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CND

Information sheet 6

SIX: THE EFFECTS OF NUCLEAR WEAPONS

THE EFFECTS OF NUCLEAR WEAPONS

THE FIRST part of this fact sheet is based on an official government document, published by the HOME DEFENCE COLLEGE (Easingwold, Nr. York) and is also to be found (with much more detail) in the HMSO publication *NUCLEAR WEAPONS*.

JARGON: The discussion of the effects of nuclear bombs takes place hidden from most ordinary people by the excessive use of jargon. It is necessary to be familiar with the following terms:

GROUND BURST (GB) A nuclear explosion at street level. GB's are 'dirty' explosions pulverising and making radioactive the soil and rock at the point of impact and releasing the newly radioactive material in the characteristic mushroom cloud.

AIRBURST (AB) A nuclear explosion above the ground. Causes less radioactive fall-out but the heat and blast effects cover a wider area (the higher the explosion the larger the area effectively destroyed).

GROUND ZERO (GZ) point of impact of a GB or point directly beneath the fireball of an AB.

DESTRUCTIVE POWER OF EXPLOSIONS is measured in multiples of 1000 Tons of TNT equivalent power. 1 MEGATON (MT) = 1,000,000 tons of TNT. 1 KILOTON (KT) = 1000 tons of TNT. 1MT = 1000KT.

EXPOSURE TO RADIATION is measured in Roentgens (r). The rate at which radioactive fall-out emits radiation is measured in Roentgens per hour (rph).

THE HOME OFFICE DOCUMENT CALLED RJJT/MJW 741126 gives the following list of likely effects for explosions of varying size. The tables overleaf give details of the best and worst possibilities envisaged in the document. They can usefully be traced as a series of concentric circles on any Ordinance Survey map (given an assumed target as GZ) to illustrate the likely effects on your town.

10MT Air Burst

DISTANCE FROM GZ	DAMAGE*	BURNS**	FIRE ZONE
0 – 0.25 miles	Category A	Third Degree 100%	Fire ball
0.25 – 0.5	Category A	Third Degree 100%	Fire ball
0.5 – 1	Category A	Third Degree 100%	Fire ball
1 – 2	Category A	Third Degree 80%	Fire ball
2 – 3	Category A-B	Third Degree 50%	Fire ball
3 – 4	Category B-A	Third Degree 50%	Fire Storm
4 – 5	Category B	Third Degree 25%	Fire Storm
5 – 6	Category C	Third Degree 0%	Fire Storm
6 – 7	Category C	Third Degree	Main fire area
7 – 8	Category C	Third Degree	Main fire area
9 – 10	Category C	Third Degree	Main fire area
10 – 12	Category C	Third Degree	Main fire area
12 – 15	Category C-D	Third Degree	Many fires
15 – 20	Category D	Second Degree	Isolated fires
20 – 25	Slight	Second Degree	Some fires
25 and over	Slight	First Degree	Slight

20KT Ground Burst

	DAMAGE	BURNS	FIRE ZONE
0 – 0.25	Category A	Third Degree	Main fire zone
0.25 – 0.5	Category A	Third Degree	Main fire zone
0.5 – 1	Category B	Second Degree	Main fire zone
1 – 2	Category C	First Degree	Isolated fires
2 – 3	Category D	Slight	Some fires
3 – 4	Slight	None	Slight
4 – 5	Slight	None	None
6 – 7	Slight	None	

NOTES: (*) DAMAGE: 'BLAST damage to average British Houses and blockage to streets.' (**) BURNS 'People exposed in the open'. Figures refer to 'survivors'. Figures in brackets refer to expected fatalities (based on NUCLEAR WEAPONS, HMSO 1956) caused by *immediate* radiation released by the EXPLOSION (more fatalities occur in the outlying areas as a result of fall-out in the following days, weeks, years). Burns figures DO NOT include those burned by the fire-storm (building on fire etc) – only the heat wave of the explosion.

DAMAGE CATEGORIES

A Houses totally destroyed, streets impassable.
B Houses irreparably damaged, streets blocked.
C Houses severely damaged, streets difficult to move along.
D Houses lightly damaged. Some streets open, flying glass and roof tiles.

BURNS

Third degree: charring of exposed skin.
Second degree: blistering of the skin.
First degree: reddening of the skin.

FALLOUT

The level of fallout produced by a nuclear explosion depends on the size of the bomb and the type of ground which it falls on. Hard rock produces a different kind of fallout to soft clay and sand. The area covered depends on the wind direction and weather conditions.

In typical British weather, the fallout plume from a 10 MT bomb would cover an area of about 1000 sq. miles stretching up to 70 miles from GZ. Heavier fallout (lumps of rock and clay lifted by the heat of the firestorm) would come down within a matter of hours, nearest GZ. Finely pulverised radioactive dust would come down more slowly and evenly – all of it highly radioactive, covering the largest area.

EXPOSURE TO RADIOACTIVE FALLOUT (likely effects)

Dose in rads(cf)
Up to 150 No acute effects, but increasingly dangerous over time.
150 to 250 Serious illness, incapacity after 2 days.
250 to 350 Serious illness after 4 hours. Most will die after two weeks.
350 to 600 Serious illness after 2 hours. Most will die after 2 weeks. Survivors will not fully recover.
Over 600 Serious illness after 1 hour. Certain death after 1 week.

Some doctors say these HOME OFFICE estimates understate the dangers of exposure to radiation.

THE EFFECTS OF NUCLEAR WEAPONS ON PEOPLE AND PROPERTY

How do we know what will happen?

In theory, we can calculate all these effects for a weapon if we know its size. In practice, there is some uncertainty. This is because calculations are based on three separate sets of facts:

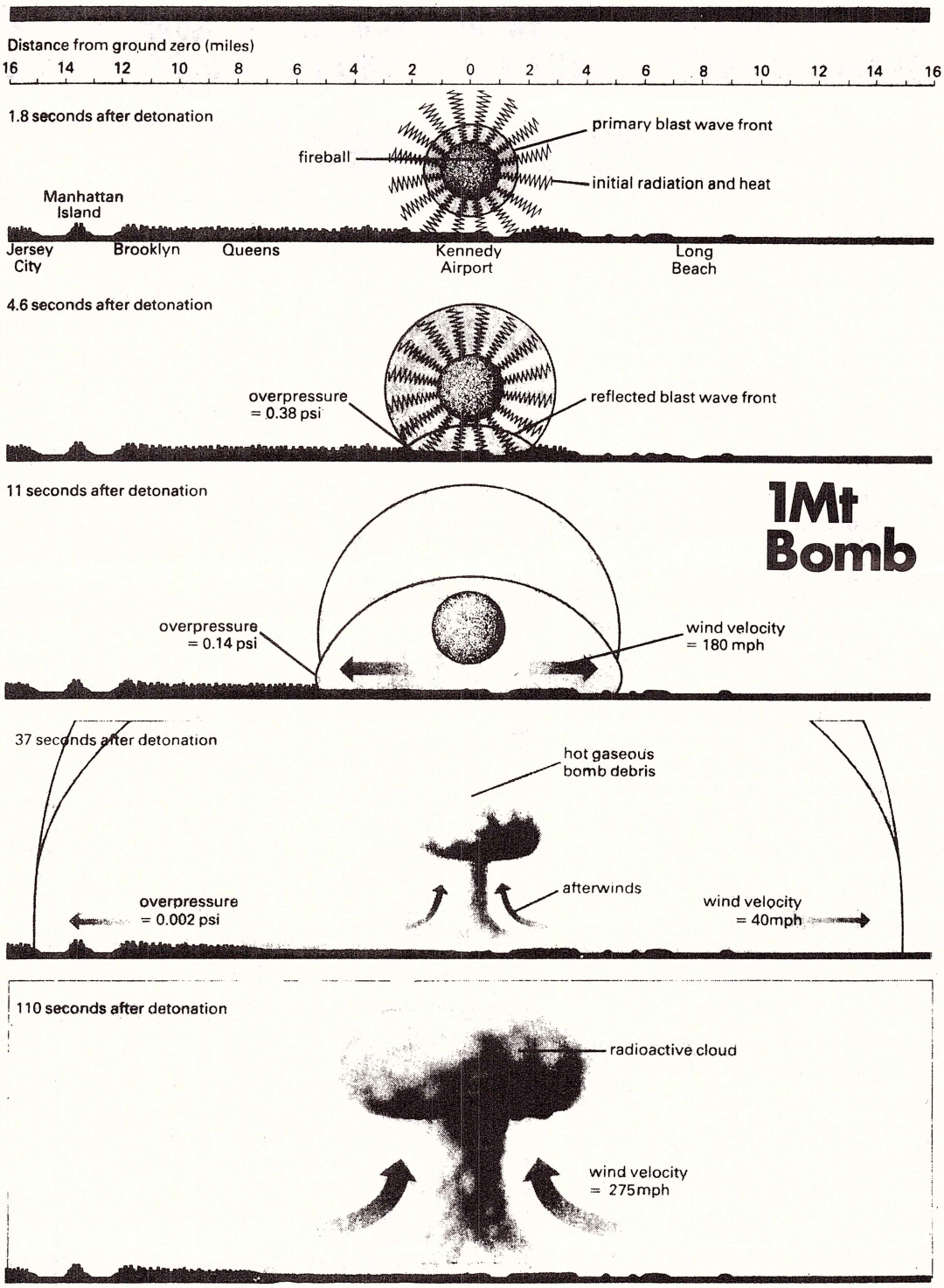
(a) what is known about the effects of conventional explosives. especially from World War II;

(b) what is known from the explosions at Hiroshima and Nagasaki;

(c) experiments and measurements made at atmospheric tests between 1945 and 1963.

But (a) the blast-wave from nuclear explosions is much longer and has greater effects than a blast-wave of the same pressure from a conventional explosive weapon, so World War II experience is not directly relevant; (b) the size of the weapons used at Hiroshima and Nagasaki is not precisely known (estimates vary between 10 and 20 KT), and they were fission weapons (A-bombs) whereas modern nuclear weapons are fusion weapons (H-bombs); (c) the effects of these weapons vary in any case depending on whether they are detonated on or near the ground (*groundburst*) or high up (*airburst*), on the precise type of nuclear device used, and on the weather conditions at the time.

In particular, estimates given of rough casualty figures cannot be more than guesses. Often they are based on what happened in the last war; but there it was unusual for many targets to be attacked at once, and so unaffected areas could help with rescue and medical services. Moreover, the people involved had had time to build up experience and preparedness. Estimates which are often used today that 'only' 20, 30 or 40% of those in the range of immediate effects of nuclear weapons would be killed *may well be far too low.*



The following table gives a rough idea of the *areas in square miles* over which three particular effects of *airburst* weapons occur (the figures are based on S. Glasstone (ed.), *The Effects of Nuclear Weapons*):

Size of weapon	*Initial radiation* greater than 50% chance of death from initial radiation	*Heat* second-degree burns or worse to people in open	*Blast* destruction of or severe damage to houses
10 kilotons	2	6	6
100 kilotons	4	20	25
1 megaton	7	314	129
10 megatons	16	1660	590

(The figures for heat and blast should be reduced by 40-50% for a groundburst weapon.)

Note that, although each weapon in the table has ten times the yield (explosive power) of the weapon in the row above it, the figures for all the areas affected do not increase by a factor of ten. Note also that, *for all weapons of 10 kilotons and over, heat and blast have a far wider range than initial radiation*; this applies to all warheads likely to be used in an attack on this country.

Effects on people

LIGHT – will cause a few minutes blinding in most cases, and possibly permanent eye damage to those looking at the explosion when it occurs (the energy produces is so great and rapid that blinking will not protect). Flashblindness will reduce the chances of survival e.g. from fire or collapsing property.

HEAT – *direct* exposure will cause burns to the skin and hair; these, if extensive, will lead to dehydration, shock and death, especially if untreated. The heat has little power to penetrate walls, and *direct* burns can be avoided by sheltering; its main effect is likely to be through fires (see below).

INITIAL RADIATION – this consists mainly of neutrons and gamma rays and, since people near enough to the explosion to receive a lethal dose will certainly be killed by blast and/or heat anyway, is not of great significance (except in the case of a neutron bomb). It will reduce the very limited chances of survival in the wider zone of fire and blast damage. Many survivors of the other immediate effects will have received *sublethal doses* of initial radiation – doses not high enough to kill, but high enough to affect health (see below under fallout).

BLAST – people are resistant to quite high levels of blast. Within the lethal radius for blast, other effects like heat and radiation are also fatal. Most fatalities from blast outside the directly lethal radius come from flying debris or from injuries received through being knocked over or into things.

FALLOUT (delayed radiation) – the radiation from fallout is fatal if received in high enough doses, and below that level will seriously affect health and resistance to disease. There is some difference between the effects of a large dose received in a very short time and the effects of the same total dose received over a much longer time and hence less intensely; the effects are less, though not much, in the latter case. Fallout is mainly a problem with groundburst weapons. In the case of airbursts the fallout comes largely from the weapon itself, enters into the upper atmostphere, and descends to earth over a long period. With groundbursts, fallout consists not only of bomb debris but also of materials made radioactive by contact with the fireball; the particles of fallout from a groundburst weapon appear as a fine dust, which starts to fall around the site of an explosion within about half-an-hour, and is spread to the surrounding area by the wind, mostly falling within the first two days.

How widely distributed and how intense the radioactivity would be would depend on the size of the weapon and the speed of the wind; but in the case of a single 1 megaton groundburst with a steady 15 mph wind blowing, these levels would be reached or exceeded over a two week period in a cigar-shaped area about 5-8 miles wide and 50-60 miles long stretching downwind from the point of the explosion.

Radiation, whether it kills or not, damages the body in a number of ways:

The *immediate effects* are to stop the cells working properly, so that supplies of food and oxygen don't reach the body system; and to cause cells to slow down or stop in reproducing themselves. This effect is particularly damaging in the case of those body cells which have a fast turnover, such as the blood, skin and membranes (e.g. in the nose, lungs and digestive system); In the *long term* radiation will cause cells to reproduce themselves too fast, or in a damaged form (i.e. *cancer and tumours* – the commonest forms of these are leukaemia and eye cataract); and there are also genetic effects such as sterility and deformed babies.

The immediate effects are the most important. In fatal cases, the first symptoms are headache, nausea, dizziness and frequent vomiting, then acute diarrhoea and fatigue. This lasts several days and is followed by apparent recovery. But two or three weeks later the symptoms return, together with internal haemorrhaging. Breathing becomes difficult, hair falls out, sores appear under and on the skin; there is fever, total fatigue and finally death. Radiation causes death through acute anaemia and ulcers in the digetive system, leading to gangrene and peritonitis, usually within a few weeks. Where the dose is not fatal, the effects may still be serious; the skin and blood will not function normally as a defence against infection, and anaemia and other side-effects of radiation will lower strength and resistance to infection.

Most fallout decays rapidly, so that the level is down to 10% of the original level after about 7 hours, 1% after about 2 days, and 0.1% after about two weeks. Even so, the levels in affected areas will still be far higher than those regarded as 'safe' in peacetime conditions for months and even years after the attack. There will also be three long-term problems:

(a) atmospheric fallout – fine radioactive dust and radioactive gases which can be breathed in and absorbed into body tissues;

(b) radioactive contamination of water supplies;

(c) radioactivity in food chains: some common components of fallout are elements chemically similar to important elements in food and body chemistry and would tend to build up the in the body. Small amounts of radioactivity taker into the body have a far greater effect than equivalent amounts present in the surrounding environment.

Effects on property

The immediate effects on property are through fire and blast, though the initial radiation will leave the worst affected areas radioactive, possibly for some time. Ordinary houses simply collapse above a certain pressure (usually said to be about 5-6 pounds per square inch above normal atmospheric pressure). Beyond the zone in which this happens, there will still be severe damage, making houses unsafe and preventing their giving much shelter against fall-out or further attacks;. Even beyond the zone of severe damage, windows will still be broken – flying glass was one of the main sources of injury and death in the bombing attacks of World War II. The blast from a 1 megaton airburst is enough to shatter windows 12-15 miles from ground zero (the point on the ground immediately below the explosion). Fire will also be a risk beyond the zone of blast destruction and severe

damage. In certain conditions there may be 'fire-storms' – this happens where the heat from a large number of fires causes air to rise fast enough to suck in air at ground level and feed the fire. Even those sheltering in undamaged cellars or shelters will suffocate because of the resulting lack of oxygen, as happened in the Hamburg fire-storm in World War II. Death and complete destruction of property are virtually certain within the area of a fire-storm.

The effects on property other than houses are less certain. Some things, like railways, bridges and powerlines were found in World War II to be fairly resistant to blast and fire, and to be easily repairable. This does not mean that it would be possible to repair them either quickly or effectively after a nuclear war, when many of the skills and equipment needed to repair them will have been destroyed or be inaccessible.

ELECTRICITY SUPPLIES are vulnerable. Nuclear power stations are likely targets; there will be difficulties in supplying all power stations with fuel; the electromagnetic pulse will damage switchgear and other control mechanisms.

GAS PRODUCTION is also vulnerable, for similar reasons. Even where storage facilities for gas remain intact, it will not be possible to restore supplies until broken gas-mains have been sealed off or repaired. Broken gas mains and furnaces will add to the 'fire-storm' caused by the heat of a nuclear bomb in a built-up area.

> 'For planning purposes it may be assumed that, after a nuclear attack, all energy production and supply would soon cease . . . ' (Annexe to Home Office Circular ES 5/1976)

WATER SUPPLY AND PURIFICATION depends in most parts of Britain on electricity. Except for those who have access to wells, there will be little in the way of clean and uncontaminated water beyond what they have been able to store in their homes. Water-mains are also likely to be broken in areas of blast, and will need to be sealed off from the system before supplies can be got going again.

SEWAGE DISPOSAL AND TREATMENT also depend on the supply of electricity.

> 'the breakdown of these services, on which most of the public unquestionably rely, would be inevitable over much of the country. Water would not flow from the tap or into the sewage system. Electricity would be cut off, refuse collection would cease. Large numbers of casualties would lie where they died.' (Annexe to Home Office Circular ES 8/1976)

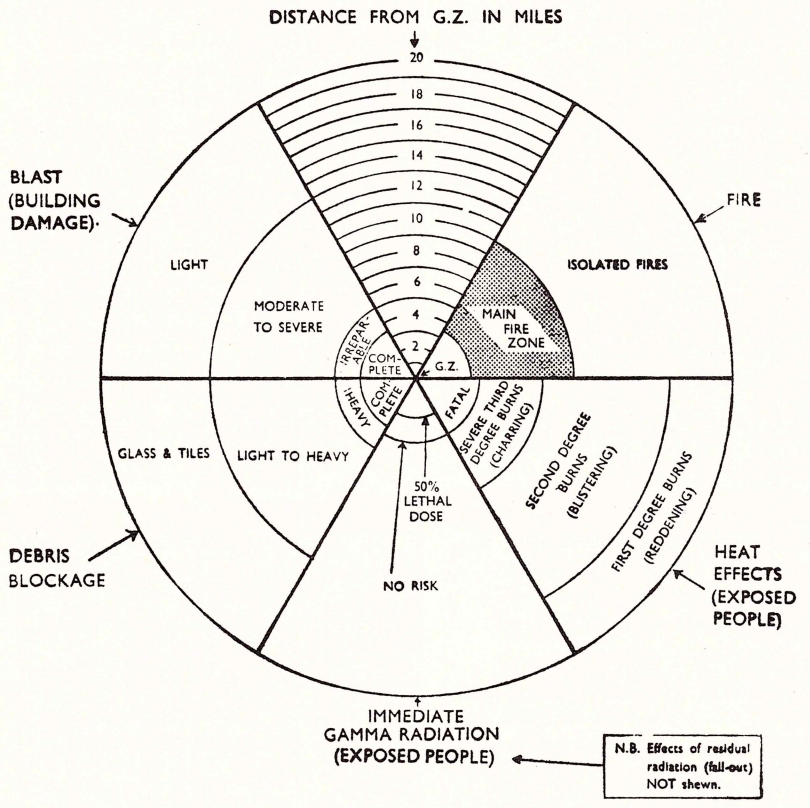
ROAD TRANSPORT will be very restricted if not non-existent: vehicles are vulnerable to heat (petrol-tanks), as are fuel supplies (*including farm animals*) and birds in very high proportions. Insects and other pests are much more resistant to radiation, and will survive and subsequently increase.

FOOD SUPPLIES will be very restricted. Existing stocks held in warehouses will be available for use, *provided that they can be decontaminated and transported.* But much of the food we eat is imported, and much of it is also processed in factories which require supplies of electricity and water – supplies that are likely to have broken down (see above.)

> 'After nuclear attack food would be scarce . . . for planning purposes it should be assumed that no significant food imports would be received for some time . . . peacetime systems of food processing and distribution would cease to function . . . no arrangements could ensure that every surviving household would have, say, 14 days supply of food after attack.' (Annexe to Home Office Circular ES 1/1979)

ALL FORMS OF COMMUNICATION USING ELECTRICITY – telephones, radio and television – will be damaged by the electromagnetic pulse, unless precautions are taken to shield them.

This fact sheet gives an idea of what the effects of a nuclear war would be. For further information about what civil defence measures are possible against nuclear attacks, and what civil defence is actually being planned, see CND fact sheet **ONE** 'THE MYTH OF CIVIL DEFENCE'.



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***Based on factsheets produced by Exeter Campaign for Nuclear Disarmament.**

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