DESTROING OF CHEMICAL AND OIL INDUSTRY, BOMBING OF ENERGY SOURCES AND USE OF DEPLETED URANIUM AMMUNITION DURING NATO BOMBING IN FR YUGOSLAVIA

Introductive Review by

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During the NATO bombing of the FR Yugoslavia from March 24 to June 10, 1999, according to NATO's data, there were 34 250 takeoffs of the 1200 aircrafts; 367 000 tonnes of kerosine were consumed; there were 400 Tomahawk cruise missiles and 130 air-to-ground missiles. It is estimated that 22 000 – 79 000 tonnes of explosives were dropped; in addition to 20 000 smart bombs and 5000 conventional bombs of various weight and purposes. The bombing had the characteristics of an ecological war, among other things. During the air strikes A-10 aircrafts fired shells with depleted uranium from 30 mm guns. According to NATO estimates, around 31 000 projectils were fired (298 g of depleted uranium for each bullet, and more than 10 tonnes of uranium-238 as a contaminating agent), and according to the Yugoslav Army estimated, around 50 000 were fired. Some radiological, chemical and ethical consequences of NATO bombing in FR Yugoslavia are reviewed.

Key words: depleted uranium, environmental consequences, radiological impact, chemical impact, comparative analysis

NATO ATTACS

During the NATO agression from March 24 to June 10, 1999, around 1200 aircrafts took part in the air strikes, including 850 fighter planes. According to NATO there were 34 250 aircraft takeoffs during 2300 air strikes.

It is estimated that 22 000 tones of explosives (estimates go up to 79 000 tones) were dropped on FR Yugoslavia. In addition to 20 000 smart bombs and 5000 conventional bombs of various weight and purposes, including arms with depleted uranium, there were also strikes by around 400 Tomahawk cruise missiles. During the attacs it has been calculated than around 367 000 tones of kerosine were consumed.

CHEMICAL AND OIL INDUSTRY AND THE ENERGY SOURCES AS THE TARGETS

The air strikes destroyed or damaged 25 000 residential buildings, 78 industrial sites, 42 power facilities (refineries, fuel deports, transformer stations), 64 telecomunication facilities and broadcasting systems, 66 road and railroad bridges, 32 farms, 23 railroad lines and stations, 8 airports, numerous hospitals, health centers, schools, public buildings and other facilities [1]. Generally speaking about the consequences on the environment of FR Yugoslavia, one cannot say that an environmental disaster was caused at the level of our entire country, but one can reliably claim that the effects in particular industrial zones were disastrous [2]. .

Figure 1. presents the position of FR Yugoslavia in the Balkan region and the positions of the republics and provinces.

Figure 2. presents the major natural features, biodiversity and protected areas of FR Yugoslavia.

Chemical and oil industry and the energy sources as the targets of the NATO bombing FR Yugoslavia (published by UNEP, report [4]) are presented in Figure 3.

Remote sensing assessment of major impacts at oil and chemical industry complexes at Pančevo, Novi Sad and Barič, according to UNEP, and the maps of BTF sampling sites in Pančevo and Novi Sad Oil Industry Complexes are presented in Figures 4. to 8.

Figure 1. Balkan Region and FR Yugoslavia

Figure 2. Major natural features, biodiversity and protected areas of FR Yugoslavia

Figure 3. Targeted industrial facilities (chemical and oil industry) and electrical energy plants and facilities in FR Yugoslavia

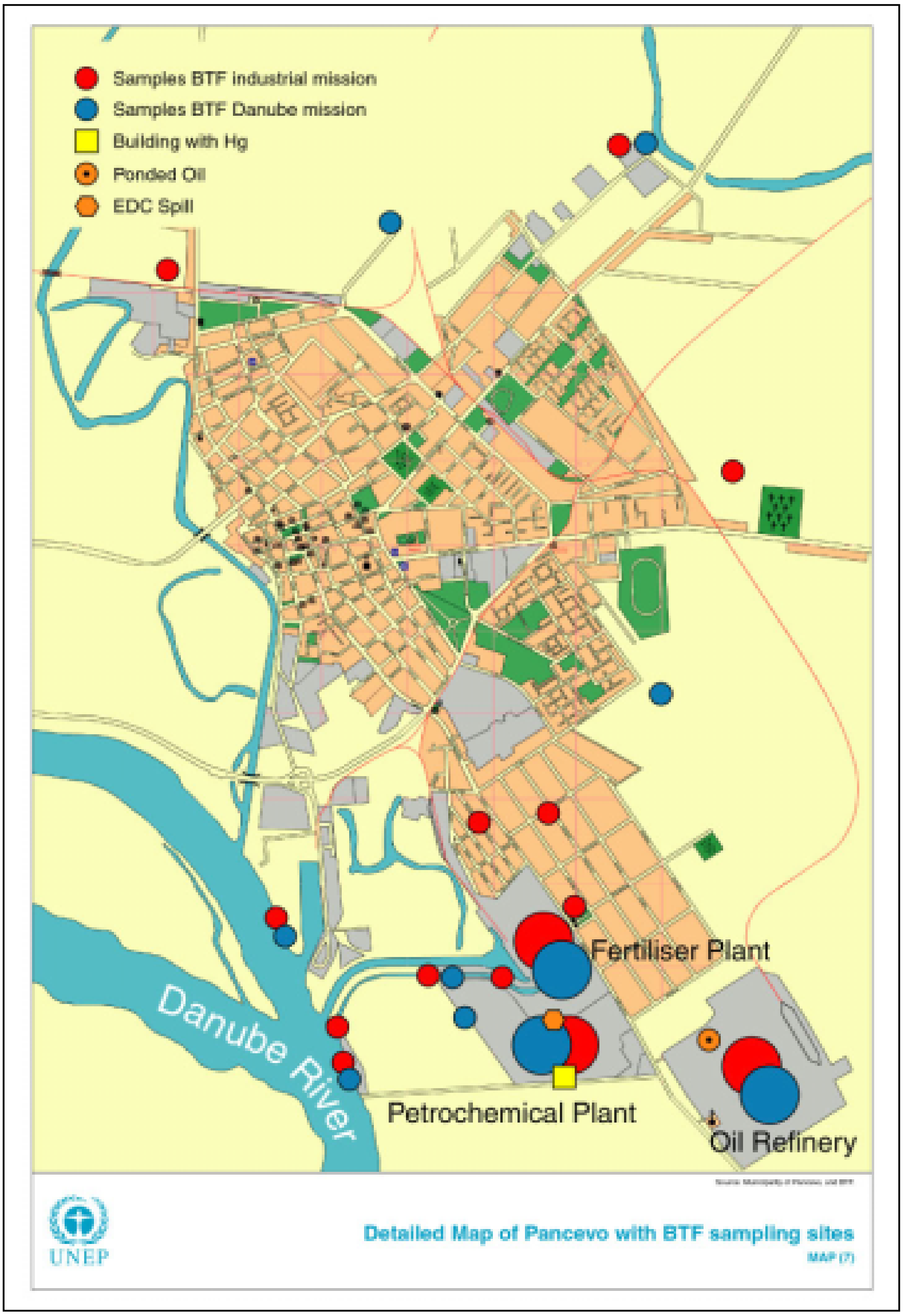


Figure 4. Map of BTF sampling sites in Pančevo Oil Industry Complex

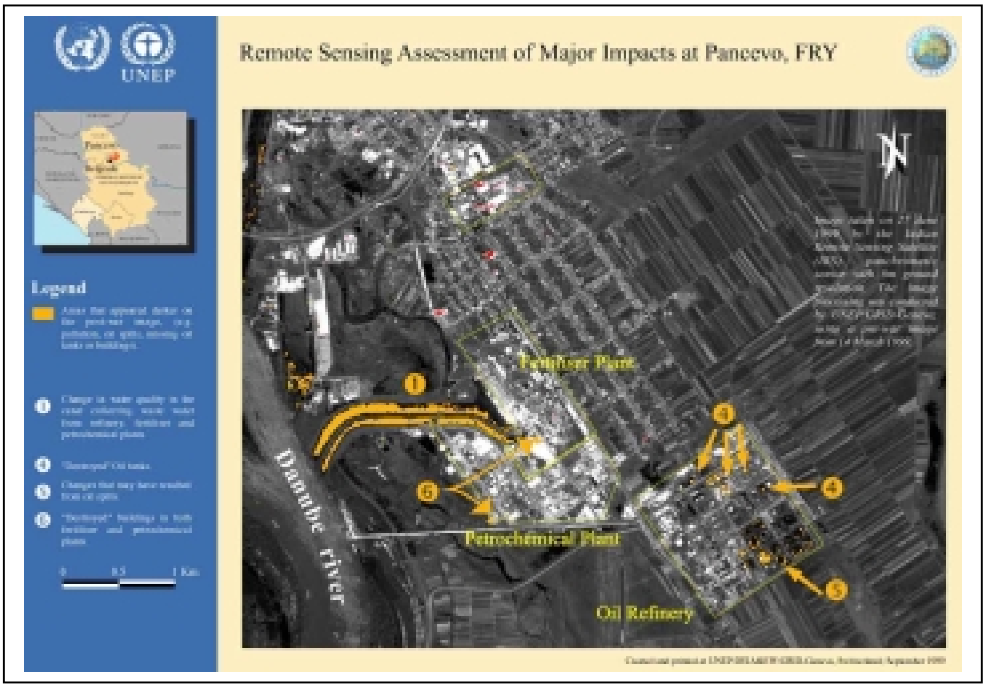


Figure 5. Remote Sensing Assessment of Major Impacts at Pančevo Oil Industry Complex according to UNEP

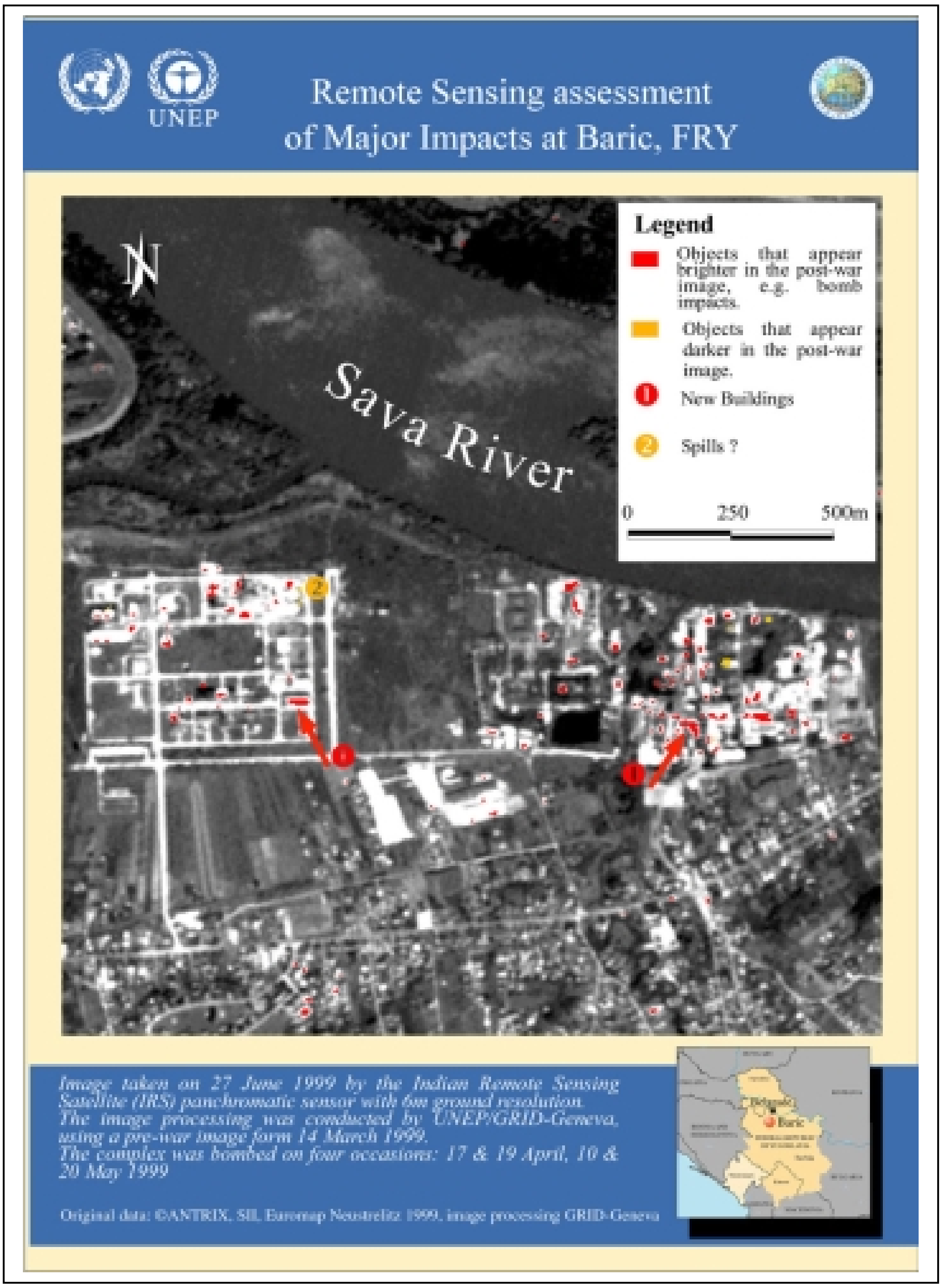


Figure 6. Remote Sensing Assessment of Major Impacts at Barič Chemical Industry Complex according to UNEP

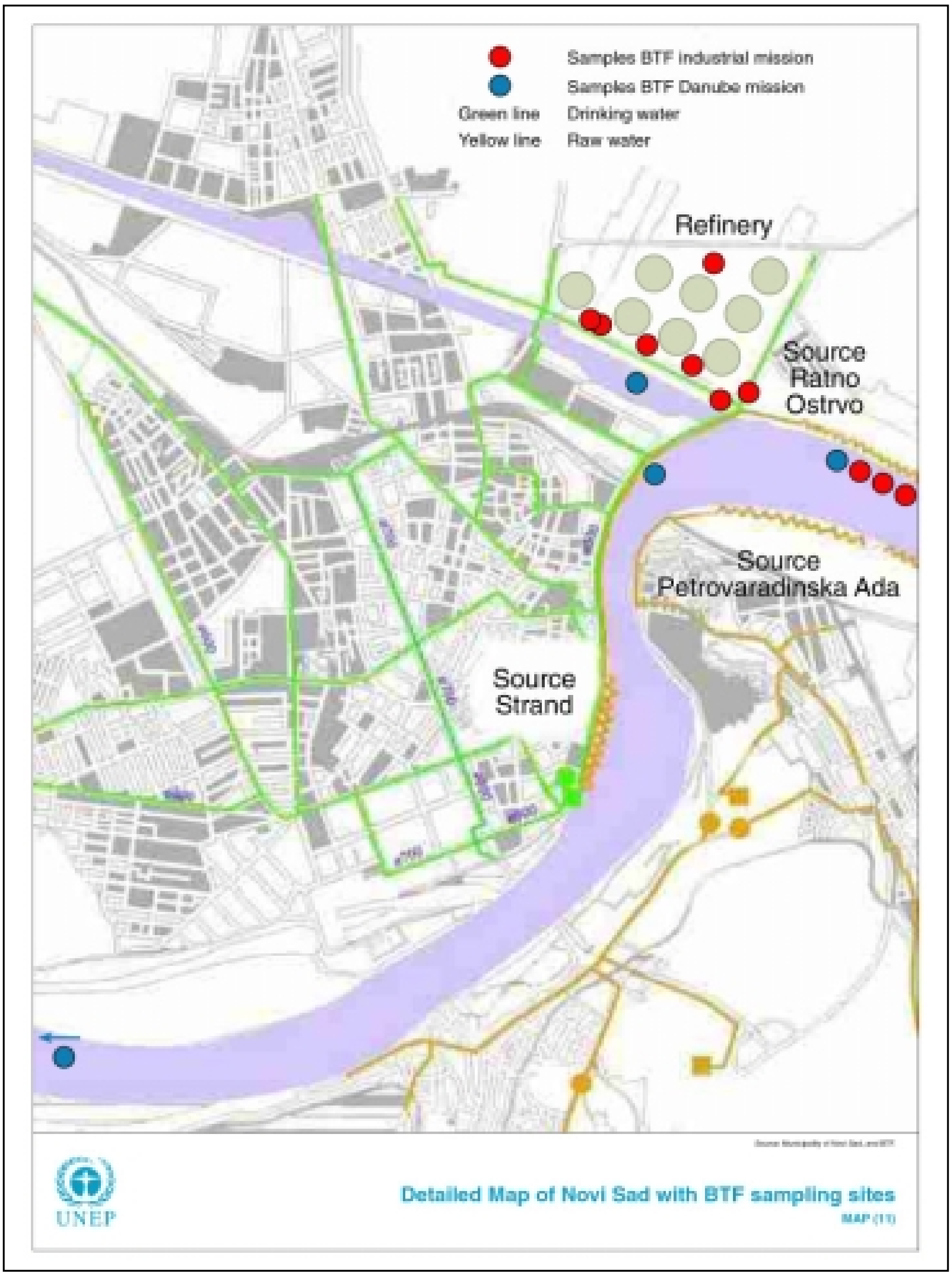


Figure 7. Map of BTF sampling sites in Novi Sad Oil Industry Complex

Figure 8. Remote Sensing Assessment of Major Impacts at Novi Sad Oil Industry Complex according to UNEP

DEPLETED URANIUM: FACTS

World Health Organization (WHO) in the document **"Fact Sheet N° 257", Revised April 2001 (http://www.who.int/inf-fs/en/fact257.html)**, gives depleted uranium characteristics:

Uranium

- Uranium is a silver-white, lustrous, dense, natural, weakly radioactive element. It is ubiquitous throughout the natural environment, and is found in varying but small amounts in rocks, soils, water, air, plants, animals and in all human beings.
- On average, approximately 90 µg (micrograms) of uranium exist in the human body from normal intakes of water, food and air. About 66% is found in the skeleton, 16% in the liver, 8% in the kidneys and 10% in other tissues.
- Natural uranium consists of a mixture of three radioactive isotopes which are identified by the mass numbers ^{238}U(99.27% by mass), ^{235}U(0.72%) and ^{234}U(0.0054%).
- Uranium is used primarily in nuclear power plants. However, most reactors require uranium in which the ^{235}U content is enriched from 0.72% to about 3%.

Depleted uranium

- The uranium remaining after removal of the enriched fraction contains about 99.8% ^{238}U, 0.25% of ^{235}U and 0.001% ^{234}U by mass; this is referred to as depleted uranium or DU.
- DU is weakly radioactive and a radiation dose from it would be about 60% of that from purified natural uranium with the same mass.
- The behaviour of uranium and DU in the body is identical radiologically and chemically.
- Spent uranium fuel from nuclear reactors is sometimes reprocessed in plants used for natural uranium enrichment. Some reactor-created radio-isotopes can consequently contaminate the reprocessing equipment and the DU. Under these conditions another uranium isotope, ^{236}U, may be present in the DU together with very small amounts of the transuranic elements plutonium, americium and neptunium and the fission product technetium-99. However, on the basis of the concentrations of these radio-isotopes found in DU, the increase in radiation dose from uptake by the human body would be less than 1%.

Applications of depleted uranium

- The main civilian uses of DU include counterweights in aircraft, radiation shields in medical radiation therapy machines and containers for the transport of radioactive materials.
- Due to its high density, about twice that of lead, and other properties, DU is used in munitions designed to penetrate armour plate and for protection of military vehicles such as tanks.

Exposure to uranium and depleted uranium

- The average annual intakes of uranium by adults are estimated to be 460 μ g from ingestion and 0.59 μ g from inhalation.
- Under most circumstances, use of DU will make a negligible contribution to the overall natural background levels of uranium in the environment. The greatest potential for DU exposure will follow a conflict where DU munitions are used.
- A recent United Nations Environment Programme (UNEP) report giving field measurements taken around selected impact sites in Kosovo (Federal Republic of Yugoslavia) indicates that contamination by DU in the environment was localized to a few tens of meters around impact sites. Contamination by DU dusts to local vegetation and water supplies was found to be extremely low. Thus, the possibility of significant exposure to the local populations was found to be very low.
- However, levels of DU may be significantly raised over background levels in close proximity to DU contaminating events. Over the days and years following such an event, the contamination will become dispersed into the wider natural environment. People living or working in affected areas can inhale dusts and can consume contaminated food and drinking water.
- There is a possibility that people near an aircraft crash may be exposed to DU dusts if counterweights were to combust on impact. Significant exposure to people from this situation would be rare. Exposures to clean-up and emergency workers following aircraft accidents are possible, but normal occupational protection measures would prevent any significant exposure occurring.

DU exposure pathways

- Individuals can be exposed to DU in the same way they are routinely exposed to natural uranium, i.e. through inhalation, ingestion, dermal contact or injury (e.g. embedded fragments).
- Each of these exposure situations needs to be assessed to determine any potential health consequence.
- The relative contribution from each of these pathways to the total DU uptake into the body depends on the physical and chemical nature of the DU, as well as the level and duration of exposure.

Intake of depleted uranium

- Intake by ingestion can occur if drinking water or food is contaminated by DU. In addition, the ingestion of soil by children via geophagia (the practice of eating earth, clay, chalk, etc.) or hand-to-mouth activities is also an important pathway.
- Intake by inhalation can occur following the use of DU munitions during or when DU deposits in the environment are re-suspended in the atmosphere by wind or other forms of disturbance. Accidental inhalation may also occur as a consequence of a fire in a DU storage facility, an aircraft crash, or the decontamination of vehicles from within or close to conflict areas.
- Intake by contact exposure of DU through the skin is very low and relatively unimportant.

- Intake from wound contamination or embedded fragments in skin tissues allows DU to enter the systemic circulation.

Absorption of depleted uranium

- Most (>95%) uranium entering the body via inhalation or ingestion is not absorbed, but is eliminated via the faeces.
- Of the uranium that is absorbed into the blood, approximately 67% will be filtered by the kidney and excreted in the urine within 24 hours; this amount increases to 90% within a few days.
- Typical gut absorption rates for uranium in food and water are about 2% for soluble uranium compounds and down to 0.2% for insoluble uranium compounds.

Health effects of exposure to depleted uranium

DU has both chemical and radiological toxicity with the two important target organs being the kidneys and the lungs.

- In the kidneys, the proximal tubules are considered to be the main site of potential damage. Long-term studies of workers chronically exposed to uranium have reported impairment of the kidneys that depended on the level of exposure. There is also some evidence that this impairment may return to normal once the source of excessive uranium exposure has been removed.
- In a number of studies on uranium miners, an increased risk of lung cancer has been demonstrated, but this has been attributed to exposure from radon decay products. There is a possibility of lung tissue damage leading to a risk of lung cancer if a high enough radiation dose results from insoluble DU compounds remaining in the lungs over a prolonged period (many years).
- Erythema (superficial inflammation of the skin) or other effects on the skin should not occur even if DU is held against the skin for prolonged periods (weeks). There is no established data to suggest that skin cancer results from skin contact with uranium dusts.
- No consistent or confirmed adverse effects have been reported for the skeleton or liver. However, few studies have been conducted.
- No reproductive or developmental effects have been reported in humans, but studies are limited.
- Although uranium released from embedded fragments may accumulate in the central nervous system (CNS) tissue and some animal and human studies are suggestive of effects on CNS function, it is difficult to draw firm conclusions from the studies.

Maximum radiation exposure limits

The following doses, from the International Basic Safety Standards agreed by WHO in 1996, are in addition to those from normal background exposures.

- The general public should not receive a dose of more than 1 millisievert (mSv) in a year. In special circumstances, an effective dose of up to 5 mSv in a single year is permitted provided that the average dose over five consecutive years does not exceed 1 mSv per year. An equivalent dose to the skin should not exceed 50 mSv in a year.

- Occupational exposure should not exceed an effective dose of 20 mSv per year averaged over five consecutive years or an effective dose of 50 mSv in any single year. An equivalent dose to the extremities (hands and feet) or the skin should not surpass 500 mSv in a year.

Guidance on exposure based on chemical and radiological toxicity

The World Health Organization (WHO) has guidelines for determining the values of health-based exposure limits or tolerable intakes (TIs) for chemical substances. The TIs given below are applicable to long-term exposure in the general public (as opposed to workers). In single and short-term exposures, higher exposure levels may be tolerated without adverse effects.

- The general public's intake via inhalation or ingestion of soluble DU compounds should be based on a tolerable intake value of 0.5 µg per kg of body weight per day. This leads to an air concentration of 1 $\mu g/m^3$. For ingestion, this would be about 11 mg/y for an average adult.
- It would be appropriate to reduce the TI for intake of insoluble DU compounds to 0.5 µg per kg of body weight per day so that compatibility is achieved with the public radiation dose limit. When the solubility characteristics of the uranium species are not known, which is often the case in exposure to depleted uranium, it would be prudent to apply the more stringent tolerable intakes, i.e., 0.5 µg per kg of body weight per day for oral exposure.
- Uranium compounds with low absorption are markedly less nephrotoxic, and a tolerable intake via ingestion of 5 µg per kg of body weight per day is applicable.

Monitoring and treatment of exposed individuals

- For the general population, neither civilian nor military use of DU is likely to produce exposures to DU much above normal background levels produced by uranium. Therefore, an exposure assessment for DU will normally not be required.
- When an individual is suspected of being exposed to DU at a level significantly above the normal background level, an assessment of DU exposure may be required. This is best achieved by analysis of daily urine excretion. The amount of DU in the urine is determined from the $^{235}U:^{238}U$ ratio, obtained using sensitive mass spectrometric techniques. Faecal measurement can give useful information on intake if samples are collected soon after exposure (a few days).
- External radiation measurements over the chest, using a whole-body radiation monitor for determining the amount of DU in the lungs, have limited application since they require specialist facilities and can only assess relatively large amounts of DU in the lungs.
- There are no specific means to decrease the absorption of uranium from the gastrointestinal tract or lungs, or increase its excretion. Thus, general methods appropriate to heavy metal poisoning could be applied. Similarly, there is no specific treatment for uranium poisoning and the patient should be treated based

on the symptoms observed. Dialysis may be helpful in extreme cases of kidney damage.

Recommendations

- Levels of contamination in food and drinking water could rise in affected areas after some years and should be monitored where it is considered that there is a reasonable possibility of significant quantities of DU entering the ground water or food chain.
- Where possible, clean-up operations in impact zones should be undertaken where there are substantial numbers of radioactive projectiles remaining and where qualified experts deem contamination levels to be unacceptable. If very high concentrations of DU dust or metal fragments are present, then areas may need to be cordoned off until removal can be accomplished. Disposal of DU should come under appropriate national or international recommendations for use of radioactive materials.
- Young children could receive greater exposure to DU when playing in or near DU impact sites. Typical hand-to-mouth activity could lead to high DU ingestion from contaminated soil. Necessary preventative measures should be taken.
- Individuals who believe they have had excessive intakes of DU should consult their medical practitioner for an examination and treatment of any symptoms. General screening or monitoring for possible DU related health effects in populations living in conflict areas where DU was used is not called for.

Research

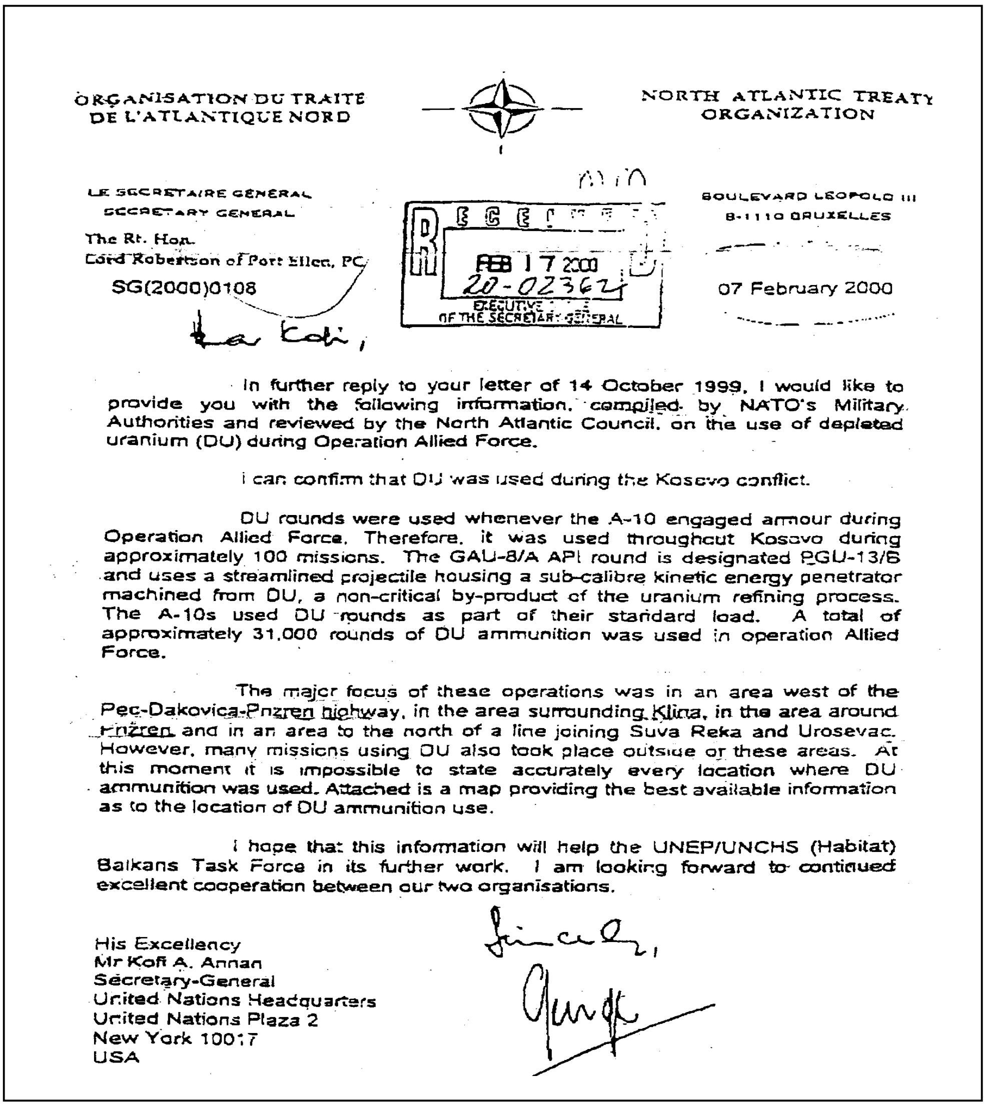
In April 2001, WHO published a monograph entitled *Depleted Uranium: Sources, Exposures and Health Effects.* It is the product of a review of the best available scientific literature on uranium and depleted uranium. The monograph provides a framework for identifying the likely consequences of public and occupational exposure to DU. It is available at:

http://www.who.int/environmental_information/radiation/depleted_uranium.htm.

The monograph identifies a number of future research needs.

DEPLETED URANIUM AMMUNITION DURING NATO BOMBING IN FR YUGOSLAVIA

"I can confirm that DU was used during the Kosovo conflict" – testifies the Secretary general of NATO in the letter of February 07, 2000, to the Secretary General of UNO and in the report presented by NATO on Sept. 21, 2000, at the meeting of experts of Working group for depleted uranium UNEP/Balkans Unit in Geneva (Figure 10). The 112 locations in Kosovo and Metohija were attacked by 31 000 projectiles with depleted uranium.



ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD

NORTH ATLANTIC TREATY ORGANIZATION

LE SECRETAIRE GENERAL
SECRETARY GENERAL

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The Rt. Hon.
Lord Robertson of Port Ellen, PC
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FEB 17 2000
20-02362
EXECUTIVE OFFICE OF THE SECRETARY-GENERAL

07 February 2000

In further reply to your letter of 14 October 1999, I would like to provide you with the following information, compiled by NATO's Military Authorities and reviewed by the North Atlantic Council, on the use of depleted uranium (DU) during Operation Allied Force.

I can confirm that DU was used during the Kosovo conflict.

DU rounds were used whenever the A-10 engaged armour during Operation Allied Force. Therefore, it was used throughout Kosovo during approximately 100 missions. The GAU-8/A API round is designated PGU-13/B and uses a streamlined projectile housing a sub-calibre kinetic energy penetrator machined from DU, a non-critical by-product of the uranium refining process. The A-10s used DU rounds as part of their standard load. A total of approximately 31,000 rounds of DU ammunition was used in operation Allied Force.

The major focus of these operations was in an area west of the Pec-Dakovica-Prizren highway, in the area surrounding Klina, in the area around Prizren and in an area to the north of a line joining Suva Reka and Urosevac. However, many missions using DU also took place outside of these areas. At this moment it is impossible to state accurately every location where DU ammunition was used. Attached is a map providing the best available information as to the location of DU ammunition use.

I hope that this information will help the UNEP/UNCHS (Habitat) Balkans Task Force in its further work. I am looking forward to continued excellent cooperation between our two organisations.

His Excellency
Mr Kofi A. Annan
Secretary-General
United Nations Headquarters
United Nations Plaza 2
New York 10017
USA

Figure 10. NATO Secretary-General Testimony

Sites identified as being targeted by ordnance containing depleted uranium are given in Figure 11. (published by "Peacelink", [3]) and in Fig. 12 (from the UNEP report [4]).
The use of the depleted uranium in NATO bombing in FR Yugoslavia is the experiment in NATO war doctrine and one of the chip way of nuclear waste deposal. Because of the the very long half-life of uranium-238 ($4.47 \cdot 10^9$ y) depleted uranium particles **contaminate soil for thousands of years (practicaly, for ever)**. As this is a well-known fact, it means that NATO **deliberately caused significant, permanent and dangerous radioactive contamination of our country's environment**.

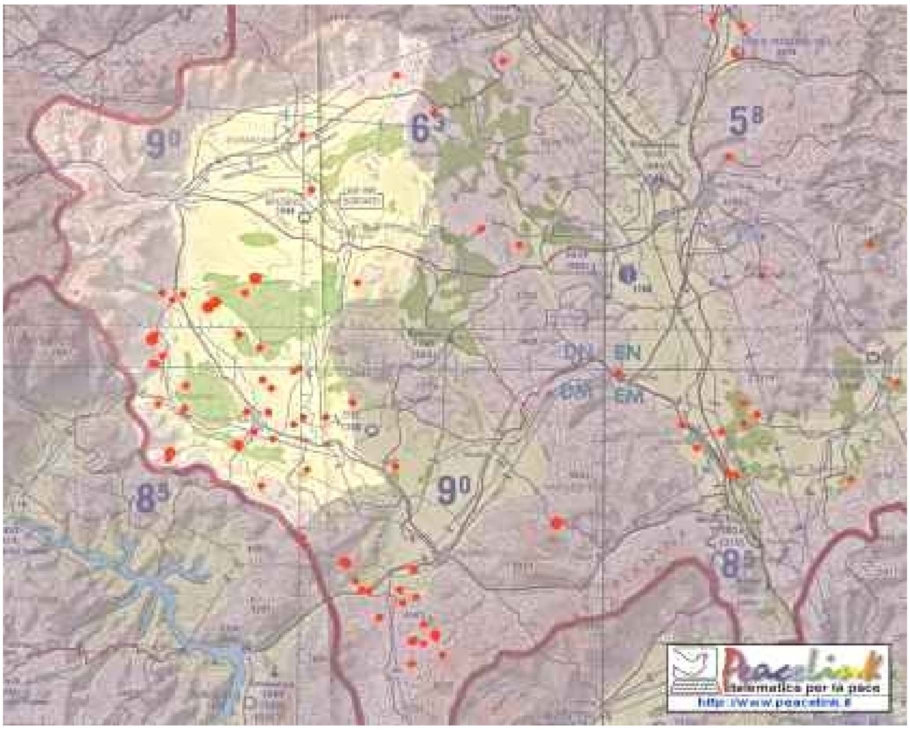

Figure 11. The targets of the NATO bombing using DU ammunition (published by PEACELINK)

The official purpose (**military effect**) of the use of projectiles with depleted uranium is to slice through thicker, tougher armor at greater ranges than other high-velocity rounds (because of the extreme density of the metal and its self-sharpening).

Other („collateral") consequences are:

(1) chemical consequences (because of the high chemical toxicity)
(2) radiological consequences (because of the depleted uranium radioactivity and very long half-life)
(3) ethical consequencec (immoral arms, toxic material and radioactive waste introduced in the environment, long-term contamination, "vivo experiment").

The results of a comparative study based on the experience in assessment of the relative ecological impact of different energy sources show an illustrative presentation of the consequences of the NATO bombing in FR Yugoslavia [5], shematic given in the Table 1. It is very important that the **military effect is neglectable**.

Figure 12. The targets of the NATO bombing using DU ammunition (published by UNEP)

Table 1. Consequences of the NATO bombing in FR Yugoslavia using ammunition with depleted uranium

TYPE OF CONSEQUENCES	EFFECTS AND PROBLEMS
Military effects	Neglectable effects
Technology development	Very expensive experiment
CHEMICAL CONSEQUENCES	Contaminated terrain, health danger for the local people and for the NATO soldiers
RADIOLOGICAL CONSEQUENCES	For ever contaminated terrain, health danger for the local people and for the NATO soldiers
ETHYCAL CONSEQUENCES	Immoral arms Toxic contamination Radioactive waste introduced in the environment Long-term contamination (for ever) „Vivo experiment”

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