Eos weapons study in Lebanon, September 2006 - interim report

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Introduction

This interim report summarises initial observations and questions arising from my visit to Lebanon in September 2006. It is written for local and international personnel in Lebanon who are investigating the nature and consequences of IDF (Israel Defence Force) attacks during the Israel / Lebanon conflict, 12th July to 14th August 2006. It focuses on issues and concerns that I raised in my paper **UN priorities for investigating uranium and other suspected illegal weapons in the Israel / Lebanon conflict** published on 30 August (ref 1).

My visit was an opportunity to see the post-conflict situation in Lebanon first hand. I met people who directly experienced or witnessed IDF attacks and recorded their personal testimonies. I was also able to gather further documentary evidence relevant to the suspected use of uranium or other illegal weapons during the conflict. It was also an opportunity to exchange information with several organisations that are also investigating health, safety and humanitarian issues in Lebanon arising from the conflict.

This was a brief reconnaissance exercise, self-financed. It included 4 days of field visits to target locations in Beirut and southern Lebanon and 4 days of interviews and discussions. I received valuable assistance and support from local scientific and media contacts. These interim observations may help other investigators to target potentially hazardous locations or important evidence - particularly the UN HRC (Human Rights Council) Inquiry Commission (refs 2, 3, 4) and the UNEP Post Conflict Assessment Unit (PCAU) (refs 5, 6).

It also offers some practical illustrations for other researchers and media commentators around the world who are investigating the proliferation of a new generation of known and suspected uranium weapons. Similar independent field studies were carried out by UMRC in Afghanistan and Iraq in 2002 and 2003 (refs 7, 8).

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Part 1: Context

1. Exchange between UNEP and Eos post-conflict investigations

UNEP offers full range environmental impact assessments to countries and governments that have suffered recent disasters or wars. My interests are mainly in investigating the suspected use of uranium metal and alloys in a new generation of "conventional" weapons developed since 1980 (refs 9, 10, 11).

According to the US and UK governments uranium has only been used in anti-tank ammunition. However scientists in UK, Hungary and Greece detected unusually high levels of airborne uranium dust after recent military operations in the Balkans, Afghanistan and Iraq. This suggests that much larger uranium weapons may have been used during these conflicts. These observations coincided with the development and combat use of a new generation of guided weapons with secret, high density warheads. These include guided bombs, missiles and sub-munitions.

If uranium has been used in any of these weapon systems I am also concerned about the potential additional health and environmental problems caused by toxic, radioactive combat materials. As a work psychologist I have a special interest in occupational health and safety, toxicology and epidemiology. UNEP's post conflict studies are very important for the health and safety of citizens, workers and troops during conflicts, reconstruction and longer term.

2. Post conflict issues in Lebanon

I presented my concerns about the use of suspected uranium or other illegal weapon systems in Lebanon in my report of 30th August 2006: "**UN priorities for investigating uranium and other suspected illegal weapons in the Israel/Lebanon conflict**".
www.eoslifework.co.uk/pdfs/u26leb806.pdf

This year's conflict in Lebanon has been more accessible for international inspections than recent conflicts in Afghanistan and Iraq. Several other organisations (from Germany, Italy, Netherlands and the USA) have also taken an active interest in suspected use of illegal weapons by the Israel Defence Forces (IDF) in Lebanon. Some of these have tried radiation testing or have collected samples for later analysis. However most of them have limited knowledge of the suspected weapons involved.

UNEP has the most experienced post-conflict assessment staff and resources. And the UN HRC Inquiry Commission is specifically committed to investigating suspected illegal weapons by the HRC resolution of 11th August 2006. I hope they can use or liaise with UNEP studies.

At the time of my visit I had not heard of any official health or environmental studies by Lebanese authorities but I expect some will be in progress. They have access to advice from IAEA and from US and NATO military specialists. Complex national and international political and commercial interests are involved. This report concentrates on practical aspects of certain weapons and their human and environmental effects.

Since the UNEP PCAU team arrived in Lebanon they can offer valuable advice and training for environmental assessments as they did for Iraq if requested to do so. I appreciate that the Lebanese authorities are dealing with major infrastructure problems which require immediate attention before medium term health and environmental concerns can be addressed.

Some private individuals, environmental and health organisations in Lebanon have taken an early interest in potential ongoing hazards from the weapons used by the IDF. Some of these assisted me in field visits and review of combat reports.

Staff on the Lebanese newspaper As-safir have researched this subject extensively in the last 3 months contacting me and several other researchers. They have published several carefully documented reports with different perspectives on known and suspected uranium weapons and their possible use in Lebanon. I am grateful for their assistance with several parts of this study.

Carefully researched and balanced reporting should help to raise interest and awareness about these weapons in scientific, medical and environmental communities without causing public anxiety. Bizarre injuries during the conflict caused understandable speculation about the secret weapons involved both in Lebanon and around the world. I hope that better informed international interest may give additional support and resources to environmental and health testing in Lebanon e.g. by local scientists and UNEP specialists. There have been very few media reports about suspected new uranium weapons in NATO countries since 2002 and only 5 in the UK.

3. Need for fast evaluation of post conflict environments

Time is important for environmental assessments because natural and human processes can cover up some immediate effects very quickly. For example rain may wash suspected toxic or radioactive contamination from the roofs of houses into their underground water tanks (cisterns). And the debris (broken concrete and steel) from structures (bridges or houses) is often cleared very fast in rescue operations, or to open transport routes.

I arrived in Lebanon on 15th September - 5 weeks after the ceasefire. Most main roads were open and thousands of tons of debris had been moved by truck from areas in South Beirut to large storage sites e.g. north of Beirut airport between the main road and the sea.

Even in remote but heavily bombed locations like Bent Jbail, Srifa and Khiam in the south and south east all roads were clear and many damaged buildings had been cleared by bulldozer. These clearance operations have created their own environmental (and health) impacts - particularly **very large quantities of concrete/mineral dust**.

The use of **water spray systems to control dust** is highly desirable in all these locations to reduce dust hazards for residents and workers. Water run-off contamination is likely to be limited by evaporation.

After the mass destruction of homes and infrastructure in Lebanon the most obvious environmental issues are unexploded ordnance (UXO) and oil pollution up the Mediterranean coast from a power station where IDF forces bombed fuel oil storage facilities. These have obvious effects and have attracted immediate attention and international support.

As a psychologist I am deeply impressed by the resilience of the population in Lebanon and the speed of their response to restore the basic economic infrastructure. In the first 2 months this has been similar to the community response in New York after the 9/11 disaster. I expect that a similar short term community response has occurred in northern Israel.

However this rapid response means that many parts of the post-conflict landscape are changing rapidly - mainly due to human reconstruction, but also to natural atmospheric processes - wind and sometimes rain. These healing forces are essential in post-conflict communities. But they mean that early environmental assessments, and documentation of events and damage during the conflict, are essential to comprehensive post-conflict assessments in Lebanon.

Part 2: Field Observations

4. Unexploded ordnance (UXO)

Less visible than oil pollution but far more dangerous post-conflict contamination are the large quantities of unexploded ordnance in many parts of south Lebanon. Cluster bombs may be obvious if they are on the surface of the ground. But they may still be difficult to recognise where concrete dust from clearance operations has made everything grey. See the small aluminium cluster bomb (150 mm long, 40 mm diameter) with a white parachute among stones by a road in Bent Jbail.

Some unexploded weapons are obvious like this conventional 2000 lb Mk 84 bomb in an orchard 5 km west of Khiam. This is an old, low cost bomb. Many of these conventional weapons were used to blow up roads in southern Lebanon.

However this warhead is the same size and weight at the precision guided GBU-31 JDAM bomb which was the most widely used weapon in the US Shock & Awe bombing of Iraq in 2003. Over 5,000 of these were used in 4 weeks. So it is possible that the IDF used many guided versions as well.

Other unexploded weapons like tank and artillery shells may be partly concealed or completely buried in fields or gardens with rough ground. Many of these e.g. the M483 shells may also contain sub-munitions.

But a potentially bigger UXO problem is the issue of **unexploded penetrator weapons** (bombs and missiles) which are buried deep underground. They are designed to go 2 x deeper than traditional bombs - up to 5-15 metres or more depending on soil and rock conditions. They may have entered the ground at an angle, or may change direction underground when they hit rock or concrete.

This warhead entry hole near a bombed house in Froun is 150+ mm diameter, 30 degrees angle and 4-5 metres deep. This may have been a large artillery shell that did not explode. But other warheads in the same attack destroyed the basement of the house (see page 14). The more dangerous option is that this hole was made by a 450 kg BLU-110/B or 900 kg BLU-109/B penetrator warhead. Excavation will be a hazardous project.

In this picture another house owner points to the entry hole for a small to medium guided penetrator bomb which is now under this house in Bent Jbail. Because these weapons are designed for deep penetration their removal will require deep excavation with the risk of a major explosion.

If these unexploded bombs or shells are not removed then the location and a 100+ metre radius around it may be permanently uninhabitable for risk of a future explosion. The power of these warheads can be seen in photographs of other explosions in Part 3.

5. Missing evidence of weapons used

One problem of visiting targets 6+ weeks after attacks was that there was very little evidence of guidance or control systems which could have been used to identify specific weapons. For example the laser guidance unit and fins on this GBU-24 guided bomb are attached to the central BLU-109/B warhead (see page 23, same size as the 2000 lb Mk 84 bomb, page 4).

In large, surface explosions these fins may be destroyed in the explosion. But for guided bombs and missiles that hit large hard targets - bridges, high rise buildings etc - the whole outer casing of laser or GPS guidance systems, fins and aluminium body casing will rip off at the first point of impact. The warhead may explode many metres below. So there should have been many examples of guidance equipment, fins etc near many targets.

Some of these fins were identified during initial rescue or clearance operations. This photo from the Qana bombing on 30 July 2006 shows part of the guidance fin from a BSU-37/B guidance system for a 2000 lb Mk 84 conventional bomb. http://tyros.leb.net/qana2/index.html

There is an active scrap metal industry in Lebanon. Many pick up trucks were collecting steel and other metal debris from bomb sites for recycling. They may have cleared metal parts soon after impact. If so UNEP may find some of these components in scrap metal centres.

UN troops, Lebanese Army teams or other de-mining organisations may have collected these items when assessing targets hit by IDF weapons. If possible UNEP inspectors should ask to see the UNMAC or UNIFIL UXO storage locations. It is important to get an approximate list of all the weapon systems used by the IDF in the 2006 conflict. Photographs of unexploded weapons, remains of guidance systems etc should be useful for identification. Combined with crater analysis this evidence may help to recognise what damage was caused by each type of warhead. This may also help the UN HRC Inquiry as potential forensic evidence of suspected illegal weapons, particularly weapons of indiscriminate effect (with toxic, chemical or radiological warheads).

Ideally UNEP may request a written assessment of the types, numbers and locations of different guided weapons used by the IDF from UN observation teams, from the Lebanese Army, UNIFIL or UNMAC.

6. Target analysis - conventional weapons

Many targets were almost unchanged since they were bombed in July / August e.g. this school near Nabateya and many private homes. They may have been damaged or destroyed by several different kinds of munitions - guided bombs (from aircraft), guided missiles (from aircraft, ships or ground launchers), tank or artillery fire (ground) and infantry weapons (e.g. mortars, RPGs and back-pack missiles).

Different areas experienced different types of attack. Southern areas had air and ground attacks. Coastal targets had sea and air attacks. Inland targets were mainly hit by air or medium range cruise missile attacks.

It is hoped that IDF forces only used conventional weapons e.g. high explosive bombs, missiles and shells. These collapse buildings from the top or sides. For example this school appears to have been hit by two high explosive bombs. One explosion on the roof dropped debris into the centre of the building (photo). The second bomb collapsed the rear of the building.

Experienced target analysts will recognise targets in the south or near the coast that have been hit by conventional high explosive shells from tanks, field artillery or ships.

7. Target analysis - hard and deeply buried target warheads, (suspected uranium weapons)

The hazards of UXO are recognised. But a new threat may come from guided bombs and missiles developed since the 1990's. These are designed to defeat **hard or deeply buried targets**. They have new, high density explosive warheads that can penetrate several metres of concrete or rock. They have delayed action "smart" fuses that usually detonate at the lowest level in a building, in soil underneath it, or at a pre-set floor level.

Many high-rise buildings in South Beirut were destroyed by hard target guided bombs or missiles (bunker busters) like this location on 16 July.

Warheads went through up to 10 floors before exploding at a pre-set floor, or underground. Then buildings collapsed to the level where the explosion occurred.

In this location a 10 storey building collapsed after a bunker buster warhead exploded in the basement. Five floors of debris have been removed. 5 floors remain to be excavated in this basement area (collapsed to < 1 metre per floor).

50 to 75% of warhead weight in these new hard target guided weapons (bombs and missiles) is a secret, high density metal (see Figure 1, page 33). This may be up to 1500 kg of tungsten or uranium ballast in the 2 ton GBU 28 bunker buster warhead (see photo with F-15 aircraft).

Any of these buildings hit by new hard target guided bombs or missiles may be contaminated by from suspected uranium warheads. This may be exposed when excavation reaches the lowest level.

These targets provide major problems for local authorities and site engineers. In many locations these sites could be cleared to ground level or craters filled with debris. But this ground would be unstable for future construction.

Some of these locations may include unexploded penetrator warheads. Seismic survey or similar techniques may be important to locate unexploded warheads underground in towns or villages.

In several locations these basement areas have been flooded by domestic water supplies or sewers. Some large craters in main roads were also flooded. If illegal warheads were used in some bombs or missiles then some of these lakes may contain toxic or radioactive materials. All should be tested for toxic and radioactive materials as well as potential organic hazards.

In many locations potentially contaminated targets had been back-filled e.g. craters in roads and at Beirut airport. If toxic or radioactive weapons were used these may be sources of long term ground water pollution. This may be important if houses in the area take drinking water from wells.

Very large craters in urban areas were most likely caused by the 2000 lb GBU-24 or 31, or the 2 ton GBU-28 or 37 precision guided bombs with hard target penetrator warheads. These are different from the conventional, lower penetration Mk 84 warheads. Hard target warheads contain secret, high density metals.

Part 3: Documentary sources

8. Photo archives and other reports of weapons and their effects

Unlike recent conflicts in the Balkans and Afghanistan there are many photographs and some video reports from the 2006 Israel / Lebanon conflict showing attacks with the new generation of guided weapons in progress. Where these can be related to specific locations these add new evidence for analysis of the weapons used by the IDF. They may also help to focus post-conflict investigations on locations (and communities) that may have a high risk of exposure to suspected uranium or other illegal weapons.

There were many video reports of the 2003 Shock and Awe bombing in Iraq. But UNEP were not permitted access for full environmental testing of target areas. Later many medical records in bombed communities in Iraq were stolen or destroyed. However video evidence from the Baghdad bombing gave first visual documentation of the new secret, incendiary bunker buster bombs and missiles in action. These can be compared with similar explosion photographs from recent attacks in Lebanon (see page 4 of my first Lebanon report, ref 1).

The archives of recent war photographs from Lebanon include pictures of explosions, casualties, damage and reconstruction. Researchers in Lebanon are encouraged to gather any other photographic records of explosions and casualties especially where these can be identified by place and time, and linked with eye witness reports.

Ideally local communities, or central research teams, should develop a database logging all attack locations including date, time, casualties, numbers of weapons used, target or crater analysis, eye witness reports and environmental and human testing results. From these data it should be possible to identify which weapons were used, their long term hazard potential, and long term health consequences for local residents, emergency services and construction workers. In effect each attack location is a crime scene.

I took verbal reports from several witnesses of attack locations. I talked to medical personnel from two locations who described initial trauma symptoms and the subsequent health of people involved. I did not have time or resources for a comprehensive review of eye witness and medical reports, matched to the locations which suffered the largest bombs and missiles. This could be an important community health project for the medical profession in Lebanon.

Ideally this kind of study may be assisted by international medical specialists. But some external advisers may be covertly funded by the arms industry or military to conceal evidence of negative health effects from potentially illegal toxic or radioactive weapons. Ideally this would be supported by the World Health Organisation, possibly with IAEA assistance. But WHO personnel have not been allowed to conduct thorough community health monitoring programmes in any recent conflict zones where known or suspected uranium weapons have been used.

I did not meet any of the Lebanese Red Cross, UN and other paramedics who featured in many casualty photographs during the war. Their work was traumatic and hazardous. Their eye witness testimonies of casualties and target areas should be documented as soon as possible and may be particularly important for the UN HRC Inquiry team. This traumatic incident appears to have been an airborne attack on a vehicle by a high temperature missile - possibly an AGM-114 Hellfire shaped charge or thermobaric warhead.

Their own physical and mental health should be monitored and supported for at least 1 year, preferably for 5 years. The health status of medical and other emergency support teams should be monitored for each area and reported monthly. This is important in case they experience any delayed onset health problems from possible exposure to toxic or radioactive weapons, as well as high risk of Post Traumatic Stress Disorder (PTSD).

9. Local contacts and internet resources

My visit was greatly assisted by several individuals and groups in Lebanon who gave me advice, information, transport to rural and urban target locations and who translated discussions with local people and community representatives. Photographs were collated by professional photographers from their own and agency sources during the conflict.

During the visit I met a UN spokesman who listened to my concerns and initial observations. I gave him a copy of the first Eos Lebanon report (ref 1). We discussed my previous reports about known and suspected uranium weapons (for Afghanistan and Iraq) and photos of suspected Uranium weapon targets taken during the conflict in July/August and other public domain resources from the Internet.

The Internet has many useful sources for researching the development and use of known and suspected uranium weapons. These provide many sources of military, medical and environmental data (see References on page 33).

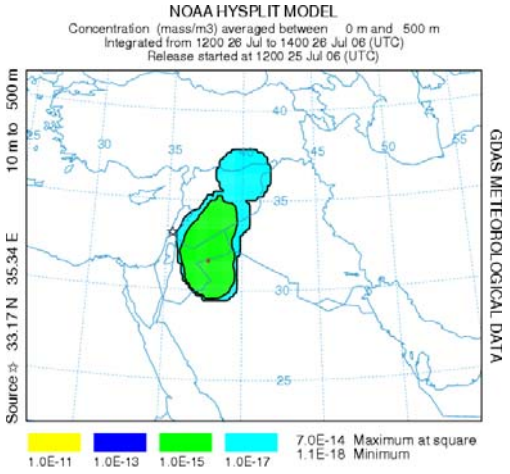
The NOAA Air Resources Laboratory website www.arl.noaa.gov can model wind conditions and smoke plume dispersal around the World for example from volcanoes, industrial accidents or large explosions during wars. It has been useful for tracking explosion plumes and dust dispersal from recent conflicts in the Balkans, Afghanistan and Iraq.

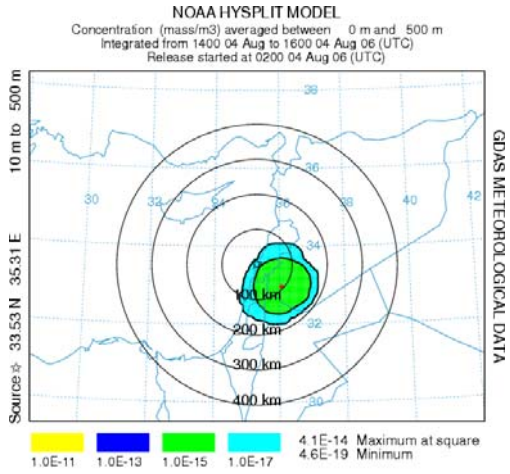
These charts from the NOAA Hysplit system shows the way that possible contamination from bomb attacks in Lebanon may have spread across southern Lebanon, Northern Israel and Syria, taking account of local wind conditions.

The top chart shows the likely dispersal of dust after 24 hours from bomb attacks on Khiam on 25th July 2006. See explosion plumes page 15.

The bottom chart shows the likely dispersal of dust after 12 hours from the large incendiary bomb attacks on Beirut on 4th August 2006, see photographs on page 14.

Israel and the USA will have many military satellite images of smoke plumes from attacks on Lebanon throughout the war. These may be of interest to the civilian population in Israel, as well as Lebanon, Jordan and Syria. But low level winds and smoke plumes may go in different directions from the mass of dust at higher levels. So full meteorological analysis will be needed to assess the spread of contamination from multiple attacks. I hope that UNEP and the Lebanese Department of Environment will be given full access to weather and satellite data.





Other valuable Internet sources for local organisations and scientists in Lebanon include some of the previous post conflict assessments conducted by the UNEP PCAU like their target assessments in the Balkans and other post conflict environmental assessment proposals for Afghanistan and Iraq (ref 6).

10. Combat statistics

Ideally the IDF may publish an analysis of the types and numbers of weapons they used during land, sea and air strikes in July and August 2006. For comparison see the USAF report "**By the Numbers**", April 2003, for the start of the Shock and Awe campaign see: www.globalsecurity.org/military/library/report/**2003**/uscentaf_oif_report_30apr**2003**.pdf

An analysis of types and numbers of weapons used and their numbers will assist estimates of potential contamination if illegal weapons have been used. Even if official data is offered it is good to compare figures from a combination of sources.

The IDF have volunteered general information about the number of sorties flown during the operation. UN OCHA reports presented regular information during and soon after the conflict. Other sources like Amnesty have produced some general figures. The maps in the Appendix indicate main areas bombed and infrastructure targets, plus one example of daily IDF maps.

Amnesty International offered the following summary in its assessment of 23 August 2006
Israel/Lebanon Deliberate destruction or "collateral damage"?
(ref http://web.amnesty.org/library/Index/ENGMDE180072006)

> The Israeli Air Force launched more than **7,000 air attacks** on about **7,000 targets** in Lebanon between 12 July and 14 August, while the Navy conducted an additional **2,500 bombardments**. (ref: Israel Defence Force website, http://www1.idf.il/DOVER/site/mainpage.asp?sl=EN&id=7&docid=56765.EN)
>
> The attacks, though widespread, particularly concentrated on certain areas. In addition to the human toll – an **estimated 1,183 fatalities, about one third of whom have been children** (ref Middle East Crisis UNICEF Situation Report No. 26: http://www.reliefweb.int/rw/rwb.nsf/db900SID/HMYT-6SSLUF?OpenDocument&rc=3&emid=SODA-6RT2S7)
>
> **4,054 people injured** and 970,000Lebanese people displaced (ref Lebanese Higher Relief Council: (ref http://www.reliefweb.int/rw/rwb.nsf/db900SID/EKOI-6ST5ZM?OpenDocument.)
>
> the civilian infrastructure was severely damaged. The Lebanese government estimates that **31 "vital points"** (such as airports, ports, water and sewage treatment plants, electrical facilities) have been completely or partially destroyed, as have around **80 bridges** and **94 roads**. (ref http://www.reliefweb.int/rw/rwb.nsf/db900SID/EKOI-6ST5ZM?OpenDocument)
>
> More than **25 fuel stations** (ref Lebanese Higher Relief Council, 16 August 2006: http://www.reliefweb.int/rw/rwb.nsf/db900SID/EKOI-6ST5ZM?OpenDocument)
>
> and around **900 commercial enterprises** were hit. The number of **residential properties, offices and shops completely destroyed exceeds 30,000.** (ref Engineers Syndicate, released in Lebanese media 17 August 2006. Also see: http://www.reliefweb.int/rw/rwb.nsf/db900SID/EKOI-6ST5ZM)
>
> **Two government hospitals** – in Bint Jbeil and in Meis al-Jebel – were completely destroyed in Israeli attacks and **three others were seriously damaged**.(ref Report of the Council for Development and Reconstruction).

US air operations in Afghanistan and Iraq used a high proportion of guided weapons. Similar tactics were used by the IDF in Lebanon - hitting a large number of strategic targets within a short period (4 weeks), though with fewer aircraft. However the IDF may have used many more ballistic weapons - shells from tanks, artillery and ships.

My prime concern regarding suspected uranium weapons are large (250 kg+) guided weapons with hard target warheads. These were used on strategic infrastructure (e.g. bridges, "vital points" and larger residential properties). Many roads and small houses may have been hit by unguided munitions. Vehicles will mostly have been hit by smaller air to ground missiles.

Of 7000 targets probably at least 3,000 were hit by precision guided weapons. In many cases air attacks involved two bombs, one conventional, one incendiary. In total this may have involved about 6,000 guided bombs, plus perhaps 3,000 guided missiles, 4,000 unguided bombs and many naval, tank and artillery shells. Of the estimated 9,000 guided weapons (bombs and missiles) up to 1 in 3 may have been incendiary - say 3,000. Warheads may have ranged from 50 to 500 kg for missiles and 250 to 2000 kg for bombs. Large numbers of smaller sub-munitions were also used. It is not possible to estimate how much uranium may have been used in these munitions until further environmental testing has been done.

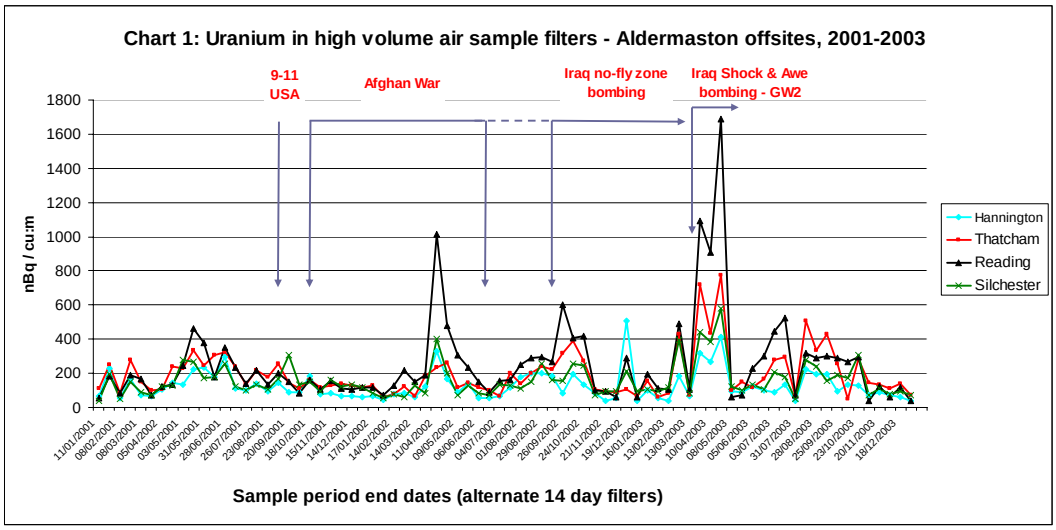
Part 4

11. Suspected use of (undepleted) uranium weapons

After inspecting 22 bomb or missile targets, seeing hundreds more and viewing 200+ explosion and casualty photos **I remain seriously concerned that the IDF have used small (1 - 50kg), medium (50 - 500 kg) and large (500 to 1500 kg) warheads that may have contained uranium metal or alloys**. Several organisations are investigating this possibility.

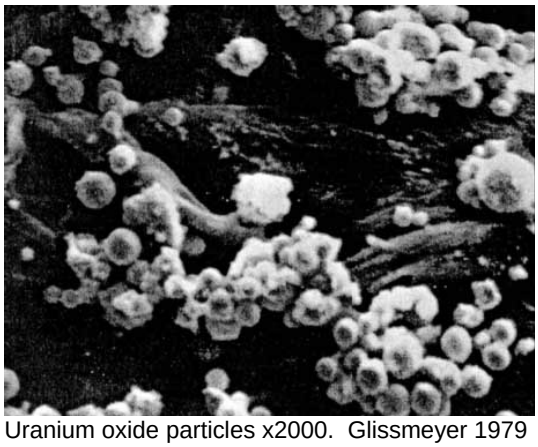
If high levels of uranium contamination are detected in or near recent IDF targets then these are most likely to be undepleted Uranium (U238 99.3%, U235 0.7%) oxides. I do not expect any depleted uranium (DU) munitions to be detected in Lebanon unless near IDF tank or helicopter attacks. DU contamination is easy to identify. So it would be unwise for arms manufacturers to use it in high value guided weapons. Any evidence that large uranium warheads (dirty bombs) have been used in any country could result in major legal actions.

High levels of airborne undepleted uranium dust were reported by Kerekes et al in Hungary soon after NATO bombing during the 1999 Balkans War. High levels of undepleted uranium contamination were detected in urine samples from civilians in Afghanistan living near recent US bombing targets in 2002. And high levels of uranium dust were measured by the UK AWE in April 1999, March 2002 and March /April 2003 (Chart 1 & Busby & Morgan, ref 12).



If large **undepleted uranium** weapons were used in Lebanon in 2006 the contamination may be "invisible" to conventional laboratory assessments previously used by UNEP studies in the Balkans. The isotopic ratio of undepleted uranium will appear normal, easily (and perhaps intended to be) confused with natural uranium. UNEP scientists and laboratories need to include the possibility that weapons may use uranium metal or alloys with a range of isotopic profiles.

If uranium weapons have been used then very close inspection (within 1 cm) of contamination (black dust) in or near the target may indicate abnormally high levels of alpha emissions. And microscopic inspection of black uranium oxide dust (2000 x magnification) may reveal the characteristic "grape" shapes of ceramic uranium oxides (see photograph). Natural uranium does not occur as a free metal but in situ with complex natural minerals or salts. These are likely to widely varied or amorphous shapes.



Uranium oxide particles x2000. Glissmeyer 1979

These and similar tests to differentiate undepleted uranium contamination from natural uranium will be essential in all future scientific analysis of human and environmental samples concerned with the known or suspected use of uranium weapons.

Any radiation assessments in Lebanon that indicate "only natural background radiation" for areas known to have experienced recent guided bomb or missile attacks may need retesting. Are IAEA inspectors aware of the suspected radioactive weapon systems identified in my reports? UN contacts are welcome to forward this and my previous reports to them.

IAEA requested urgent radiation testing in Iraq after the US Shock and Awe bombing campaign in April 2003. I understand they were prevented from doing so except in Al Tuwatha where high level radioactive materials had been looted. IAEA has excellent equipment if they are willing and permitted test for suspected uranium munitions.

The **highest concentration** of contamination is likely to be at the bottom of collapsed high rise buildings where the IDF clearly used large penetrator warheads in guided bombs or missiles.

The **largest quantity** of uranium contamination, if any, is likely to have been dispersed from high smoke plumes (2-3000+ metres) over large areas downwind of large incendiary bomb targets. These may have contaminated agricultural land and water catchments.

Many targets have been hit by conventional high explosive bombs and shells. These cause severe damage but reconstruction is possible. The potential hazards of suspected uranium or other unconventional weapons - if any have been used in Lebanon - are hopefully confined to relatively small areas. UNEP's ability to investigate potential air, soil and water contamination will be important to re-assure communities that their areas have not suffered toxic or radioactive contamination. If contamination is found it is important to identify exactly which areas are affected and how seriously. This is directly linked with one of the objectives of the UN Human Rights Council Inquiry Commission (see ref 1).

12. Key features of suspected uranium targets

These observations are offered to assist UNEP inspectors in identifying the most relevant locations for environmental testing including air, soil and water testing for potential uranium contamination from military operations.

During July - August 2006 many targets in Lebanon were hit by a wide variety of old and new munitions. Random testing of craters could easily miss targets that may have been hit by suspected uranium weapons (possibly only 1 in 10 or less of total munitions, and up to 1 in 3 of guided weapons). It is also possible that some locations that suffered previous military attacks since 1990 may also have some uranium contamination from guided weapons and shells.

Even with radiation detectors careful target analysis is important to check whether uranium warheads may have been used and so whether additional testing is justified. In heavily bombed areas (e.g. south Beirut, Srifa, Bent Jbail and Khiam) many targets overlap and it is very difficult to identify individual weapon targets within a field of rubble. Limited survey resources need to be concentrated on the most obvious targets. If any of these show evidence of increased radiation levels or uranium contamination then survey methods and priorities can be reviewed.

The features on the next 6 pages may indicate that targets were hit by suspected Uranium weapons. They include the type of target (hence the tactical choice of weapon - guided or unguided, bomb or missile), characteristics of the impact or explosion (incendiary or not), characteristics of explosion smoke plumes (colour, height), characteristics of debris (effects of heat, colour of dust, heavy shrapnel), eye witness reports (blast effects, smell etc), unusual injuries (e.g. soot, blast, extreme burns) and unusual health problems for local residents or workers since the war.

a) **High value strategic targets** - bridges, airport, urban intersections, power plants and communications masts, plus mosques and schools and high rise buildings (apartments), with suspected Hizballah resources underground.

This bridge about 40 km east of Beirut illustrates a complex precision guided weapon attack. It may have included bombs on the road decking. But the columns may have been hit by large shaped charge missiles (note the black smoke around the hole in the damaged column) - possibly AGM 84 Harpoons or AGM-154C BROACH warheads.

The large crater filled with water was one of several intersections and bridges in South Beirut targeted by very large, precision guided bombs or missiles.

The very large crater with the blue car at the bottom was made on 16 July.

These high value targets required very accurate targeting. This would justify the cost and risks of using of large precision guided weapons. The largest craters may have been caused by 2 ton GBU-28 (or GBU-37) bunker buster guided bombs. The most widely used warheads were probably 2000lb (900 kg) GBU-24 guided bombs or 1000 lb (500 kg) bomb or large missile warheads e.g. the BGM-104 Tomahawk if the IDF Navy has launch facilities for these.

My studies of recent bombing operations in Afghanistan and Iraq suggests that **up to 1 in 3 of these hard target guided weapons may use uranium** to increase the penetration and incendiary effects of their warheads. See *Figure 1: Hard target guided weapons in 2006: guided bombs & missiles with "dense metal" warheads* on page 33 and on page 9 of my first Lebanon report (ref 1).

b) **Medium value tactical targets** - smaller and mid range penetrator warheads (from 250 to 900 kg) were used on many houses. Conventional unguided (dumb) bombs would have been sufficient to destroy most of these. But the Israelis may have suspected that houses in Lebanon had deep bomb shelters similar to those in northern Israel.

These guided weapons usually targeted basements and then the rest of the building collapsed. In such cases the roof and upper floors may be intact but folded down or titled over into the crater below ground level (see building on next page).

So the **type of building damage** may indicate whether guided or unguided weapons were used. Entry holes for unexploded bombs also indicates the use of guided, penetrator warheads (see photo in section 4 above, taken near this house).

c) **Large fireball explosions:** at night these may start with intense white light and a large fireball that grows over 3-4 seconds, then fades leaving "white stars" of burning shrapnel. These were seen in TV reports from Baghdad and on 4 Aug 2006 in Beirut, see pictures below and the BBC online video report (ref 14) at http://www.bbc.co.uk/mediaselector/check/nolavconsole/ukfs_news/hi?redirect=st.stm&news=1&bbram=1&bbwm=1&nbram=1&nbwm=1&nol_storyid=5247118

Very large incendiary bombs in Beirut, night and dawn, 4 August 2006 (source BBC news)

In daylight these large fireball explosions also develop **high smoke plumes** due to powerful convection currents lifting dust sometimes up to 2000 or 3000 metres. See these pictures from Khiam on 25 July 2006 (by Lotfallah Daher AP):

And a few minutes later

One potential effect of the convection from large incendiary explosions may be to create a "firestorm" (like WW2 bombing in Dresden). Targets may have been partly “self-cleaned" by fresh air sucked in at ground level while most contamination was carried to high altitudes in the explosion smoke plume.

This may have reduced levels of local contamination (if uranium warheads have been used) except within the target itself. But it could increase dispersal of uranium dust over a very wide area - over hundreds, possibly thousands of miles. Airborne Uranium dust was detected by the UK Atomic Weapons Establishment 8-14 days after US bombing in Afghanistan and Iraq, see Chart 1 on page 11 and the report by Busby and Morgan (ref 12).

d) Dense black smoke sometimes local, sometime 100's of metres high. In some locations this may be from attacks on petrol stations. But many photos show dense black smoke plumes like this plume from an attack on Maaraka. What was the target here?

See the central black smoke column from first strikes in this picture from Rashaya, plus new fireballs developing from a second strike a few seconds later.

e) High, thin, black smoke plumes
- with a mushroom cloud at the top were reported in a number of locations. These may have been from penetrator warheads that exploded underground forming a deep, narrow hole. Smoke then comes out vertically - like a chimney. This picture of a precision guided bomb strike on the runway at Beirut airport should not be confused with later smoke plumes from burning aviation fuel tanks at the airport.

One eye witness reported attacks from IDF ships offshore (possibly shell fire or missiles, not bombs) and said these resulted in dense black smoke from targets. These were possibly using Tactical Tomahawk penetrator warheads with "high density" ballast or shorter range missiles. Such eye witness and photographic reports need to be linked in full target analysis.

Black smoke also occurs where large fuel tanks have been targeted e.g. at Beirut airport and power stations south of Beirut. This may be normal hydrocarbon smoke (carbon soot). Beirut suffered both types of black pollution clouds - some from oil, some from bombs. Which is this?

Environmental testing e.g. of buildings, air-conditioning filters etc in Beirut should identify hydrocarbon soot from vehicles emissions and the oil fires at Beirut airport and power stations on the coast. They may also include the dust from large incendiary bombs and missiles - possibly ash or oxides from uranium or other novel explosive warheads.

f) High temperature "baking" of soil and debris in and near the target.

Craters from conventional high explosives may have blast and heat effects leaving grey dust in and near explosion craters. Colours may vary depending on the type of soil and on the type of explosive. Military personnel will be familiar with these effects as part of routine crater analysis.

But UNEP and some military personnel may be less familiar with targets hit by new, very high temperature warheads. These targets may have black dust contamination. If this dust is found near very large craters, or where concrete structures have been destroyed, it may require full laboratory testing for Alpha radiation, chemical and isotopic analysis.

Some NATO and IDF specialists may quickly recognise the effects of new unconventional weapons. But they may be forbidden to discuss any weapons that are classified as secret. They may also be instructed to discourage UNEP and other agencies from inspecting targets which may have toxic or radioactive contamination.

Other explosion debris may assist weapon identification. Fragments of shrapnel may be embedded in buildings, trees, vehicles or on nearby roofs.

Left: Shrapnel embedded in a vehicle; Srifa.

Right: Steel shrapnel showing sharp, brittle fractures.

TV reports of large incendiary bombs at night (ref 13) show pieces of **burning shrapnel** scattered over several hundred metres (see also the white stars in the orange night sky in the thermobaric explosion picture on page 19, and from Baghdad on page 4 of my first report)

Light incendiary materials like phosphorus, magnesium or titanium will burn brightly. But they are not heavy enough to travel long distances. Tungsten does not burn. So there may be many traces of burned or part-burned uranium shrapnel in the wider area around major incendiary targets.

If shrapnel near large penetrator bomb or missile targets is very heavy it may be tungsten or uranium. These may have similar fragmentation patterns to conventional steel shrapnel from bomb or missile casings (see above) but will be much heavier. It may be useful for inspectors to carry a piece of tungsten as a reference sample to judge high density by hand, or to take a portable density testing kit. Tungsten (S.G. 19.25) and Uranium (S.G.18.7) are both a similar density to Gold (S.G. 19.3). Uranium & Tungsten are 2.4 x heavier than Iron / steel (S.G. 7.8).

If uranium shrapnel is found it will constitute serious long term contamination hazards for soil and water supplies. So it is important to try to locate high density shrapnel and to test samples.

13. Thermobaric weapons

The USA first reported using thermobaric penetrator weapons during the Afghan War early in 2002. The BLU-118/B thermobaric bunker buster warheads used the same AUP-116 secret metal casing as the upgraded BLU-109/B 2000lb hard target guided bomb.

Thermobaric weapons use a combination of high temperature and a low frequency/high pressure blast effect to kill any humans in the immediate area of the warhead, or in underground shelters, caves or bunkers. Early versions (like the US Daisy Cutter) used liquid fuel/air bombs, or metalised explosives using aluminium powder. New versions use SFAE - solid fuel air explosives. Some of these also use a "reactive metal" - possibly aluminium like the earlier types. But new versions are 3 times more powerful, suggesting that they may use uranium grains as the "reactive metal".

Eye witness reports indicate that the IDF may have used several large thermobaric bombs or missiles in Beirut and other parts of Lebanon. Reports included these effects:

"When it drops you don't hear it. You see the fire. You feel you can't breath. Then you hear the explosion." (witness about 500 metres from impact).

"The ground shakes. The air disappears as if all the oxygen has gone."

"buildings collapse inwards, not outwards."

"Killed not because of the bomb but because of no air, no oxygen".

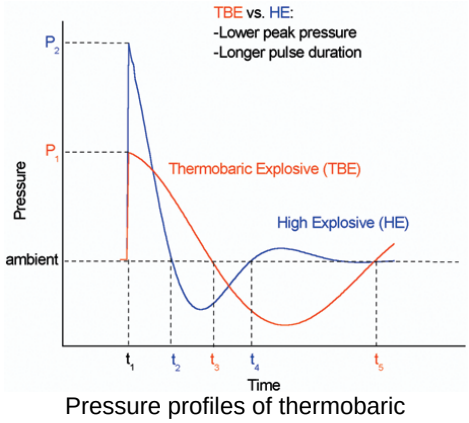
Other reports included "silent" explosions - perhaps because the initial blast was underground, or it was burning more slowly than high explosive. At night burning shrapnel was seen over a large area (see photograph above). Sometimes there was a strange smell (also reported in Afghanistan).

From the locations and other target effects most of these incendiary explosions appear to have been caused by precision guided, hard target penetrator warheads, possibly BLU-118/B. The sense of suffocation is due to a powerful, low frequency pressure wave which drops then increases atmospheric pressure dramatically. This pressure wave collapses walls and low strength buildings and has sucked people out of buildings. Also reported in Fallujah.

Victims close to these warheads may have died rapidly from collapsed lungs or internal bleeding. They may have suffered extreme flash burns from a 5000C explosion. If they are protected from direct flash burns they may be covered with black soot. Further medical investigations need to be matched to the incidents that caused unusual or extreme injuries.

An Australian report (reference 13) gives detailed descriptions including these comments:

- The primary injury mechanisms are blast and heat, with secondary effects through flying fragments and toxic detonation gases.
- The kill radius for blast is usually greater than the kill radius for burns, so that protection against thermal injuries has little benefit.
- Blast injuries include internal injuries that can be difficult to diagnose and treat without sophisticated medical support.



Pressure profiles of thermobaric versus high explosives

The largest confirmed US thermobaric bomb is the **2000 lb (900 kg) hard target BLU-118/B**.
A medium sized weapon is the new **AGM-114N Thermobaric Hellfire missile** (see below).
A new infantry weapon is the **SMAW-NE (novel explosive) thermobaric infantry missile**.

This technology has developed rapidly in the USA since 9/11. Other thermobaric weapons have been developed in Russia and other countries. It has had minimal review in the media.

14. Other intense heat weapons

Some intense heat explosions were due to missile attacks on vehicles (probably by Hellfire or Maverick air to ground missiles). In some locations there was no bomb crater, but there were intense fires and extreme burns on fatalities [see casualties from the Beirut marina attack below].

Hellfire, Maverick, TOW and other small to medium size missiles use **shaped charge** warheads. Some shaped charge explosives are known to have used uranium “liners” since 1982 and are referred to on the Janes Defence and UK MoD websites. Radiation testing should be a standard procedure on all shaped charge warhead targets.

A new thermobaric warhead has also been added to the Hellfire missile (AGM-114N). This uses a novel Solid Fuel Air Explosive (SFAE). Several types have been developed in different countries. Some thermobaric explosives use different types of “reactive” (i.e. pyrophoric) metal as fine particles mixed within an explosive. This is described in **US Patent 6955732**). Uranium is not mentioned in this patent but it is likely to provide the highest explosion temperatures combined with relatively low ignition temperature.

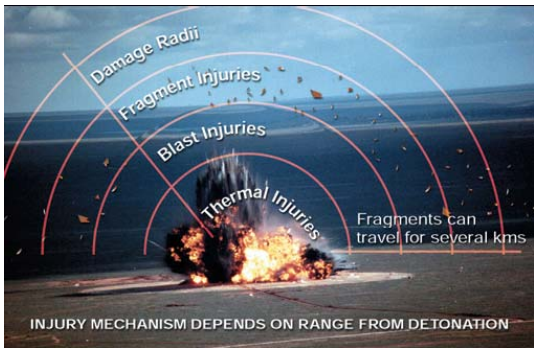
Wherever new high power, high temperature weapons are used casualties and targets hit by very high temperature weapons should be tested for traces of uranium shrapnel or uranium oxides in explosive residues.

Uranium warheads are reported to create explosion temperatures up to 5000 degrees C. Humans exposed to such heat only for 3-4 seconds may suffer extreme flash burns on the side of their body exposed to the explosion, but the skin and clothes protected from the flash may be almost unburned like this victim on 15 July.

Carbonised casualties were a familiar site on the Highway of Death between Iraq and Kuwait in 2001 where it was known that depleted uranium weapons were used. Doctors in Lebanon may not have realised that the IDF could be using a variety of small, medium and large uranium warheads in this latest conflict.

Tissue samples were tested from some casualties who were covered in black dust but apparently not burned. These were tested in Germany but no analysis of the dust has been published yet.

If thermobaric weapons were used they may have been killed by blast over-pressure collapsing their lungs, then covered in dust from whatever explosive was used. With thermobaric weapons "the kill radius for blast is usually greater than the kill radius for burns" (ref 15 and image right).



Several reports of casualties with extreme burns during the latest Israel/Lebanon conflict led to speculation about whether the IDF used **Directed Energy Weapons** (DEW). Mobile laser weapons have been reported in Iraq for crowd control. DEW weapons large enough to carbonise whole people or vehicles may be technically feasible but require very large power sources. This may be feasible on a vehicle the size of a tank or large lorry. But such weapons are probably too big for aircraft delivery at this time.

DEWs and other prototype unconventional weapons like SMAW-NE, high density tungsten explosives (DIME), and chemical or biological weapons may be considered for unusual injuries in areas near the Israel border - particularly if unusual IDF tanks or large unconventional vehicles were seen. In other locations away from IDF ground operations e.g. in Beirut it is more likely that casualties with extreme burns were exposed to high-temperature incendiary or thermobaric warheads. Extensive chemical and biological testing, combined with full autopsies and incident reports, are needed whenever possible on victims of new unconventional weapons.

15. Mixed strikes - conventional HE plus unconventional incendiary warheads

Photos of air strikes on several strategic targets suggest that IDF strikes often used a combination of guided weapons in the same attack - one high explosive and one incendiary. Photographs may suggest these are single weapons. But the soundtrack of the BBC video of this dawn strike in Beirut on 4 August (ref 13) has two explosions. The first gives the very large incendiary fireball (front) followed by a high explosive explosion (behind) about 1 second later.

The use of mixed strike attacks on reinforced concrete targets e.g. the following sequence of photographs of the Zafrina bridge, near Saidi (Sidon) strike below, suggests that both the high explosive and incendiary weapons were precision guided hard target warheads.

This first picture shows an incendiary warhead in front, with a high explosive warhead behind.

A few seconds later the explosion plumes expand

Soon after another incendiary warhead starts another high temperature fireball on the other side of the carriageway.

The incendiary fireballs may be thermobaric warheads. Against large concrete structures these create a Lower frequency but very powerful air pressure wave that can collapse large structures.

These mixed strikes may be consistent with Lockheed Martin's US patent 6,389,977 for the upgraded BLU-109/B (AUP-116) 2000 lb hard target warhead used in the GBU-24, GBU-31 and GBU-118/B. (See diagrams on next page).

The US patent describes two versions - claim 4 "wherein the penetrating body is made of tungsten" and claim 5 "wherein the penetrating body is made of depleted uranium". www.eoslifework.co.uk/pdfs/u25.pdf pages 36/37. It seems likely that both types of warhead metal may be produced to cover different target types, or to provide the “double whammy” mix of high explosive and alternative thermobaric blast effects.

Tungsten warheads would give maximum penetration and HE effects but no fire. Uranium ballasted warheads would give high penetration plus a 5000C incendiary fireball.

Design from Lockheed Martin's US patent 6,389,977 for a Shrouded Aerial Bomb to upgrade the 2000 lb BLU-109/B warhead.

The outer casing (Fig 1) conceals the new, thinner, high density explosive penetrator warhead (Fig 2). This is either made of tungsten or uranium.

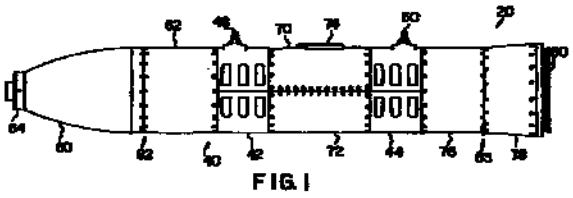


FIG. 1

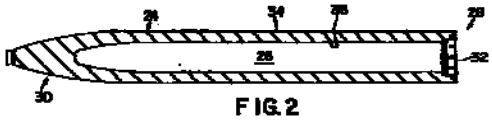


FIG. 2

This photograph of the attack on Rashaya (near Khiam, shown on page 16 and right) also illustrates a mixed strike combination of High Explosive (grey smoke) and incendiary (suspected uranium, - fireball and black smoke) weapons. 6 or more bombs or missiles appear to be exploding in this picture.

6 separate air strikes were reported on the town of Khiam on 25 July, and similar attacks over several days with many more guided weapons. One of these strikes killed 4 UN personnel - part of the sustained attacks on the town see page 15 and right.

Many buildings in Khiam were devastated including the former prison. Increased radiation was reported in August from the crater in the red circle, below right. On 17th September I witnessed radiation levels at the bottom of this crater that were significantly higher than on the road and much higher than in Beirut. Other researchers will publish further information in due course.

Many large guided weapons were used in several other parts of Khiam (see photographs). Detailed air, soil and water tests are required for at least 2 kilometres around Khiam and Rashaya.

Detailed target mapping for these areas is also required to match photo images of explosions and plumes to actual target locations.

Biological (e.g. urine) testing is also desirable on a sample of local residents from both areas. Construction operations may have buried contamination on specific targets but people in the area may be carrying a permanent record in their lungs if they inhaled measurable doses of uranium oxide dust.

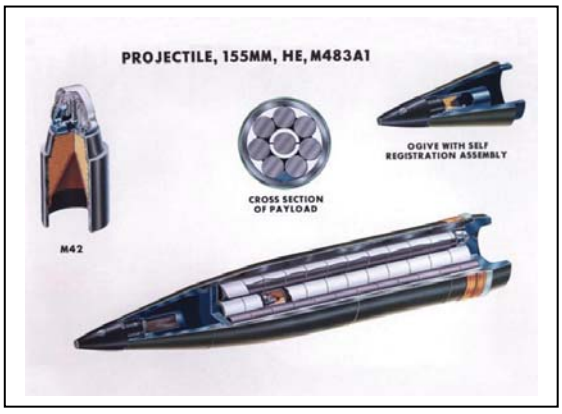
16. Artillery and other ground launched weapons

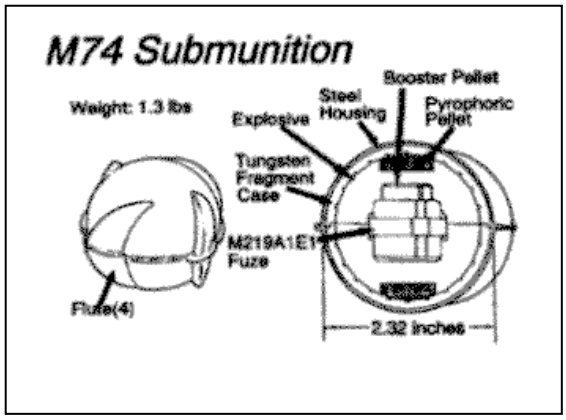
IDF operations in the southern villages included a variety of tank and artillery shells. One photograph showed an IDF tank crew with armor piercing shells. These may have been DU but Israel also produces a tungsten version that looks the same. DU anti-tank penetrators are mainly used against tanks. These might have been relevant if the Lebanon army had been involved. I am not aware that Hizballah had any tanks.

I have not studied tank and artillery weapons for Uranium because I have been mainly looking at larger bombs and missiles. DU campaigners have challenged the use of DU penetrator rounds in tank. However some tank shells also use HEAT (high explosive anti tank) **shaped charge warheads**. I don't think these have been investigated by DU campaigners. But Janes Defence and the UK MoD website confirm the use of DU (or just U) in a variety of shaped charge warheads. If so some of these warheads may use about 1-2 kg of Uranium each as an alternative to the official metal copper. These could cause some local uranium contamination depending on numbers used - not good, but relatively less than bombs or missiles.

However another concern is the possibly large scale use of anti-personal anti-material tank shells (APAM) by the IDF. These fire sub-munitions (cluster bombs) including some with pyrophoric shrapnel, or pellets. Recent medical reports from Gaza indicate that the IDF have been using weapons with **pyrophoric shrapnel** that continues to burn inside victims. Because of its high density and pyrophoric properties Uranium would be a logical military choice for many anti-personnel weapons, but would also violate the CCW Convention.

No information is available about the IDF's own APAM shells. But the US M39 Army Tactical Missile System fires 950 M74 submunitions with fragmenting case and pyrophoric pellets. As a new system it is likely that the IDF may have combat tested some of these for Lockheed Martin or have produced their own equivalent system.





The IDF used large quantities (estimated 1.5 million) of cluster bombs / sub-munitions in southern Lebanon. All shaped charge and other weapons using pyrophoric materials developed by any country in the last 20 years must be vetted for potential uranium components.

If any of these sub-munitions contain Uranium they may have scattered larger numbers of uranium pellets or shrapnel across target areas. Burned or unburned these constitute a serious toxic and alpha radioactive threat to future cultivation. Long term this may represent an even worse health risk than the obvious physical threat of unexploded munitions.

One cluster bomb target was reported to show increased radiation relative to adjacent ground. My first report already questioned possible use of uranium in two aerial cluster bombs - BLU-108/B and BLU-97B. The Gaza report of pyrophoric shrapnel, together with IDF stocks of APAM shells, indicates the need to add uranium assessments to ALL cluster bomb and

anti-personnel sub-munitions - air or ground launched, old and new. UNEP may wish to discuss these with UNMAC and UNIFIL de-mining teams.

More study is needed of the full range of IDF tank shells. If they are like the US arsenal some may include chemical and biological agents. I guess most were conventional high explosive shells used to destroy buildings. Some may have delivered chemical weapons (e.g. the Carpet short range rockets fired from some IDF tanks - officially described as small fuel air bombs to clear minefields or enemy personnel in surface bunkers). To inspect this claim it is necessary to work from eye witness and injury reports from medical organisations.

The Lebanese Army, UNIFIL and Hizballah will have a lot of information about conventional (and unconventional) land-based weapons used by the IDF from many years of resistance and occasional wars. They should be able to give detailed briefings to UNEP and the UN HRC team. The one area they may have least information about is the suspected use of uranium options to dramatically increase the effects of previously conventional weapons.

A Janes expert told me 4 years ago that uranium is used interchangeably with copper in some shaped charge weapons. And the UK MoD reported testing a tandem warhead missile “with DU lined rear charge” in 1999. The Israeli SPIKE anti-tank missile uses a very effective tandem warhead. The US TOW anti-tank missile uses another type of tandem warhead. This may have been used by Hizballah to defeat several Israeli tanks. If these remain in Lebanon they should also be tested for uranium contamination - in this case possibly DU.

Part 5: Interim conclusions

17. Interim conclusions offered to UNEP

Cluster bombs are the most publicised post-conflict hazards in Lebanon and they are the most obvious immediate hazards. It is good that they are getting serious attention from UNMAC, UNIFIL with the Lebanese Army and probably other NGOs.

But my primary concerns are about the potential hazards of invisible toxic and radioactive materials - particularly uranium oxides - near targets where large bombs and missiles were used.

It would be good to say these targets did not have any uranium contamination. But at least one bomb crater has increased radiation and will need testing for uranium. I will need to see much more extensive and rigorous testing before I am convinced that uranium weapons have not been used by the IDF in Lebanon. A few may also have been used by Hizballah - from US sources.

If uranium weapons have been used this will become evident sooner or later from environmental testing and from increases in uranium related illnesses. By then it will be too late protect civilians from local sources of contamination e.g. domestic water contaminated by toxic dust from house roofs and contaminated crops.

Rigorous testing is essential to quantify or eliminate these potential post conflict hazards in Lebanon - and possibly in adjacent countries if large amounts of airborne contamination were dispersed in southern Lebanon.

Airborne contamination may be the biggest hazard. High volume air sampling surveys across all combat regions may help to identify if any contamination exists, and if so whether it is concentrated in specific areas. Implications for domestic and community water supplies are important.

Certain areas like Khiam, Rashaya, Bent Jbail, Maaraka, south Beirut and all rubbish tips where bomb debris are stored, appear to be the most obvious starting points for air, soil and water testing for uranium oxides. Any elevated levels of uranium must also be tested to differentiate between natural background uranium, and man-made undepleted uranium used in warheads.

Human health monitoring and urine testing in for communities in these areas is also desirable, especially if any unusual health problems or epidemics develop in the next 1-5 years. Local health centres and central public health authorities may also need to monitor the medium and long term health status of rescue workers, demolition and salvage workers and truck drivers involved in moving debris from heavily bombed sites. Dust control measures are vitally important for these workers.

18. Interim conclusions offered to UN HRC Inquiry inspectors

The Inquiry Commission has a support team including a military expert. They may already be fully aware of the range of weapons used by the IDF including those supplied by the USA or other countries. They may also be aware of the secret metals used in the 25 guided weapons that I suspect may have uranium warhead options. If so they may not be allowed to disclose this information. However the information offered here, plus ongoing investigations by several organisations, may provide an opportunity for the HRC Inquiry Commission to bring several new warhead technologies into the public domain for international inspection.

Several individuals or groups have been seeking evidence of radiation or uranium weapons in Lebanon including IAEA and people from Switzerland, Netherlands, the USA, Germany and Italy. How well they understand known and suspected illegal weapons may be important in whether they find evidence of toxic, radioactive or other illegal weapons. As targets are cleared it rapidly becomes more difficult to find material evidence.
The use of thermobaric weapons by the IDF seems clear from eye witness reports. The HRC Inquiry may collect similar testimonies. However more detailed investigations of casualties, contamination and the ongoing health status of local residents in target areas are required.

Thermobaric weapons may already be weapons of indiscriminate effect regardless of what materials they are made of. But if they use uranium - either in their warhead casing or in reactive metal explosives - they will undoubtedly constitute "dirty bombs" with irreversible health and environmental consequences. These weapons are likely to be a significant part of the UN HRC Inquiry.

I understand that the use of incendiary weapons is also limited by parts of the CCW (Inhumane Weapons) Convention (ref 4). Whether uranium or other reactive metals are being used in new US and Israeli weapon systems these need full investigation.

Key evidence of the suspected use of uranium weapons for the UN HRC Inquiry may need high volume air sampling equipment across southern Lebanon. UNEP and IAEA have access to the equipment and specialists with the capability to conduct such surveys - subject to resources and UN consent. They will need to be last at least 12 months to determine seasonal fluctuations in potential uranium dust contamination.

Scientists in several countries are following these studies with interest. Airborne radiation studies are being carried out regularly in many countries. The IAEA should have global data for the last 8 years. This should be requested and published by the UN.

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19. Other issues for further investigation

My prime interest is in the health and safety consequences of using suspected uranium weapons for civilians and military personnel. The development of these weapons has been concealed over 15-20 years but is now on record. The combat use of uranium weapons is indicated by UK AWE air sampling data (Chart 1, page 11), which shows that increased uranium levels in sample filters are strongly associated with specific periods of conflict.

There are potential health hazards for UN and other personnel investigating weapon targets - both from UXO and potential toxic or radioactive contamination. Higher risks apply to people who were in combat regions during the conflict, who still live or work there, and to construction workers involved in clearing and transporting debris from potentially contaminated targets. Their health status should be subject to regular monitoring.

UNEP and the UN HRC will be aware that many of the suspected weapon systems represent major commercial investments in the USA, Israel and up to 20 other countries. They may face pressure to minimise health and environmental monitoring, or to censor publication of adverse results. If contamination is located in Lebanon a counter-propaganda exercise may be expected to trivialise the health hazards of uranium weapons - as operated by NATO in 2001 to distract attention from mysterious deaths of Balkans troops.

Open and regular communication of results is one of several strategies to enable UNEP and UN HRC to conduct reasonably objective studies and assessments for Lebanon.

I hope that both the UNEP and UN HRC Inquiry Commission teams will be allowed to do rigorous investigations. I am grateful to all those who assisted my brief study including photographs illustrate new, unconventional weapons used by the IDF. Many of these unconventional weapons were supplied by the USA and were similar to those used in Iraq. So the UN studies may have implications for further studies in other recent conflict zones.

This interim report has concentrated mainly on target descriptions to enable weapon identification. My first report on 30 August added a number of suggestions regarding health and safety issues and protection of people and organisations involved in investigations. It is available online at www.eoslifework.co.uk/pdfs/u26leb806.pdf .

This report explains why any post conflict studies that only refer to investigation of “depleted uranium” weapons or contamination may be dangerously inadequate. Such limited analyses may give local communities and public authorities false confidence suggesting environments contaminated with undepleted uranium oxide are safe. If such contamination was created in July / August this will become obvious within 5 years as delayed onset health problems develop. The international scientific and medical communities must watch this issue.

The range of uranium warhead technologies expands each year. Uranium can be used in at least 5 different kinds of weapons from sub-munitions to bunker-buster bombs and missiles. The use of non-fissile uranium appears to be proliferating rapidly in over 25 suspected weapon systems traded across 20 countries. Future Post Conflict assessments may need to include low level (alpha) radiation monitoring, uranium testing of air, soil and water, analysis to include all isotopic profiles (natural, depleted or enriched) and associated alloy metals (titanium, niobium, molybdenum etc).

There are some important factors to consider for communities in Israel. This report has not addressed the weapon systems used by Hizballah during the conflict because I did not have time to visit target areas both sides of the border. Most of the missiles reported for Hizballah use conventional materials and explosives. The UN HRC team will assess the criminal liability of both sides for targeting civilian communities.

One report suggested that Hizballah may have used new generation US anti-tank weapons - possibly the US TOW missile. If so the IDF will need to test damaged tanks and exposed troops for potential radiation and uranium contamination. Health and safety precautions should extend to rescue, recovery and repair teams. The UN HRC should give the IDF full opportunities to report such use of potentially illegal systems as well. IDF forces and their US military advisers have access to full radiation testing equipment and design details for US weapons. UN teams, the Lebanese Army and Hizballah are unlikely to have these resources.

If tests indicate that IDF forces did use significant quantities of uranium weapons in Lebanon this could have serious environmental implications for communities in northern Israel and Syria. When UNEP does NOAA wind analyses for the July-August period it will be obvious whether airborne radiation spread over adjacent countries - at it did in the Balkans in 1999.

In this scenario UNEP may wish to offer the Israel government advice on environmental testing (air, soil and water supplies) throughout northern Israel. Significant uranium contamination may re-suspend in hot weather for several years, needing ongoing air monitoring systems. Contamination of water catchments would also be an issue.

Several small studies from other countries are continuing in parallel with the UNEP and UN HRC studies in Lebanon. I hope these will exchange information about weapon types, materials and testing results. Longer term independent inspection and control of all new weapon systems is desirable, within manufacturing countries and by international arms control agencies.

The absence of widespread physical health problems in Beirut and southern Lebanon is encouraging. Trauma may be the most widespread health issue. I hope that no uranium weapons have been used in Lebanon or Israel. If there is significant uranium contamination it may have been widely dispersed. If so then short term health hazards may be limited to small groups e.g. construction or rescue workers. But community health and environmental monitoring will be important in all regions for at least 18 months.

I hope these notes will be relevant for the UNEP and UN HRC teams in Lebanon, plus UNMAC, UNIFIL and other professionals helping the Lebanese Government to assess the full effects of the conflict in July- August 2006 and support programmes for communities affected.

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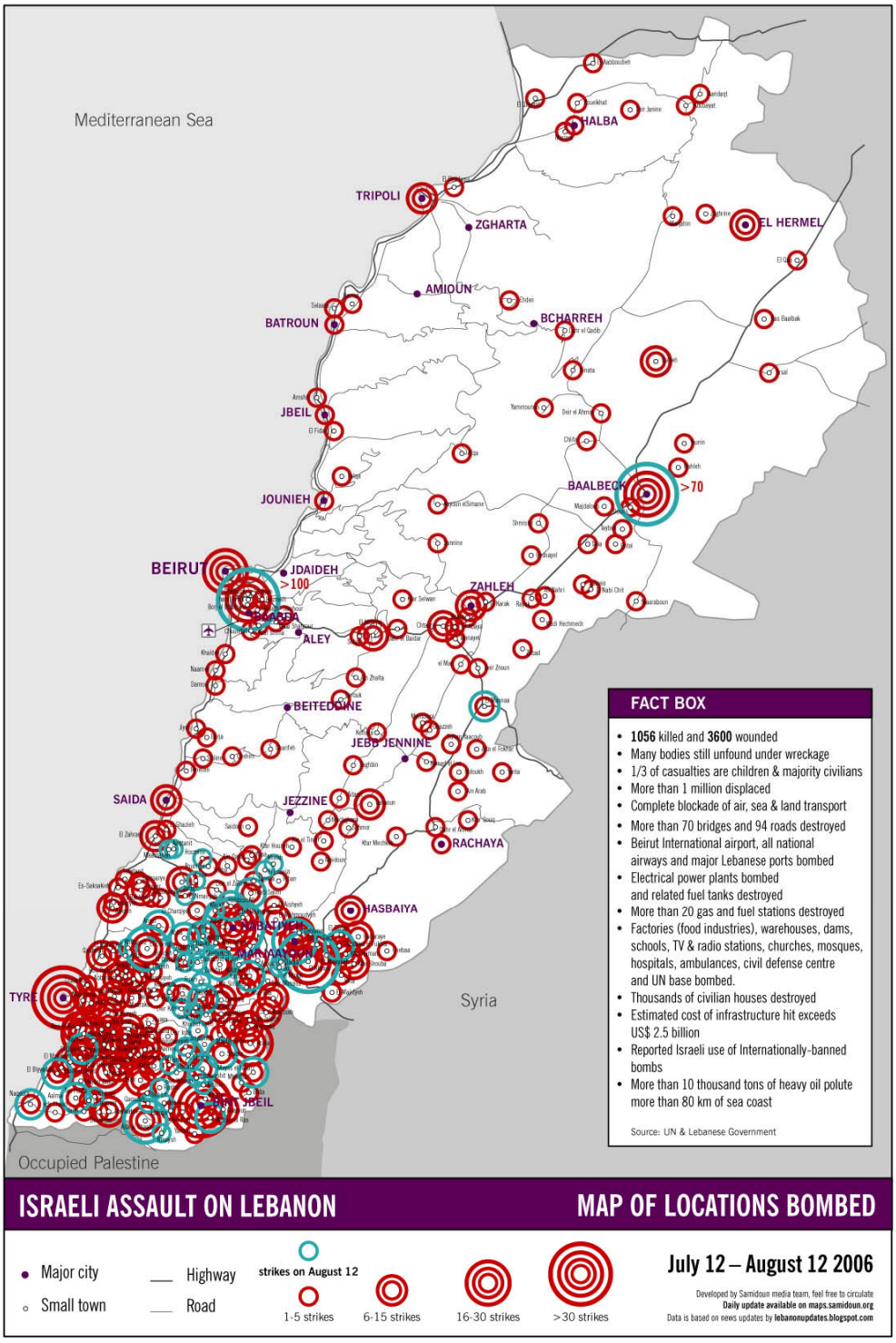
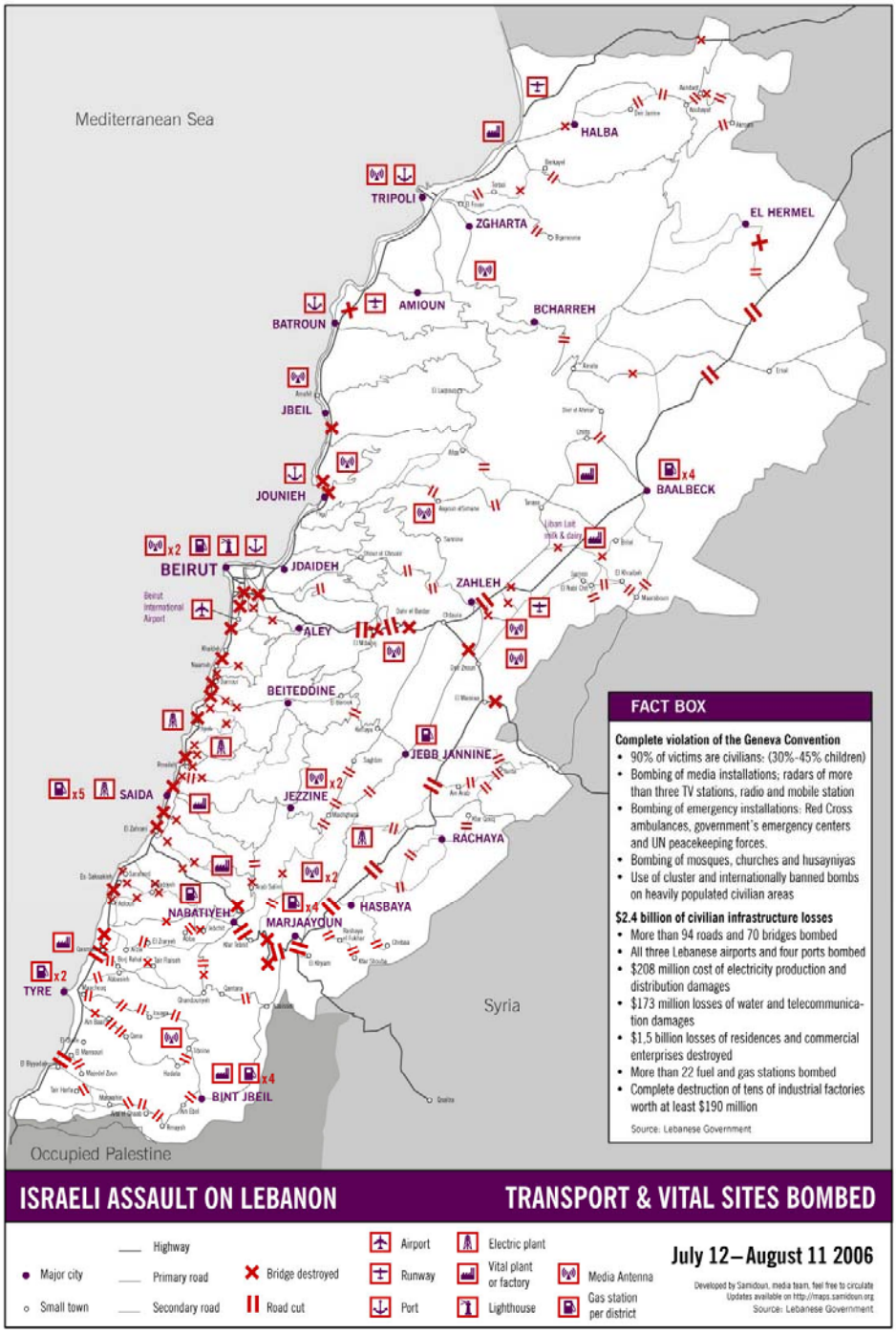
APPENDIX



This gives a general indication of most heavily bombed areas. Other maps e.g. from UN organisations like OCHA give more detailed targets. But this reminds investigators to inspect locations in northern and eastern Lebanon, as well as more obvious targets in Beirut and the South. Source: http://www.samidoun.org/?q=taxonomy/term/69+70/0 - map archives

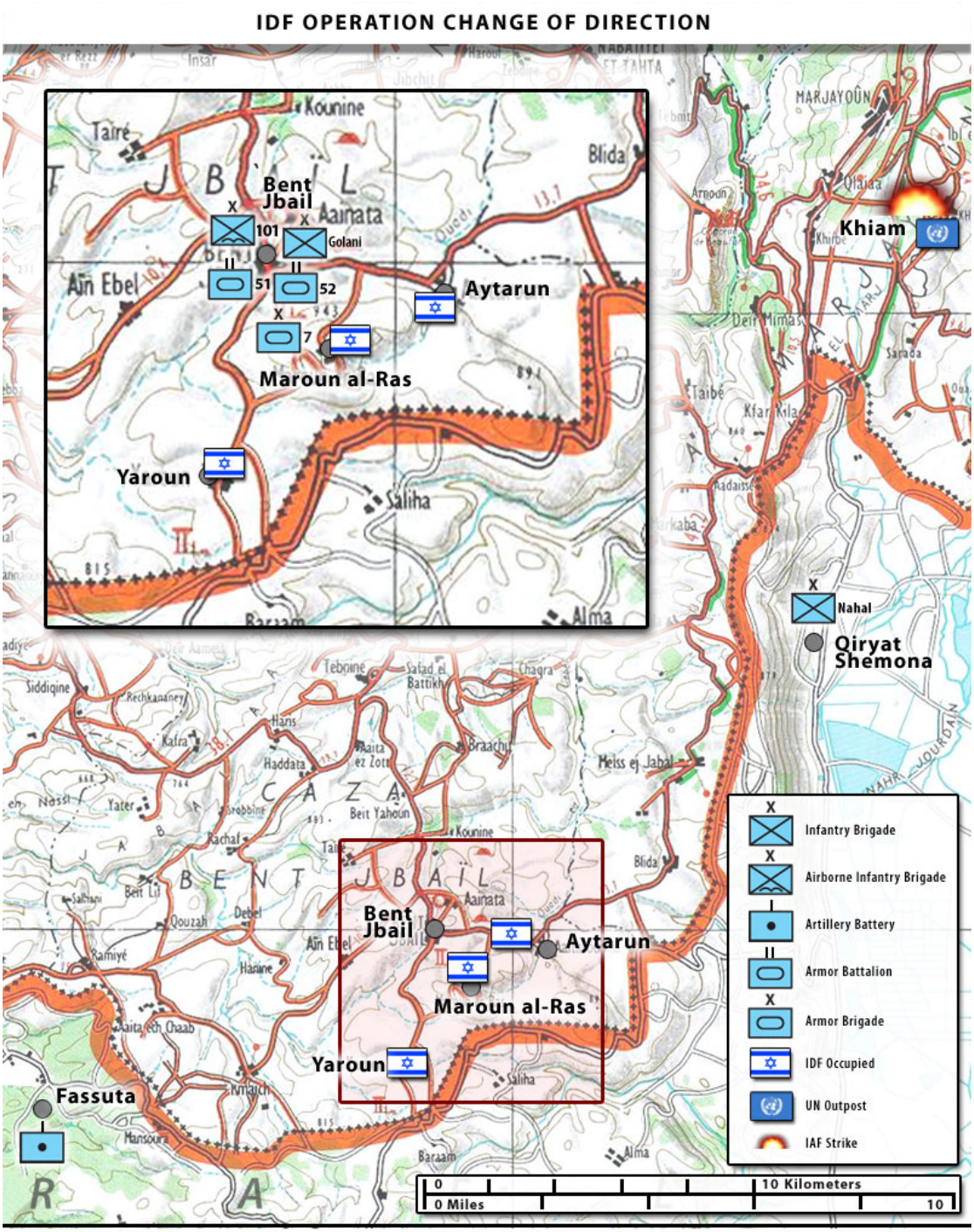


This map gives a general indication of different types of targets attacked by bombs or missiles during the 2006 conflict. These may help to indicate the types of weapons most likely to have been used by the IDF.

High value targets - bridges, airport, and industrial or energy targets plus suspected Hizballah centres or bunkers (high rise buildings in Beirut, schools and mosques) were hit with large, hard target guided bombs and/or missiles, possibly 1 in 3 with incendiary warheads - see page 33.

Technical targets e.g. navigation and communications sites, plus vehicles (buses, trucks, ambulances, cars) were likely to be hit by small or medium sized missiles - also see page 33.
Low value targets like roads were likely to be hit by conventional HE bombs and shells.

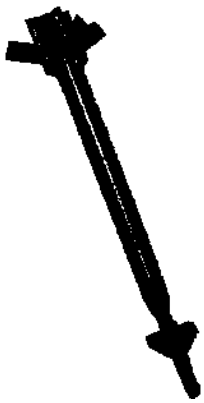
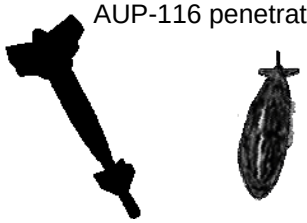
Source: http://www.samidoun.org/?q=taxonomy/term/69+70/0 - map archives



This is an example of daily IDF operations maps by Stratfor. Published 26 July it showed the Khiam strikes on 25 August during which 4 UN Personnel were killed. Map online at:
http://www.lib.utexas.edu/maps/mideast_war_2006.html

Figure 1: Hard target guided weapons in 2006: guided bombs & missiles with "dense metal" warheads. (Sources: FAS & Global Security, updated 2006)

Warhead weight

SMART or GUIDED BOMBS	kg	lbs	CRUISE, GUIDED & PORTABLE MISSILES
GBU-28, EGBU-28 & GBU-37) > 2 ton Bunker Busters (BLU-113 / AUP-113 / BLU-122) Advanced Unitary Penetrators 	2000	4400	
		4000	
	1500		
		3000	
	1000		
GBU-15, GBU-24, GBU 27, GBU-31 JDAM > (BLU-109/B, BLU-118/B TB fill AUP-116 penetrators) 	900	2000	**AGM-130C** (boosted GBU-15 +AUP-116) < **AGM-118/B** (AUP-116 + TB fill) 
			AGM-86D CALCM (AUP3M 1200 lb) 
		1200	**AGM-158 JASSM** (AUP) **BGM-109 Tactical Tomahawk** (AUP)
GBU-32, GBU-35 JDAM > (BLU-110/B, AUP) 	500	1000	**<**
		800	**< AGM-142** (I-800 AUP)
			Storm Shadow / SCALP-ER (BR)
			AGM-154C JSOW (BR)
	250	500	**< AGM-84 SLAM-ER**
Durandal Runway bombs >		300	**< AGM-65G Maverick** (S/CH)
SDB Small Diameter Bombs > (AUP)		250	**< Hellfire; Brimstone** (S/CH)
	100		" **AGM-114N** (TB)
A-10 strike 30mm x 200 rounds >	50	25	**< TOW 2 A/B** (S/CH);
		5	**< SPIKE**; **Javelin** (S/CH); **SMAW-NE** (TB)

Warhead weights include explosives (~20%) and casing. Dense metal ballast estimated 50-75% of weight. Tungsten or uranium alloys. **AUP** - Advanced penetrators. **S/CH** - Shaped Charge. **BR-** BROACH Multiple Warhead System (S/CH+AUP). **TB** = Thermobaric

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Photo credits: AFP from BBC website (2003, 2006). AP from The Independent (July, Aug 2006).
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