Use of Depleted Uranium in Military Conflicts and Possible Impact on Health and Environment

Jan Olof Snihs and Gustav Åkerblom
Swedish Radiation Protection Institute
SE-17116 Stockholm
Sweden

BACKGROUND

There has been concern regarding the possible environmental impacts of depleted uranium (DU) and its possible health effects on both military personnel and on civilians following the Gulf War 1991 (e.g. 1, 2, 3). These issues have been raised by several non-governmental organizations, some scientists and by a number of press reports. Since DU could also have been used in the Balkan conflict 1999, there has been a concern about the possible consequences of its use for the people and for the environment of this region.

Because of this concern it was considered necessary to review existing information on DU and give appropriate recommendations in the aftermath of the Balkans conflict.

In May 1999 a UNEP/Habitat Balkans Task Force (BTF) was set up to make an overall assessment of the environmental consequences of the conflict and impacts of the conflict on human settlements in Kosovo, Macedonia, Montenegro, Albania and in Serbia. The work was done by organising Technical Missions to provide independent and reliable information which was relevant for the problem under consideration. As regards depleted uranium, a special international expert group, the ‘Depleted Uranium Desk Assessment Group’ was appointed to analyse and assess the situation particularly in Kosovo.

The task of that group was to “assess the potential health and environmental impact of depleted uranium used in the Kosovo conflict” by:

1. collecting pre-information from existing material, in close co-operation with relevant institutions and organisations, concerning
   -potential effects of depleted uranium on human health or the environment;
   -quantity and quality of depleted uranium used in the conflict;
   -location of affected sites to be assessed.
2. assessing, by means of a desk study, the medium- and long-term potential health and environmental impacts of depleted uranium used in the Kosovo conflict, and depleted uranium dumped into the Adriatic Sea.
3. making a Fact-Finding Mission to Kosovo to prepare a sampling campaign and Field Study.
4. considering the possibility of conducting a Field Study in Kosovo, (based on the findings of the desk assessment and preparatory mission), to gather information from selected sites by using appropriate methodologies to assess the radioactivity and toxicity of depleted uranium.
5. analysing information in order to quantify ‘on the ground’ problems in respective areas and to provide qualitative answers concerning the possible risks to human health and further environmental damage.

The purpose of the task was to obtain a reliable baseline for deciding whether people can move back to abandoned areas, to judge the need for special control and countermeasures, and, through information dissemination, to avoid unnecessary concern. The study concludes with some recommendations (4).

LIMITATIONS OF THE STUDY

The study of the “DU group” was limited by a number of conditions, cicumstances and other influencing factors like

- there were no official documents confirming that depleted uranium was, or was not, used in the Kosovo conflict. There were only various oral statements, some of which were contradictory;
- consequently there was no information on where and how depleted uranium has been used;
- it was not possible, within the given time framework, to organise and perform measurements, or take samples, in areas identified as affected by depleted uranium (the limited Fact Finding Mission to Kosovo did not identify any contamination in the selected areas, see below);
- there were (and are) a number of publications and articles of varying scientific quality quoted and used by persons engaged with this issue. These may influence judgements about the health effects of depleted uranium, leading to the magnitude of the risks being either over-estimated or under-estimated. Time did not allow a scientific review of all these documents;
- the work was done pending results of new ‘generic’ assessments by WHO of the health risks of exposure to depleted uranium, whilst other scientific assessments are in preparation;

On the other hand there is already a lot of reliable information and data which make it possible to draw up conclusions and recommendations, having in mind the limitations and uncertainties described above.

So, there is a lot of knowledge concerning the physical and chemical properties and qualities of uranium and depleted uranium, its chemical and radiological health effects, particularly in animals, its dispersion in air and uptake by plants, animals and human beings, and of its metabolism in the body etc.

CHOSEN APPROACH

In order to obtain a basis for judgements,conclusions and recommendations the following approach was chosen

- assume that depleted uranium was used in the Kosovo conflict
- use information from the Gulf conflict concerning the military use of depleted uranium and observed effects
- use available information on other military uses of depleted uranium and the observed effects
- apply scientific data and knowledge of depleted uranium with regard to its physical and chemical properties and qualities, behaviour in the environment, metabolism in the human body etc.
- develop a scenario that considers and includes possible events and consequences
- make comparisons between the results of the scenario study and existing natural levels of uranium, natural radiation, present limits and hygiene standards etc. in order to put the possible risks into perspective
- from this, identify the significant risks arising from exposure, and taking the uncertainties into account, judge the results, draw conclusions and make recommendations.

WHAT WAS DONE

Of that done the most relevant can be summarised as

1. Compilation of data and information
2. Fact Finding Mission to Kosovo
3. Scenario and conclusions
4. Recommendations

1. Compilation of data and information.

Available information on a number of relevant issues was compiled such as

- general information on natural and depleted uranium regarding physical and chemical properties, natural levels of uranium and radiation, exposure pathways in the environment, metabolism of uranium in the body, and observed health effects caused by the chemical and radiological properties of uranium
- use of depleted uranium for military purposes
- long-term environmental behaviour and effects of depleted uranium
- immediate and short-term problems, including some introductory remarks and reflections on the problems of measurements, possible decontamination and waste management and disposal.

2. Fact Finding Mission to Kosovo

The Fact Finding Mission to Kosovo was conducted to determine whether it would be possible, under present conditions, to make an expanded field study (sampling and measurements campaign) related to depleted uranium (DU) in the environment.

3. Scenario and conclusions.

By use of the available information a hypothetical scenario was described based on a number of conditions and assumptions that were chosen to be as realistic as possible. In case of uncertainties, conservative assumptions were made; i.e. the real levels and consequences would most probably be less than those described. Through this means, all possible exposures to depleted uranium were discussed and conclusions drawn about their significance.

4. Recommendations.

On the basis of the conclusions a number of recommendations were made on actions that should be taken within the short-term future.

COMPILATION OF DATA

Depleted uranium (DU) is a waste product of the process that is used to enrich natural uranium ore for use in nuclear reactors and in nuclear weapons. Compared to natural uranium which has a U-235 isotopic content of 0.7%, the isotopic content of U-235 in DU is partially depleted to about a third of its original content (0.2%)

DU is reported to have been used in the tips of bullets that are used with the intention of piercing armour plating. It may also be used in cruise missile nose cones and is used in the amoury of tanks. One of the main reasons why DU metal is used in these applications is because of its high density. In the case of weapons, this makes them extremely hard and able to pierce armour plating. In addition to its high density, other reasons for its use in military applications include its cheapness and the fact that it is available in huge quantities.

Depleted uranium as a metal has a theoretical density of 19.07 g/cm^3 (1.7 times the density of lead). In DU, only minute traces exist of the decay products beyond U-234. This is due to the fact that all the later decay products are separated in the processing of uranium ore, and new post-U-234 decay products have not had time to form (the half-life of the daughter of U-234, Th-230, is as long as 7.50 10^4 years). Thus, no radium and radon (post-U-234 decay products) exist as a result of contamination of DU, and it will take thousands of years before any significant amounts are formed.

The sum of the energy of the emitted alpha radiation per unit time of the isotopes in DU is 11% of the sum of the energy of all the emitted alpha radiation per unit time in the uranium-238 series in radioactive equilibrium. The energy of the beta radiation emitted from DU is about 42%, and the energy of gamma radiation about 1.4% of that in the uranium-238 series in equilibrium.

Uranium occurs in all rocks and soils. The normal activity concentration of U-238 in the earth’s crust is 5-125 becquerel per kilogram, Bq/kg, (0.5-10 ppm, 1 ppm = 1 gram/ton) and of U-235 0.2- 5 Bq/kg. The activity concentration of U-238 in some uranium-rich rock types such as alum shale is of the order of 600-5000 Bq/kg (50-400 ppm). The activity concentration in uranium ores of good quality (1-30% uranium) is 1.2 10^5-3.6 10^6 Bq/kg. The activity concentration of pure uranium metal in radioactive equilibrium with its immediate decay products is 50.23 10^6 Bq/kg. The activity concentration of DU containing U-238, U-235, U-234, Th-234, Pa-234 and Th-231 is 39.42 10^6 Bq/kg ((12.27+0.16+2.29+12.27+12.27+0.16) 10^6 Bq/kg respectively).

Metallic DU reacts chemically in the same way as metallic uranium, which is considered to be a reactive material. It reacts readily with all the non-metallic elements and also forms numerous inter-metallic compounds. The general chemical character of uranium is that of a strong reducing agent, particularly in aqueous systems (5).

DU, particularly as powder, is a pyrophore, which means that it can ignite spontaneously at temperatures of 600-700 ^oC. When DU burns, the high temperatures oxidise the uranium metal to a series of complex oxides, predominately triuranium octaoxide (U_3O_8), but also uranium dioxide (UO_2) and uranium trioxide (UO_3).

Detrimental health effects of DU may be caused by external radiation and by internal radiation from inhaled and ingested uranium. Depleted uranium has a low specific activity (39.4 kBq/g) and may be considered as ‘only weakly radioactive’. Nevertheless, given the linear dose response relationship, exposure to it must be considered as carrying a potential risk of cancer, although at a lower level than many other radioactive materials present in the environment from both natural and man-made sources.

However, high exposure to radioactive particles in the guts of grazing animals can cause beta-burns on the walls of the intestines and also tumours after 2-5 years. Sheep and pigs, which ingest a lot of soil, are especially vulnerable to exposure in case of heavily contaminated ground.

Detrimental health effects may also be caused by ingested or inhaled uranium and its chemical toxicity. The chemical effects are normally dominating as compared with the radiological.

There are few reports on harmful effects on humans from intake of uranium. Few humans have had such a large intake of uranium that it may be harmful. Therefore, information on the possible health effects of uranium intake relies mainly on experiments with animals that have similar digestive systems as humans, e.g. rats, dogs, pigs, and monkeys, but not rabbits and ruminants.

In general, it can be concluded that soluble uranium compounds do have a greater chemical toxicity than insoluble compounds. This toxicity results primarily in kidney damage. Depending on the degree of exposure, impairment of kidney function could occur after a few days. Often these effects will disappear after cessation of exposure, although kidney morphology will not return to normal.

In a report on DU in Iraq after the Gulf War it was hypothesized that the current health and environmental problems in Iraq may be in part linked to DU. It noted that the incidence of several cancers has increased, including childhood leukemia. It also states that congenital malformations and diseases of the immune system have increased (6).

Thousands of American, Canadian and British soldiers who participated in the Gulf War have since claimed to be suffering with a variety of incapacitating symptoms which are generally termed as Gulf War

Syndrome. The veterans were exposed to a variety of damaging or potentially damaging risk factors including environmental adversities, pesticides such as organophosphate chemicals, skin insect repellents, medical agents such as pyridostigime bromide (NAPS), possible low-levels of chemical warfare agents, multiple vaccinations in combinations and depleted uranium (7).

In conclusion, today research has shown that many of the veterans with Gulf War Syndrome were exposed to a number of substances but little research has been carried out whether DU plays a role as an agent for the Gulf War Syndrome (7).

FACT FINDING MISSION

During the Mission some preliminary measurements were performed e.g. on absorbed dose rates in air and surface alpha and beta contamination levels around destroyed and damaged military vehicles along the roads, on which the team travelled, and, in Pristina, around and partly inside two official buildings, that had been destroyed by fire after being hit by cruise missiles.

The Mission did not locate and sample any targets that had been hit by depleted uranium.

There were no elevated levels of radiation measured in the vicinity of the destroyed military vehicles and no elevated levels of radiation were found on, or alongside, the roads the mission team travelled. Based on these preliminary measurements, the team did not find any evidence or indication of the presence of DU at the locations visited.

However, as the effects of DU are mainly localised to the places where DU ammunition has been used and the affected areas are likely to be rather small, it was difficult to find these areas without information on exact localisation. That information was not given. Furthermore, the extension of measurements was limited by the incomplete documentation of existing landmines.

In conclusion, depending on the special conditions and cicumstances that occurred, the "negative" result of the Mission does not exclude the possibility that DU still has been used.

THE SCENARIO STUDY

The assumptions:

It is assumed that an attack includes 3 aircraft and the total DU used in the attack is 10 kg. The target is one or several vehicles and the area affected by the subsequent DU contamination is 1000 m^2. The impact of DU on soldiers and civilians in the vehicles and on the affected area during the attack is not considered specifically. The chemical and radiological impact during the attack is probably small as compared with the consequences of explosions and fire. However, the survivors may have been seriously exposed to depleted uranium on the top of the consequences of explosion and fire.

Most of the dust that is caused by explosions and fire is assumed to settle on the ground within the area of 1000 m^2. However, it is assumed that someone very close to the target instantaneously are exposed for a short time of the dust cloud, that probably has a very high density. An instantaneous intake by breathing of more than 1 g dust is unendurable and assuming 10 % DU means a maximum intake of 100 mg DU.

After some time people may enter the area which may contain cultivation. By entering the area people cause suspension and breathe contaminated air, are contaminated by touching subjects in the area, are externally exposed from solid DU pieces of the ammunition on or in the ground that are picked up.

Some of the DU will be dissolved in water in ground and contaminate the groundwater which serves a well nearby.

Some animal will graze in the area, be contaminated and eventually be used as meat and contaminate people.

By dispersion a small part of the DU dust will in the long time perspective be spread over larger areas.

The comparisons:

In order to make judgements of possible consequences comparisons have been made with a number of "reference" values for uranium. They are related to

-natural levels

-limits and standards

-impact values

-action and non-action levels (radiological)

As to *natural values* the following were used (8, 9):

-activity of U-238 is 12.3 Bq mg^{-1}

-body burden 30 μg uranium (99.8% is U-238 by weight. 360 mBq each of U-238 and 234 assumed to be in equilibrium)

-effective dose 5 μSv per year caused by U-238 + 234 only (in equilibrium and each contributing about 50%) in the body
-total effective dose 160 μSv per year caused by all uranium daughters in the body from ingestion and inhalation (except radon daughters inhaled). The main part is from Pb/Po-210 ingested

-concentration in air 1 μBq m^{-3} each of U-238 and 234 (8 10^{-5}μg m^{-3}, 99.8% U-238 by weight)
-inhaled 7 mBq per year each of U-238 and 234 (~0.6 μg uranium, 99.8 % U-238 by weight)
-effective dose caused by inhaled uranium 0.3 μSv per year if all uranium daughters (except radon and its daughters) are in equilibrium 5.9 μSv per year from uranium and its daughters as they are in air (major part caused by Pb/Po –210) 0.06 μSv per year from U-238 solely and 0.07 μSv per year from U-234 solely

-normal dust load 50 μg m^{-3}
-natural uranium in soil 36 Bq kg^{-1} of each U-238 and 234 (3 mg per kg)
-uranium in dust as in soil i.e. 1.8 μBq m^{-3} air of each U-238 and 234

-ingested by food 5.2 Bq per year (0.4 mg uranium per year, the major part U-238 by weight) of each U-238 and 234
-drinking water concentration 1 Bq m^{-3} (0.08 mg uranium m^{-3}) of each of U-238 and 234
-intake by water 0.5 Bq per year (0.04 mg uranium per year, 500 l water per year) of each U-238 an 234
-effective dose caused by ingested (by food and water) uranium 0.25 μSv per year from each of U-238 and 234

Therefore: 36 Bq/kg soil (each of U-238 and 234) leads to a total annual intake by food and water of 5.7 Bq of each of U-238 and 234 which leads to an effective dose of 0.25 μSv per year from each of U-238 and 234

-the same concentration of uranium in soil leads to (with the level of equilibrium of short-lived daughters existing in ground) an external absorbed dose rate in air of 17 nGy per hour or 0.02 mSv per year (adjusted for indoor occupancy factor 0.8 and 0.7 Sv/Gy for conversion coefficient from absorbed dose in air to effective dose received by adults)

As to *limits, standards and intake-dose relationships* the following were used:

Chemical

-natural uranium with daughters in air 0.2 mg m^{-3} (US-value for workers) insoluble uranium and 0.05 mg m^{-3} soluble for long term exposure and 0.6 for short term exposure. Corresponding value for the public would be 0.15 mg m^{-3}.
-proposed (by EPA) drinking water standard for naturally occurring uranium 20 μg/l (10)
-tolerable daily intake (WHO) of natural uranium 0.6 μg/kg body weight (bw) per day (11) Radiological
-planning dose limit for a given source 0.1 mSv per year effective dose to the public i.e. the practice shall be planned to give doses (far) below that value
-dose limit for the public from all man made sources excluding medical and natural sources 1 mSv per year effective dose
-dose limit for the public for exposure of the skin 50 mSv per year
-dose limit for worker 20 mSv per year effective dose as an average over 5 years
-dose limit for workers in a single year 50 mSv per year effective dose
-dose limit for workers for exposure of the skin 500 mSv per year

-intake of depleted uranium corresponding to 1 mSv: by ingestion 1.5 g by inhalation 10 mg

As to *impact values* the following were used:

Chemical impact: deterministic above thresholds which are assumed to be:
-air concentration 10 mg m^{-3} (no sign of pulmonary disease of U miners exposed to 0.5-2.5 mgm^{-3} of uranium dust for 5 years, for animals acute effects have been observed above 10 mg m^{-3} and no effects whatever for short or long term exposure in 0.15 mg U m^{-3}).
-water concentration 2 mg l^{-1} (short term exposure of rats)
-acute toxicity (lethality) in animals 100 mg/kg body weight, bw.

As regards long term effects see *limits* above.

Radiological impact: somatic effects (cancer) without threshold (probability = 5 10^{-2} per Sv effective dose) and deterministic effects above thresholds which are assumed to be
1 Sv for effective dose (death)

5 Gy for organ dose (organ death, skin burn)
For animals the same values are assumed.

As to *action and non-action levels* (radiological) the following were used for comparisons:
- if expected doses are > 100 mSv countermeasures to prevent these doses are mostly always justified
-actions probably justified if doses 10-100 mSv are prevented
-actions normally not justified if doses < 1 mSv are prevented
-action levels for radon in houses 10 mSv per year
-no concern if doses <10 μSv per year

The consequences:

The judgements in terms of chemical risks and radiation doses include the possibility of smaller affected areas than $1000 m^2$.

1. Picked up solid pieces of DU.

The only realistic way of exposure is by external β-radiation. The γ-radiation is very weak and the α-radiation can not penetrate the dead skin layer. The surface radiation dose rate is about 2 mSv h^{-1}. By keeping a piece of DU in the pocket for several weeks in the same position it might be possible that the skin dose will exceed values corresponding to the limit for the general public and radiation workers. It is out of question that there will be any deterministic effects (skin burns).

2. Rounds that passed or missed the target and can contaminate the ground and groundwater.

The bullet can be intact and the risks are those above (1). Alternatively it may be damaged and the risks are those described below for inhalation and groundwater contamination.

3. Instantaneous inhalation of DU dust after an attack.

The dust concentration will be very high and, if the persons survive the attack but are unprotected, there is a great risk that they have got a very high exposure (1g dust containing 100 mg DU is assumed as max.), possibly leading to acute disease caused by chemical toxicity. The radiation dose will probably be moderate, less than 10 mSv.

4. Inhalation of resuspended DU.

Due to the effects of wind, people walking in the area, digging etc., dust from the ground may be resuspended in the air and then inhaled. All DU is assumed to be present in the form of small particles (<10 μ) and to be in the form of insoluble oxides (Type S), which are cleared from the lungs only slowly.

An assumed 2 hours stay in the target area by a person would lead to doses in the range of 0.1-10 μSv. An unprotected stay in the area for a whole year, 24 hours per day, and with normal dusty conditions would lead to doses of the order of 1 mSv per year the first year. After some time, rain has made the depleted uranium less accessible for resuspension and the inhalation risks decreases.

The chemical risks are of the order of acceptable standards.

No acute radiation effect on the lung is expected to be caused by radioactive particles.

5. Ingestion of DU.

- from soil taken into a person’s mouth (e.g. a child)

Risk of acute chemical effects. The radiation doses are low (less than 1 mSv).

- by surface contamination of vegetables (before rainfall washes the vegetables)

A significant risk of chemical effects. The radiation doses are low.

- by contaminated hands (after touching contaminated surfaces)

No acute chemical effects and only low doses are expected.

-by contaminated open wounds (e.g. contaminated hands with open wounds)

The resulting doses are difficult to predict, as is the risk of internal contamination by contaminated blood. The risks should not be underestimated.

-by contaminated water (in a nearby well)

No chemical toxic effects are expected, but the concentration may exceed hygiene standards. The radiation doses will be around 1 mSv per year.

-by contaminated food (other than vegetables)

Consumption of meat and milk, from animals grazing on the area shortly after the attack and before the first rain, may be a problem to people and even more to animals. At that time, there might still be a substantial surface contamination of grass etc. After some time, the contamination of food is mainly by root uptake and the chemical toxic effects and radiation doses will be insignificant (less than 10 μSv per year). Root vegetables contaminated on the surface by DU-contaminated soil might be considered as a potential risk, even if the risk is minor. It very much depends on the hygiene standards followed in food preparation.

6. External radiation

The external doses from gamma radiation will be insignificant (less than 10 μSv per year) or low (less than 1 mSv per year).

7. Activity spread over large areas

It has been suggested that depleted uranium will be spread over much larger areas and cause many health effects. However, if DU was spread over a wide area, the concentration in the environment will be much less than assumed in the assessments above. Consequently, no chemical toxic effects are expected, and the radiation doses will be negligible.

THE CONCLUSIONS

The following conclusions have been drawn:

1. The lack of official confirmation from NATO that depleted uranium has, or has not, been used distort the prerequisites of this study.

2. The absence of systematic measurements in Kosovo is a fundamentally weak point in this study. Measurements are necessary to verify the extent of the problem. These should focus on attacked areas and specifically on attacked targets.

3. The results of the study and the analyses depend on the assumptions made for the assessments. Some of these assumptions can not be verified at this time and therefore the results are subject to uncertainties. This is taken into account in formulating the recommendations by framing them conservatively.

4. With the given conditions and assumptions, the significant risks are restricted to a limited area around the target. If the depleted uranium is dispersed to larger areas the corresponding risks are considerably reduced.

5. If contaminated vehicles and apparent accumulations of uranium pieces and dust are removed from the target area, the possible risks of significant exposures are related to a few specific circumstances that could be avoided by provision of adequate information and instructions.

6. Some of the early significant risks of exposure are no longer (after some months) relevant, e.g. open wounds, contaminated leafy vegetables, milk and meat from the target area. However, possible risk of continued contamination of animals, milk and meat because the animals eat cotaminated soil should be considered.

7. The possible contamination of land from depleted uranium is not an obstacle to moving back to those villages and regions that were affected by attacks, and at which DU ammunition may have been used, providing that the given recommendations (see below) are taken into account.

8. During and immediately after an attack at which depleted uranium has been used, some people in the immediate vicinity may have been heavily exposed to depleted uranium by inhalation. The extent of this possible problem might be verified by special health examinations. This is applicable also to potentially affected individuals who are no longer in the area.

9. The results of these analyses are general in nature and therefore applicable not only to Kosovo but also to other areas in the Balkan region.

THE RECOMMENDATIONS

On the basis of the results of this study and the conclusions, the following recommendations have been made:

1. Obtain information from NATO concerning if, how and where depleted uranium has been used in order to be able to verify risk assessments, make necessary measurements, and take justifiable precautionary actions.
If it is officially confirmed that depleted uranium has not been used in the Kosovo conflict, this study can be concluded.
If it is officially confirmed that depleted uranium has been used, or if no conclusive information is obtained, the following recommendations apply:

2. The study of the situation in Kosovo concerning depleted uranium should continue according to the original tasks. The steps listed below should be given high priority:

3. Further measurements should be organised as soon as reasonable to identify possible contamination and verify assumptions. Highest priority should be given to finding pieces of depleted uranium, heavily contaminated surfaces and other 'hot spots'.

4. Pieces of depleted uranium, heavily contaminated objects and loose contamination should be collected and removed. This work should be done under controlled conditions with proper protection of people involved.
The collected depleted uranium should be stored in safe conditions under the responsibility of a designated authority and until further instructions are given.

5. At places where contamination has been confirmed by measurements, or where there is an apparent risk of contamination, signs should put up to forbid public access. These areas should also be clearly marked (i.e. by tapes or fences). Access of grazing animals should be prevented.

6. The local authorities and the people concerned should be informed about the results of the investigations, as well as the possible risks and countermeasures.

7. A programme of measurements (central and local), and a strategy for dissemination of safety instructions, countermeasures and waste disposal measures should be developed.

8. If contamination is confirmed, necessary measures and remedial actions should be implemented.

9. A program for possible health examination of people in, or close to, attacked areas where DU might have been used, should be devised. If justified by further information, this programme should be implemented, giving priority to people most at risk of having been heavily contaminated.

10. A thorough review of the effects on health of exposure to DU in the medium and long term perspective is required.

REFERENCES

1. Laka Foundation: Depleted uranium: A post-war disaster for environment and health. Laka Foundation. Amsterdam, The Netherlands. May 1999.

2. CADU a: Campaign Against Depleted Uranium (CADU) News, Issue 1. CADU, One World Centre, 6 Mount Street, Manchester, M2 5NS, 1999.

3. CADU b: Campaign Against Depleted Uranium (CADU): Briefing Pack, April 1999. Published by CADU, One World Centre, 6 Mount Street, Manchester, M2 5NS, 1999.

4. Snihs J. O., Åkerblom G., Stegnar P. van Leeuwen R., Allsopp M., Robinson C., Pronczuk de Garbino J.: The potential effects on human health and the environment arising from possible use of depleted uranium during the 1999 Kosovo conflict. – A preliminary assessment. UNEP/UNCHS Balkans Task Force (BTF). October 1999.

5. Blasch E B., Stuckenbroeker G., Lusky R.: The use of uranium as a shielding material. Nuclear Engineering and Design. Vol. 13 pp. 146-182. North-Holland Publishing Company. 1970.

6. Lancet: Does Iraq's depleted uranium pose a health risk? By K. Birchard. The Lancet 351 (Feb 28), p. 657 1998.

7. Jamal G.A.: Gulf War Syndrome – a model for the complexity of biological and environmental interaction with human health. Adverse Drug React. Toxicol. Rev. 17 (1), pp. 1-17. 1998.

8. UNSCEAR, 1993: United Nations Scientific Committee on the Effects of Atomic Radiation. Report to the General Assembly, with scientific annexes. New York. United Nations 54. ISBN 92-1-142200-0. 1993.

9. UNSCEAR, 1999: Exposures from natural radiation sources. United Nations Scientific Committee on the Effects of Atomic Radiation. Forty-eight session of UNSCEAR Vienna, 12 to 16 April 1996. Preliminary report. Draft. 1999.

10. U.S. EPA: Proposed drinking water standards. U.S. Environmental Protection Agency. 1991.

11. WHO: Guidelines for drinking water Quality. 2nd edition. Addendum to Volume 2: Health criteria and other supporting information. Geneva, Switzerland. 1998.