

[Home](#)[About](#)[Current Programmes](#)[Afghanistan](#)[Iraq](#)[Lebanon](#)[Liberia](#)[OPT](#)[Sudan](#)[Somalia](#)[Depleted Uranium](#)[Past Programmes](#)[Press](#)[Publications](#)[Photos](#)[Contacts](#)[Employment](#)[lebanon](#)[Summary](#)[Press](#)[Publications](#)[Photos](#)

UNEP Mission to Lebanon – October 2006

Sites visited

The following 25 sites were visited by the ammunition/DU sub-team:

- Transmed Industry (Beirut)
- Lebanon Company for Carton Mince & Industry (Beirut)
- Airport Fuel Storage Tanks
- Dahiya (Security Square)
- Dahiya (Mattress Factory)
- Mujamaa Sayed El Awseyae
- Maliban Glass Factory (Zahle)
- Lamartine Food Industry (Zahle)
- Alarz Lil Naseej (Zahle)
- Zahrani bridge
- Nabatiyeh
- Zawtar
- Yahmour
- Al Khardali bridge
- Damour bridge
- Hannawai
- Yatar
- Yatar helicopter crash site
- Kaffrah (Swiss Agency for Development and Cooperation clinic)
- Khiam (3 sites)
- Wadi-El-Hujair/Ghandourien
- Ayta Ash Shar
- Maroun

The sub-team collected 36 samples for detailed analysis.

Equipment used in the field

The choice of instruments used in the environmental assessment in Lebanon was driven by UNEP's in-depth experience of such equipment in past DU missions in the Balkans and the joint IAEA/UNEP mission to Kuwait. Thanks to their high sensitivity, effective sound alarm, durability, and robustness, these instruments have proven ideal for such missions.

The **Saphymo-SRAT S.P.P.2 NF scintillometer** is manufactured by Saphymo-PHY (Massy, France). It is designed for uranium exploration in rugged conditions. The detector is a 1 x 1.5 inch (15.2 cm³) NaI(Tl) (sodium iodide activated with thallium) scintillation crystal. The operation range for gamma radiation is 0.02 to 30 microsieverts per hour (µSv/h). The instrument has a built-in audible alarm that gives a high signal. The threshold and the frequency of the sound alarm can be varied according to the strength of the radiation. The time constant for the sound alarm is 0.25 seconds. The SRAT's unit of measurement is cps (counts per second). It is 32 x 13 x 12 cm in size and weighs 3.6 kg. From UNEP's point of view, it is one of the world's most effective instruments for reconnaissance.

The **Inspector** instrument is manufactured by S.E. International Inc. (Summertime, TN, USA). This instrument was chosen because of its high sensitivity to beta radiation, which is due to its pancake GM-tube, and for its rather large window, as it is necessary to measure very close to the source to detect beta radiation from DU. This detector is a halogen-quenched Geiger-Müller tube of the pancake type that has an effective diameter of 45 mm. The detector window is covered by a mica foil, which is protected against damage by a metal net. The window has a diameter of 50 mm. It can be covered by a metal lid which only allows gamma radiation to reach the detector, preventing beta and alpha rays from penetrating. When the lid is removed, the Inspector measures gamma, beta and alpha radiation. Units of measurement are cpm, cps, mR/h or $\mu\text{Sv/h}$. The instrument can be used in direct reading mode or as a counter. The counting time can be set for a range of one minute to 24 hours, and a timer can be set at the desired counting time. The instrument is equipped with a sound alarm, which clicks for each radiation event detected. The Inspector measures 15 x 80 x 30 mm and weighs 272 g.

The **Automess Dose Rate Meter AD 6** and its **Alpha-Beta-Gamma Probe AD-17**, which are manufactured by Automation und Messtechnik GmbH (Ladenburg, Germany), were used and tested by UNEP in previous missions and have proven to be well-adapted equipment allowing good quality measurements of radioactivity – dose rates and contamination levels. The AD 6 can be used with a wide range of probes. It is calibrated according to internationally accepted standards, allowing direct comparison of results measured with this instrument. In Lebanon, this instrument was mainly used to measure ambient dose rates.

The **Fieldspec Instrument identiFINDER-N/He-3** is manufactured by Target Systemelectronics GmbH (Solingen, Germany). The identiFINDER is a hand-held gammaspectrometry system with a dose rate meter and neutron counter. It includes a multi-channel analyser with memory, amplifier, and an NaI(Tl) scintillation crystal ($\text{\O} 1.2'' \times 1.5''$). The identiFINDER can measure gamma spectrums and perform gammaspectrometric analysis, including radionuclide identification, by using radionuclide libraries.

Smear Sampling was performed according to international standards. Areas of no less than 20 cm x 20 cm, usually 40 cm x 40 cm, were dry smeared on low uranium content smear papers, marked and double-packed for transportation and to avoid cross-contamination. Smear locations were chosen on surfaces untouched by the impact of the weapon, in an appropriate range of distance to the impact..

Observations on ammunition used

Visual observation was performed at the sites visited to understand what type of ammunition was used to destroy the specific site. In a number of sites, weapon parts were found and identified. In addition, intensive discussions were held with the UN Mines Action and UN Explosive Ordnance Destruction (EOD) experts, as well as, in some cases, with Lebanese Army EOD experts. To develop a comprehensive overview of the type of ammunition used during the conflict, the UNEP sub-team also visited two EOD camps, where the wide range of ammunition used was demonstrated.

The interpretation of all findings is ongoing and will be published in the final report.

The Laboratory Phase

UNEP has collaborated with the Swiss SPIEZ LABORATORY in the field of DU, as well as on other environmental impact-related questions, since the very first DU assessment performed by UNEP in Kosovo.

SPIEZ LABORATORY is a governmental institute of the Swiss Ministry of Defense, Civil

Protection and Sports. It is under the authority of the Civil Protection. The laboratory focuses mainly on nuclear, biological and chemical (NBC) defense-related questions, a field in which it has become a reference laboratory for different international organizations, such as the OPCW. SPIEZ LABORATORY's vision of is to have "a world without weapons of mass destruction".

On the national level, the laboratory is part of the Swiss emergency organization. It stays in close contact with the Swiss Army and the NBC Defense troops, and provides laboratory-related training. In addition, SPIEZ LABORATORY is very active on environmental issues. It is involved in the assessment, and in some cases the surveying, of Swiss Army training grounds on various contaminants, with a particular focus on heavy metals. Laboratory staff has a wide range of expertise and experience in all of the above fields.

Experts from SPIEZ LABORATORY have performed high quality analyses on samples collected during all UNEP DU assessment missions, and have been involved in various UNEP capacity-building courses. All SPIEZ LABORATORY departments are accredited in accordance with ISO/IEC 17025.

Samples during the Environmental Assessment in Lebanon by the ammunition sub-team were analyzed using the Finnigan Element2 sector field ICP mass spectrometer for the uranium isotopes.

Smear Samples were leached in 50 ml 8 M HNO₃ for 4 hours at a temperature of 50°C. Indium was added as internal standard. During the leaching process, the samples were put in an ultrasonic bath for one minute. The leachates were filtered through <0.45 µm cellulose filters (Spartan 30/0.45 RC; Schleicher & Schüll). Aliquotes of the filtrate were diluted with distilled water for ICP-MS measurements.

About 20 g of the soil and dust samples were ashed in quartz crucibles at 520°C in high-temperature furnaces for 16 hours (weight constancy). The ashed soil was milled in a 250 ml Syalon ball mill with silicium nitride balls (SiN₄, 15 balls, diameter 20 mm) for two minutes at 600 rpm. 5 g of the milled soil ash were mixed with 7 g of fluxing agent (lithium metaborate/lithium tetraborate 80%/20%). The mixture was transferred in a platinum/gold crucible (Pt/Au; 95/5) and indium was added as an internal standard. After drying in a drying oven for 30 minutes at 70°C, the samples were fused in a high temperature furnace for 20 minutes at 1100°C. The melt was poured into a 250 ml beaker containing 200 g 4.5 M HNO₃. 1 ml of 0.2 M polyethylene glycol (PEG-2000) was added as a flocculating agent to precipitate silica gel. This mixture was heated to 40°C with constant stirring for three hours. After cooling down, 3 ml of the upper layer solution was filtered through < 0.45 µm cellulose filters (Spartan 30/0.45 RC; Schleicher & Schüll). Aliquotes of this solution were diluted with 2% HNO₃ for ICP-MS measurements.

In addition, the prepared analytical samples were analyzed for other ammunition-related inorganic metals. Analysis was performed by the ELAN 6000 ICP Mass Spectrometer. The Perkin-Elmer "Totalquant-®" analysis program was applied; it allows a rapid, semi-quantitative determination with a precision of +/- 20%.

The results are summarized and can be accessed below.

Results

- [Smear samples results](#)
- [Soil samples results](#)

- **Sample GPS coordinates**

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