (DU) emits ionizing radiation and most of this radiation alpha particles and less beta and neither are moving a long distance in the tissue and therefore, the important impact happen by entering the body (breathing, eating ,or contamination of open wounds)[4].

DESCRIPTION OF THE BUILDING

The building located in the eastern door in front of the Tahreer Monument - the center of Baghdad, near the Tigris river to the west and surround with the shops and buildings of a commercial nature. The building consists of fourteen floor besides the basement, the area of each floor are approximately 640 m^2, the climbing to the floors building by the stairs that are on the right and left, and the Tahreer building contains in all floors on elevators and bathrooms which are currently unfavorable for use. Most floors in the building in the year 2003 exposed to the barrage, which led to damages in the structure of the building in some locations, and during the initial radiological survey by using radiation detection equipments, the team found; radioactive contamination in many floors resulting from direct hits with depleted uranium projectiles and the spread of radioactive contamination in the ground and walls and roofs of the building.

METHODOLOGY AND INSTRUMENTATION

1 – Determination of the background radiation:

The background was determined by measurement the exposure dose rate and contamination level around Tahreer Tower building .External exposure dose rates was performed using portable monitor Ludlum for gamma & beta, and the contamination rate was performed using portable monitor CAB for Alpha & Beta.

The level of contamination was determined by measuring the concentration of the potential radionuclide in the soil using gamma spectrometry techniques for the ground contamination of selected area surrounding Tahreer Tower building samples taken at depth of (5-10) cm [5].

2- Field work and portable instruments:

The exposure rates measurements were guided by using the portable scintillation counter type Ludlum (model 2241-2 survey meter Sweetwater Texaco, unit of measurement in μR/hr to R/hr) was used to measure Beta &Gamma absorbed dose rates in air, the counter consists of thallium - activated sodium iodide NaI(TI) crystal ,the instrument was calibrated using a Cs-137 standard source supplied by the manufacturer. The contamination rates measurements and the selection of the soil samples locations were guiding by using the portable rate meter type CAB (model- 18351 probe model SAB 70, Canberra, for measuring Alpha & Beta in cps). The instrument is held close to the surface, moved systematically that is sufficiently low to allow detection of changes in the radiation field.

The strategy of radiological survey was done through dividing the floors into grid boxes according to recommendations of the IAEA and by selecting the front wall to the point of entry and give it the name (W1) and identify the rest of the walls counter-clockwise (W2,W3,W4) and apply this method on the ground(G) and ceiling(C), so the floors approximately divided into 44 grid boxes of (4.5 x 1.5) m^2 for walls , 200 grid boxes of (3 x 1) m^2 for ground ,and 20 grid boxes of (20 x 1.5) m^2 for ceiling, in each grid box ,measurements are taken at location near the center of the grid box as much as possible [6] .

3- Laboratory work:

The radiological analyses of the collected soil samples were done in the laboratory of the center of Radiological Researches in the Ministry of sciences and Technology by using Gamma spectrometry which contains High-Purity Germanium (HPGe) detector with efficiency of (40%) and resolution 2 keV at 1.33 Mev gamma ray photo peak of ^{60}Co source , the data are collected using digital spectrum analyzer (DSA-2000) furthermore the analysis of each measured gamma ray spectrum was conducted by dedicated software program (Genie-2000,USA) ,Marinelli beaker geometry is used for soil sample measurements ,calibration and efficiency of the system was carried out using multi–gamma ray standard source (MGS-5,Canberra) of Marinelli Beaker geometry . All sampling activities were recorded in the site and included sample specific information such as date, time of sampling, sample location and sample number. The collected soil samples were dried at room temperature for 10 days, the soil samples were grained by using 0.9 mm sieve [7] sample of a weight between (0.5-0.8) kg by using the electrical balance (Toledo with range 0.1-15 kg) was taken and contained in clean Marinelli Beaker, those Marinelli Beaker were placed in Gamma spectrometry for 3600 seconds for each sample. Activity in soil samples was reported on a dry weight basis in (Bq/kg).

RESULTS AND DISCUSSION

More than 50 exposure reading around the building indicated ,the natural exposure rate is **9** μR/hr& contamination rates is **0.5** cps .Firstly the portable survey meter (CAB-cps) was used to detection the contamination areas in the building, because the high sensitivity of portable contamination survey instruments comparing with exposure survey instruments. Figures (1, 2, 3, 4, and 5) show the results of the contamination rates measurements before decontamination processes in the floors (5^{th}, 6th, 7th, 8th, and 9^{th}).

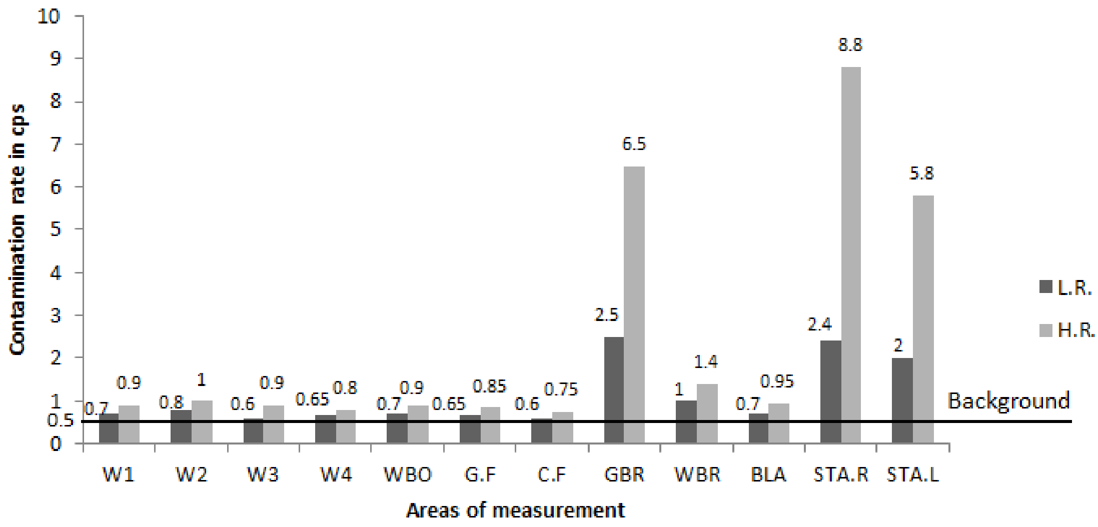

Figure (1) contamination rate in floor 5 before processes decontamination

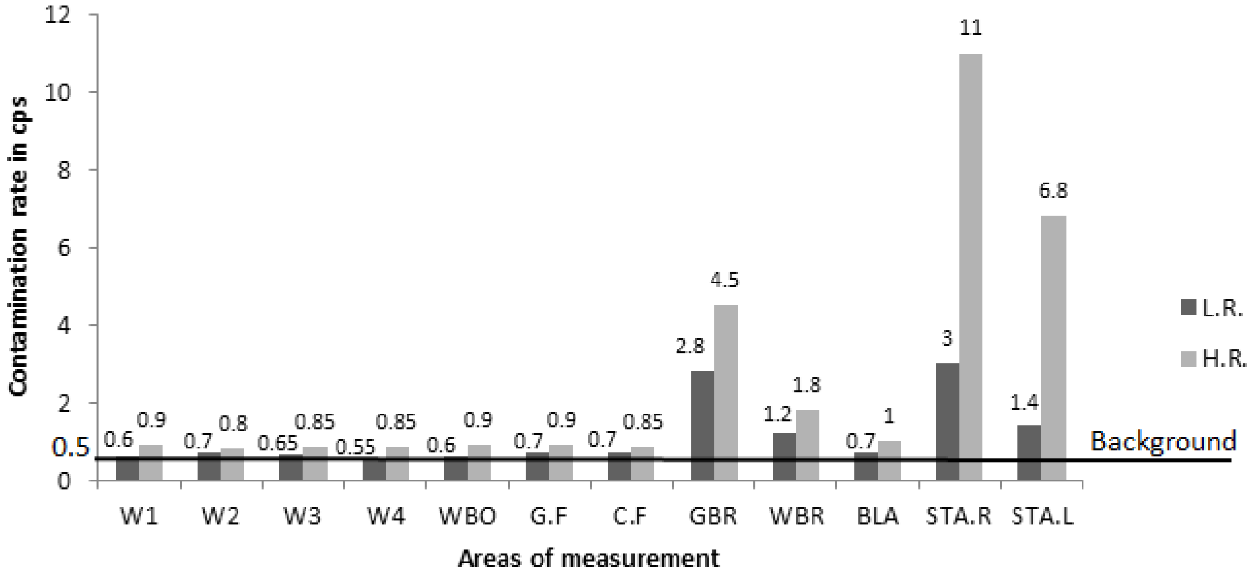

Figure (2) contamination rate in floor 6 before processes decontamination

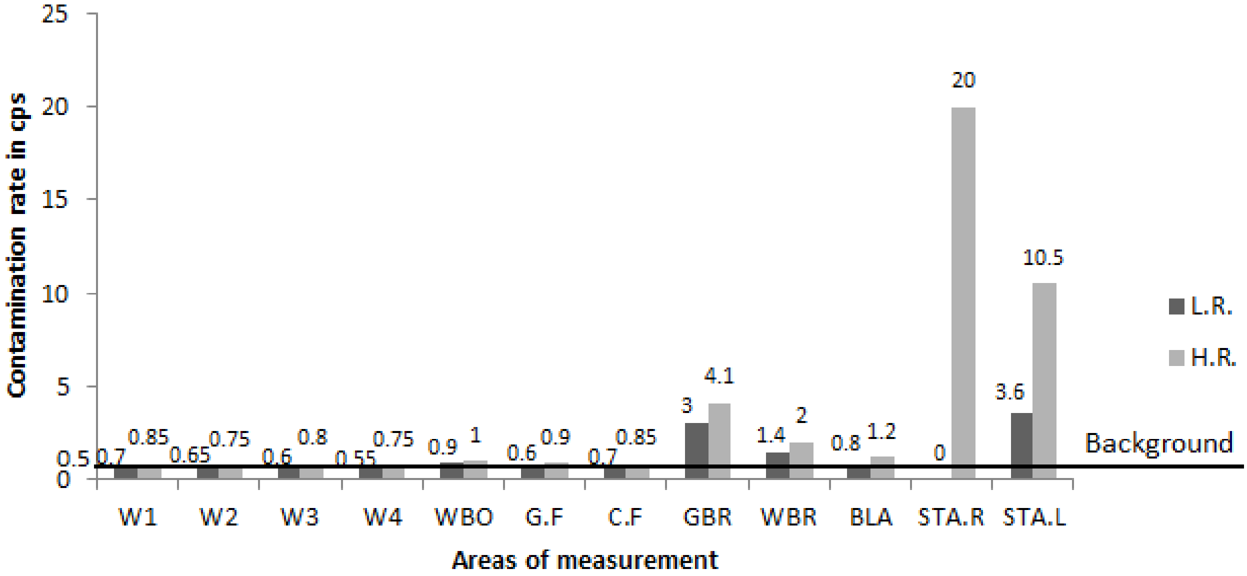

Figure (3) contamination rate in floor 7 before processes decontamination

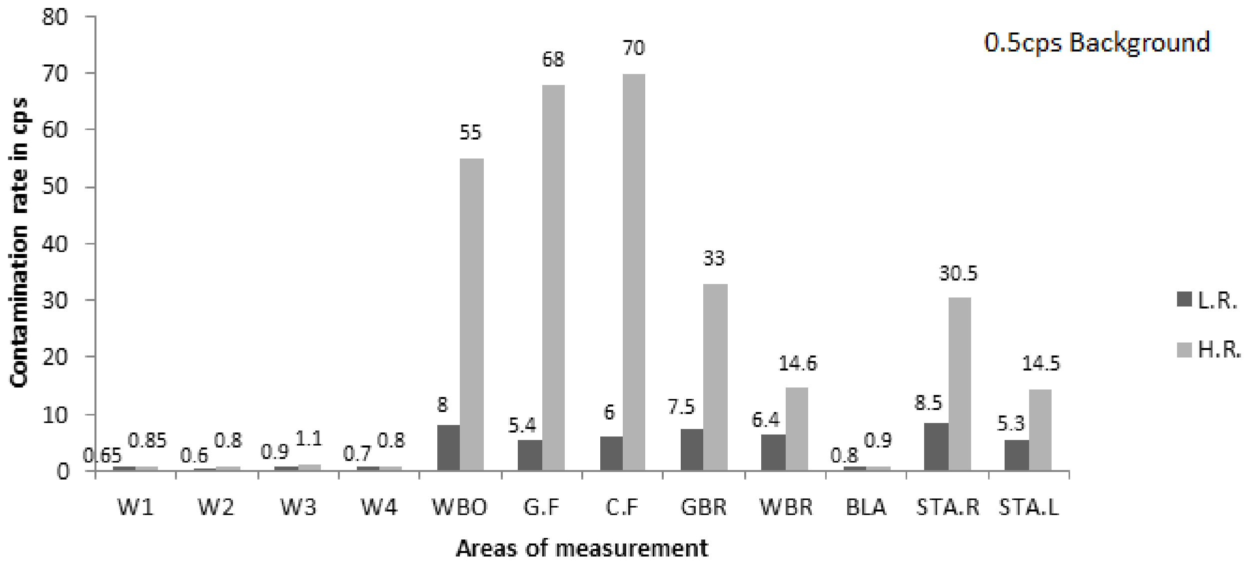

Figure (4) contamination rate in floor 8 before processes decontamination

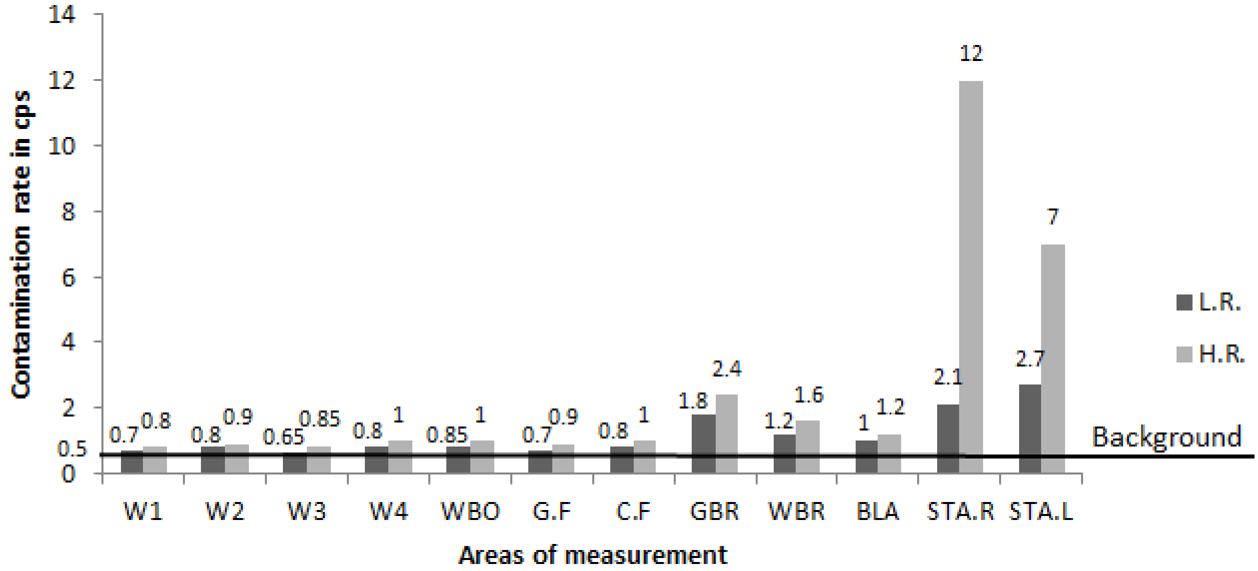

Figure (5) contamination rate in floor 9 before processes decontamination

Exposure rate measurements were performed before the decontamination processes. Figures (6, 7, 8, 9 and 10) show that.

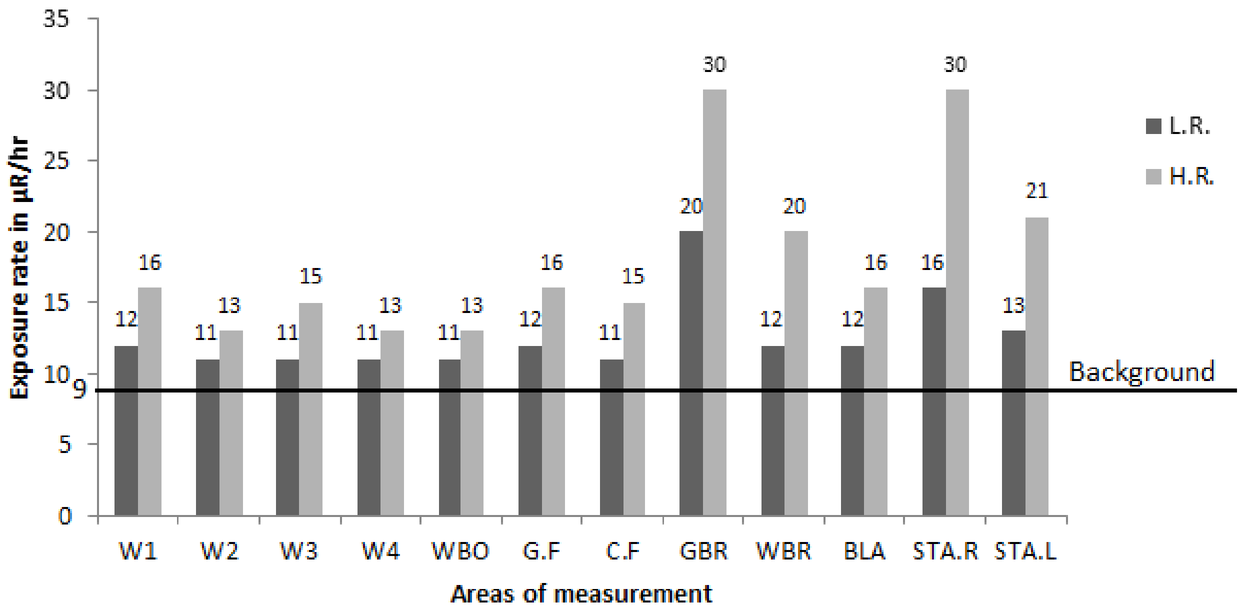

Figure (6) Exposure rate in floor 5 before the decontamination processes.

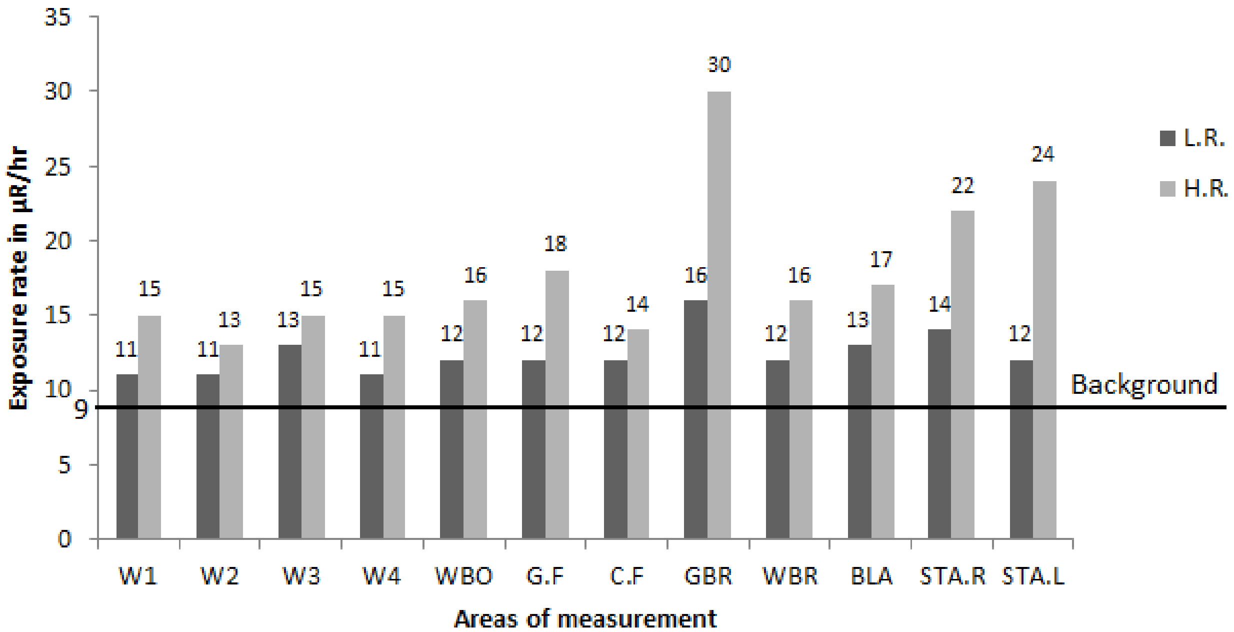

Figure (7) Exposure rate in floor 6 before the decontamination processes

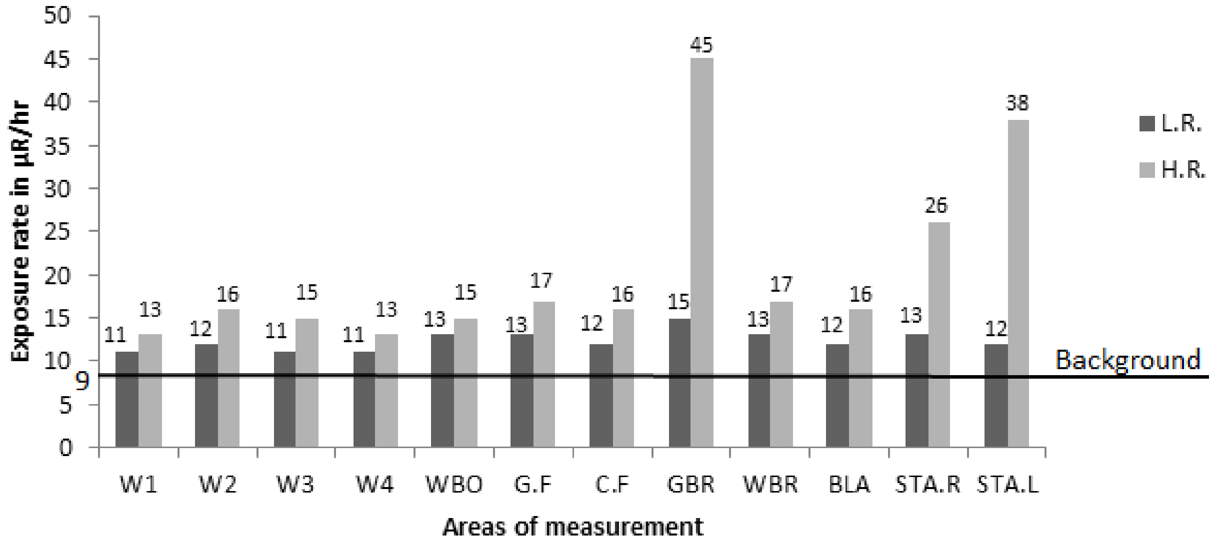

Figure (8) Exposure rate in floor 7 before the decontamination processes

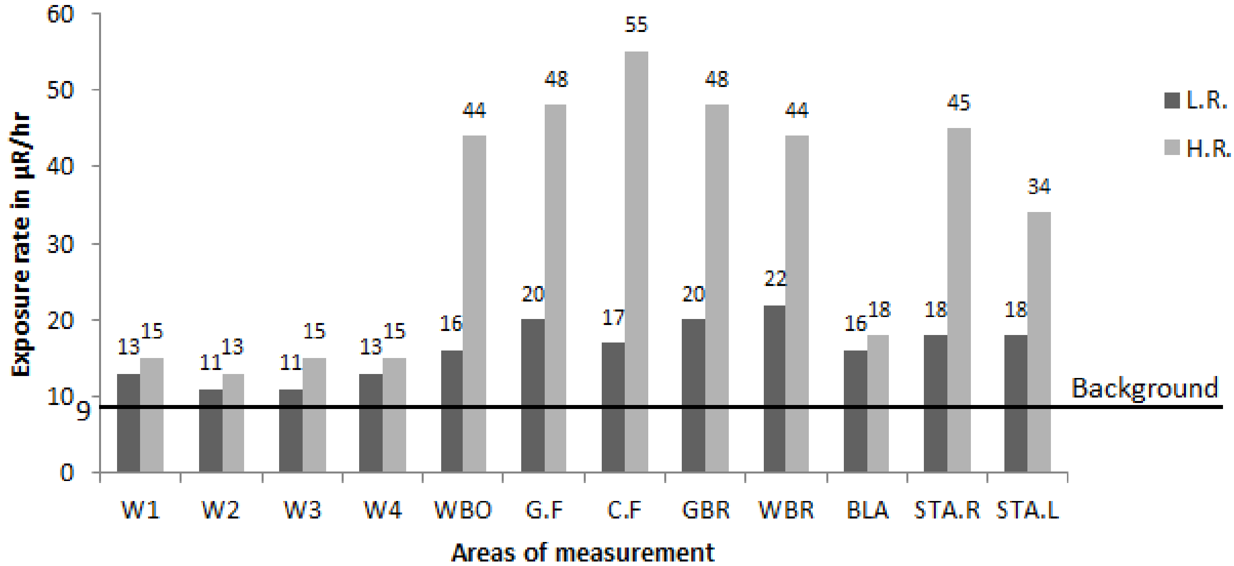

Figure (9) Exposure rate in floor 8 before the decontamination processes

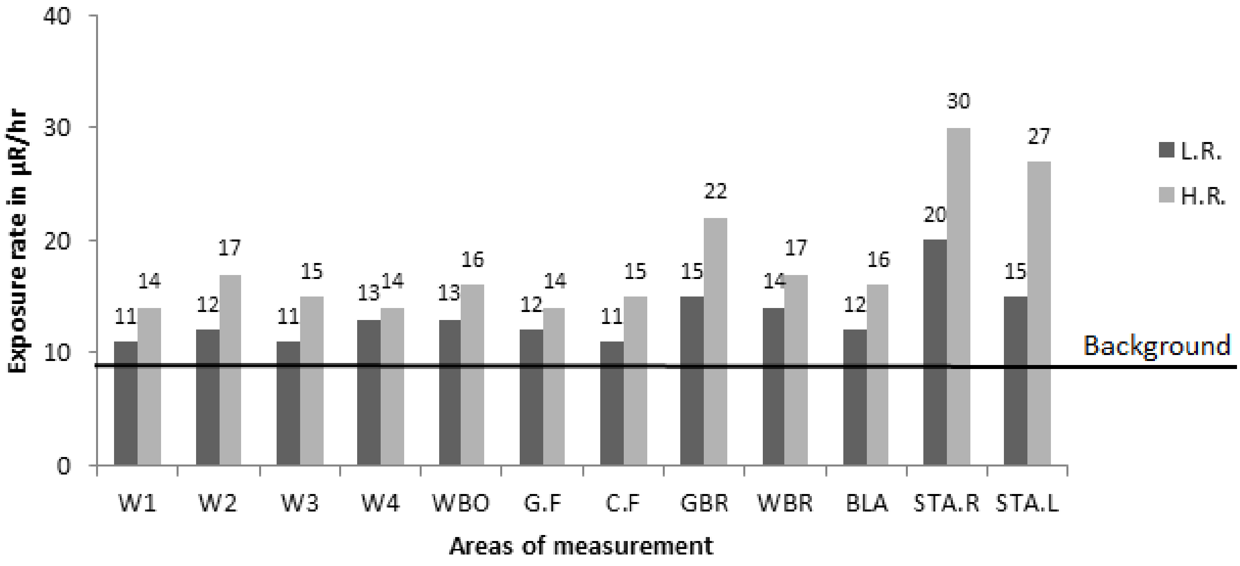

Figure (10) Exposure rate in floor 9 before the decontamination processes

Figures (11, 12) show the results of radiological survey in all floors which indicates the higher doses and contamination rates in eighth floor because the floor exposed to direct hits by depleted uranium bullets. The above figures indicate there were no significant levels of radioactivity detected in walls, and the spread of contamination in the bathrooms because the eighth floor was exposed to direct hit by depleted uranium bullets in the wall of bathroom from right side and that made a hole and contaminated large areas in floor in addition to contamination in internal walls of bathroom,

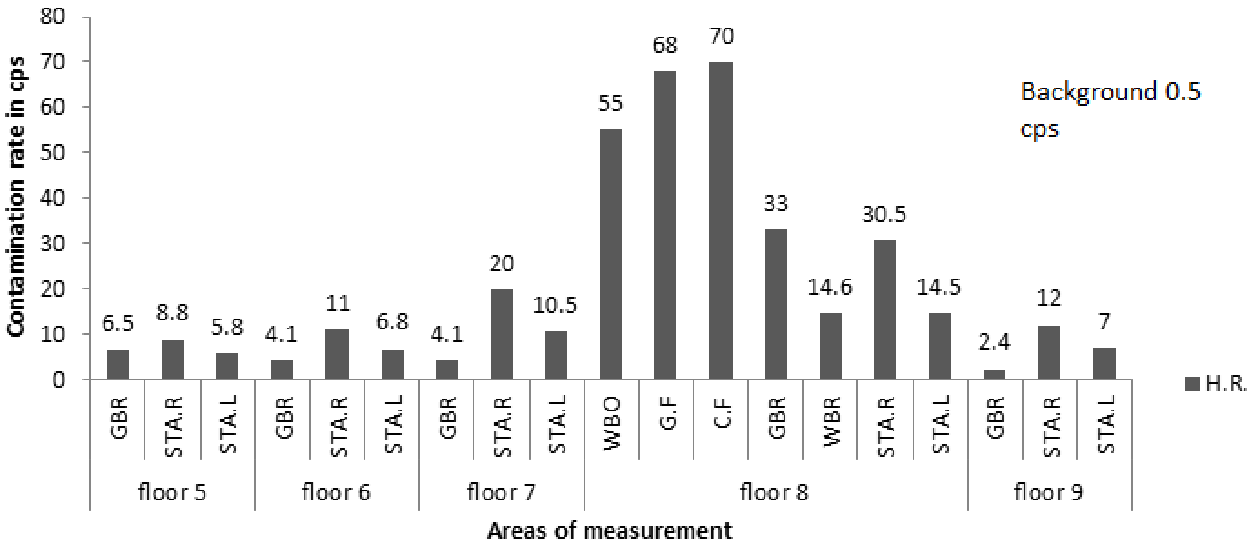

Figure (11) high value for contamination rate in all floors

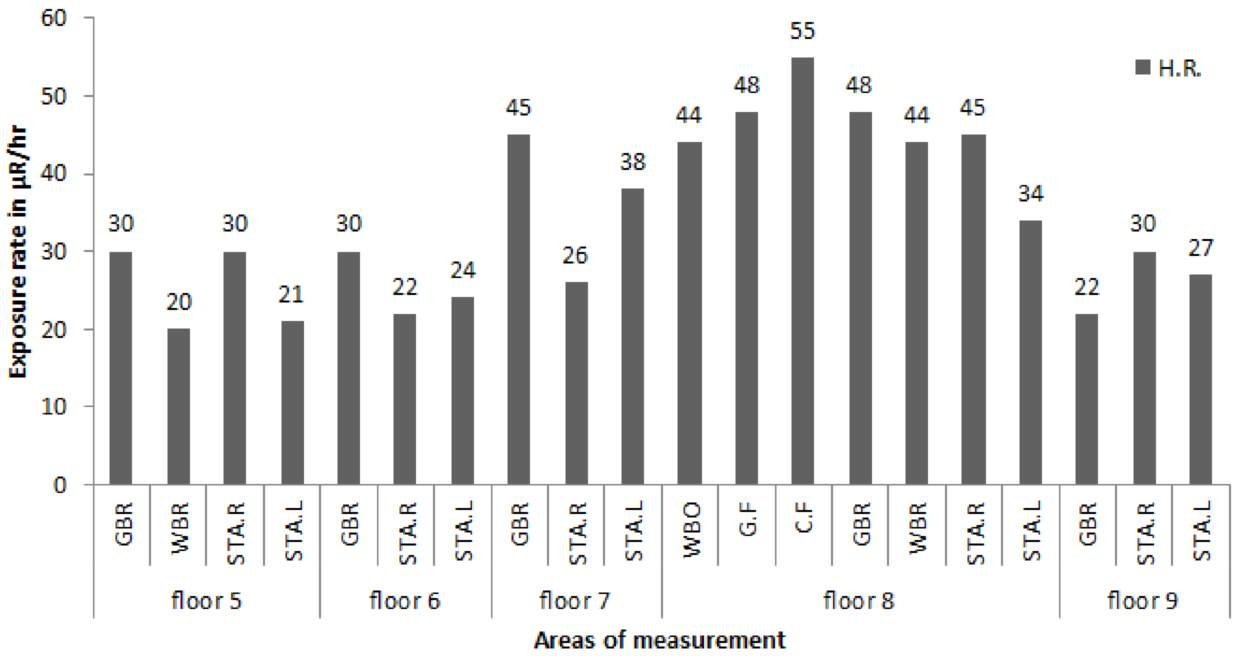

Figure (12) high value for exposure rate in all floors

The figures indicate the large spread of contamination in the bathrooms and stairs because some materials have been transported from the building to other areas without taking any environmental consideration, in addition to the building subject to movement of the winds. Therefore, the work has been focused on decontamination processes and lifted the contaminated soil which is considered more than two times higher than the natural levels when were using the portable radiation detection equipments, and sometimes were used mechanical decontamination techniques involved the removal of some thickness of the material of construction of walls, and the pipes waters especially in the eighth floor. The contaminated soil and waste collected in a special barrels intended for this purpose.

After the decontamination processes, soil samples were taken according to IAEA.The laboratory results indicated the presence of high concentrations of Th-234,and Pa-234m (an indicated nuclides for the presence of Uranium) of the soil samples in the floors (7 th,8 th and 9 th) therefore we repeated the decontamination processes by putting detector (CAB) on distance 0.5 cm and with speed less than 10cm/sec on the soils in the floors [6] .Than the contaminated soil Collected in a special barrels intended for this purpose .Soil samples were taken and the results are shown in figures (13,14).

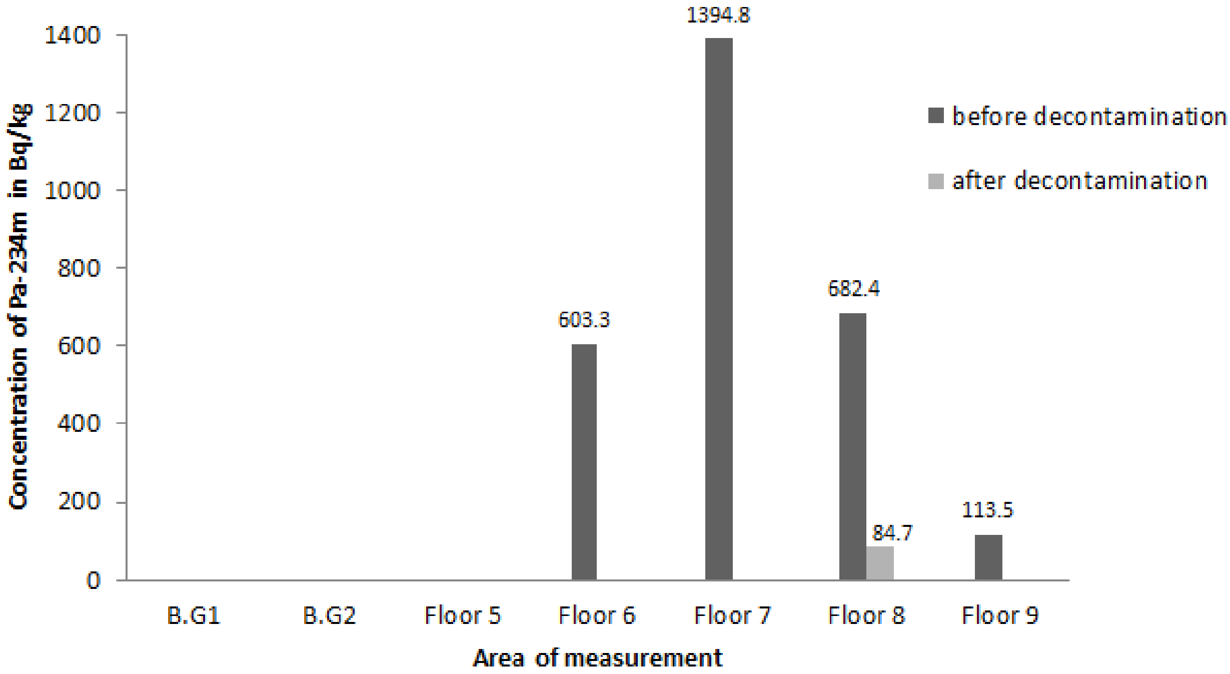

Figure (13) concentration of Pa-234m in soil sample before and after decontamination processes

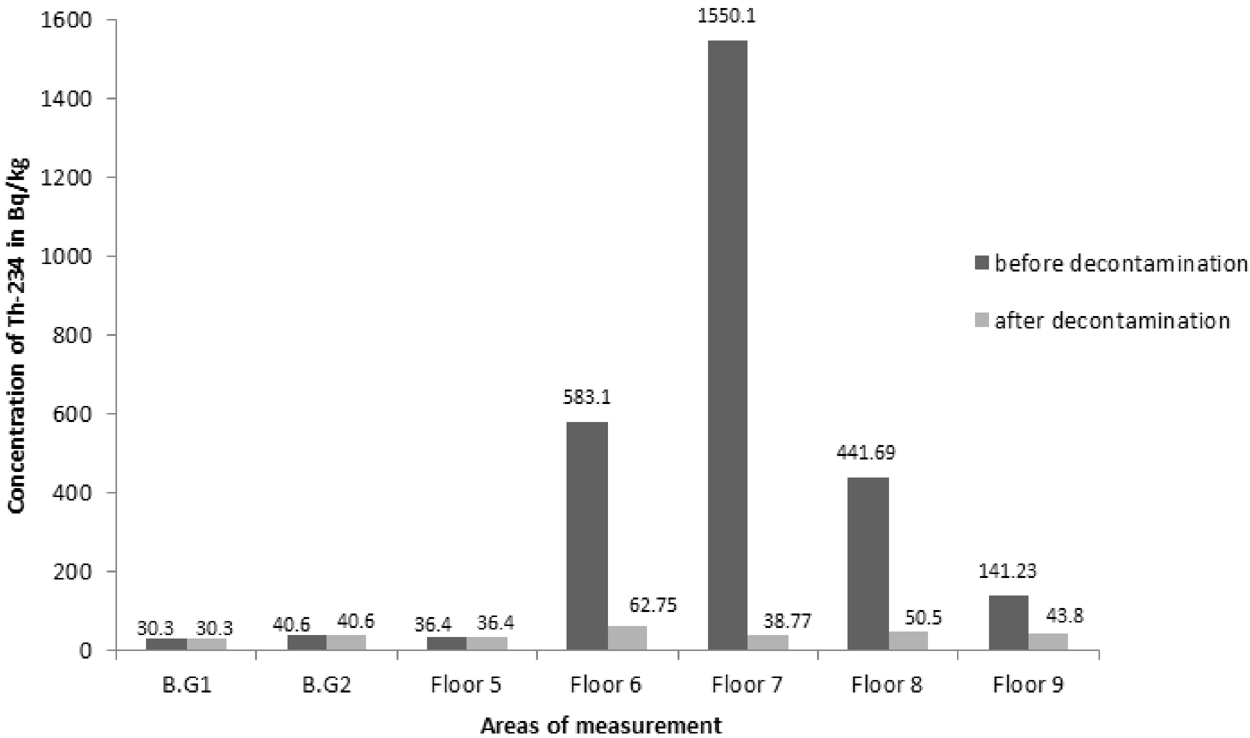

Figure (14) concentration of Th-234 in soil sample before and after decontamination processes

This laboratory results can be consider normal and slightly higher in comparison with natural background level, and these concentrations of the radioactive isotopes can be considered within the regulations limits of the environment.

CONCLUSION AND RECOMMENDATION

From field measurements, lab tests, and all other gathered information, the following be conclusions were drawn:

1- There is an increase in the radioactivity in the Tahreer Tower Building especially in the 8^{th} floor because this floor was exposed to direct hit by depleted uranium bullets, and therefore most of the bathrooms in the floors are contaminated

2- Spreading of contamination in the building may be because many of materials have been transported from the building to other areas without taking any environmental consideration, in addition to the building subject to movement of the winds.

3- The exposure and contamination rates especially near the contaminated regions are higher than the background level and within a range between (11-55) µR/h and (0.55-70) c/s respectively while the background level varies between (10-8) µR/h and (0.4-0.6) c/s

4- Samples of contaminated soil which were taken from floors indicated higher Pa-234m content, which ranged between (113 .5-1394.8)Bq/kg while in the natural background of this isotope is nil.

Recommendations

1- The Iraqi Ministry of sciences and Technology must be receive support from the international community to increase expertise of the staff on technical level in methods of measuring and detection of DU.

2- The radiological survey must be doing in all metal scrap yards that have received scraps for the potential presence of DU.

3- Education and awareness-raising efforts on DU-related issues should be scaled up throughout the country to avoid that the population be accidentally exposed to DU.

4- The international community must work together to promote a decision prevent using DU weapons.

Symbols:

L.R.: Lower Reading
H.R.: Higher Reading
WBO: wall of bathroom from outside.
G.F: Ground of floor.

C.F: ceiling of floor.
GBR: ground of bathroom on the right side.
WBR: walls of bathroom on the right side.
BLA: bathroom on the left side including ground and walls.
STA.R: stairs on the right side.
STA.L: stairs on the left side.

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