civil defense
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A DIGEST OF TECHNICAL INFORMATION

BLAST DAMAGE FROM NUCLEAR WEAPONS OF LARGER SIZES

This bulletin makes available to State and local civil defense directors, without the necessity of detailed calculations, rough estimates of the blast damage from larger nuclear weapons at various distances from ground zero. These blast damage radii vary roughly with the cube-root of the energy release of the bomb.

The graph in figure 1, with a horizontal scale of "bomb size" and a vertical scale of "GZ (ground zero) distance," shows the limits of the blast damage zones for A-, B-, C- and D-damage as defined in table 1.[1]

Determining the Blast Damage Zone

To estimate the damage at a particular distance from a bomb burst of any size, mark on the graph a point horizontally across from its "GZ distance" on the vertical scale and vertically above the "bomb size" on the horizontal scale. This will show the blast damage zone, in terms of A-, B-, C-, or D-damage in which the point lies.

Estimates of Damage

With this information one can refer to the blast damage zone columns in the table showing the degrees of damage which may be expected for each of the 17 items. Principal among these is item (1), which is a typical urban complex of buildings. With A-damage the buildings are virtually destroyed, with B-damage they have to be demolished, with C-damage they have to be vacated for repairs, whereas with D-damage the repairs can be accomplished while the buildings are in use.

The Scales in the Graph

To give about the same reading accuracy on a percentage basis for bombs of all sizes, as well as to reduce the curves

[1]See Civil Defense Urban Analysis, TM—8—1, FCDA, (OCDM), pp. 14, 15.

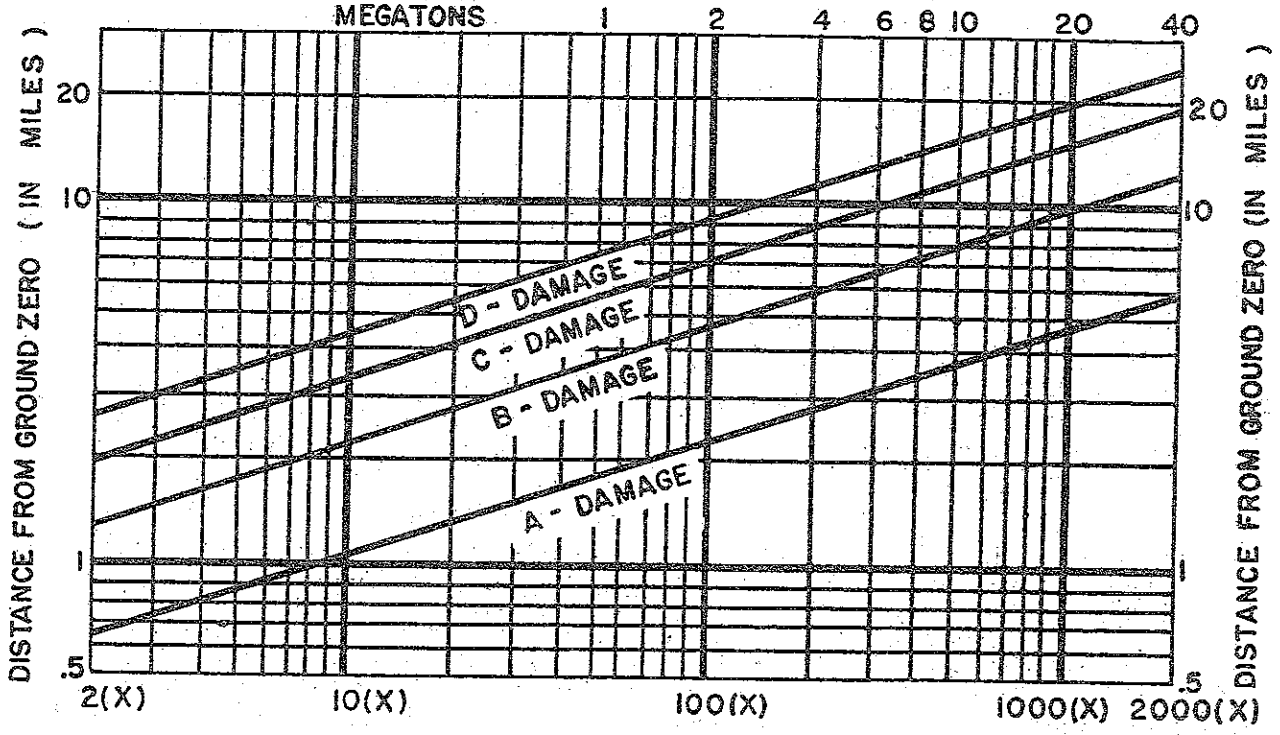

Figure 1.—Blast damage radii for nuclear weapons.

of blast damage zone limits to the form of simple straight lines, the scales of GZ distance and of bomb size have been suitably adjusted. The divisions of the scales are not all of uniform length, but this imposes no difficulty in their use. To get the 700(X) point on the bomb size scale count off 6 spaces from 100(X) in the 100(X) to 1000(X) interval. To get the megaton equivalent, count off 6 spaces of 2 MT each from 2 MT for a 14 MT or 700(X) bomb. Similarly, to fix a GZ distance of 9 miles, count up 8 spaces in the 1 mile to 10 mile interval on the vertical scale.

Limitations

A bomb burst height of 2,000 feet was assumed for the 1(X) bomb with scaling by the simple cube-root law. In theory this would require burst heights to be similarly scaled, but this probably would indicate unreasonably great burst heights for bombs in the metagon range. Damage depends not only on blast pressure but also upon blast duration (which also scales with the cube-root law), although no allowance is included here for blast duration effect. Because

Table 1.—*Blast damage by nuclear bomb—air burst*

No.	Item	Zone of A-damage	Zone of B-damage	Zone of C-damage	Zone of D-damage
	(*a*) Ordinary buildings—typical urban complex for American cities.	Virtually completely destroyed.	Severely damaged or destroyed; buildings must be torn down.	Moderately or severely damaged; moderately damaged buildings must be vacated for repairs.	Partially damaged; buildings need not be vacated during repairs.
1	(*b*) Reinforced-concrete or steel-frame buildings.	Buildings standing but most masonry panel walls and non-load-bearing partitions probably destroyed or displaced.	Buildings standing but many masonry panel walls and non-load-bearing partitions probably destroyed or displaced.	Interiors moderately damaged.	Interiors slightly damaged.
2	Highways and streets	Impassable	Impassable	Many parts blocked by rubble and require clearing before use.	Some parts blocked by rubble and require clearing before use.
3	Elevated roads and short span bridges.	Some destroyed; approaches blocked; decks of steel-plate girder bridges may shift laterally.	Some severely damaged; bridge approaches blocked by rubble and disabled vehicles.	Moderately damaged; approaches blocked; generally usable.	Partially damaged but probably usable.
4	Vehicles: aubomobiles, busses, trolleys, trucks, etc.	Vehicles unusable	Vehicles generally unusable.	Some vehicles unusable	Most vehicles usable.
5	Railroad yards and tracks.	Some tracks blocked by damaged rolling stock and rubble.	Some tracks blocked by damaged rolling stock and rubble.	Some tracks blocked by damaged rolling stock and rubble.	Some tracks blocked by damaged rolling stock and rubble.
6	Water mains	Some mains broken especially at ground zero and on bridges.	Not damaged except on bridges.	Not damaged	Not damaged.
7	Water pipes in buildings.	Numerous breaks causing loss of pressure.	Numerous breaks causing loss of pressure.	A few breaks causing loss of pressure	No breaks.
8	Elevated water tanks and towers.	Mostly destroyed or damaged beyond use, some substantial water towers may be usable.	Mostly destroyed or damaged beyond use; some substantial water towers may be usable.	Tanks supported by frames may fall.	Partially damaged but probably usable.
9	Sewers and storm sewers.	Some mains broken especially at ground zero.	Not damaged	Not damaged	Not damaged.
10	Large fuel gas storage tanks.	Destroyed	Probably destroyed	Possibly destroyed	Not damaged.
11	Gas mains	Some mains broken especially at ground zero and on bridges.	Not damaged except on bridges.	Not damaged	Not damaged.
12	Gas pipe in buildings	Numerous breaks	Numerous breaks	A few breaks	Probably no breaks.
13	Above ground oil storage tanks.	Mostly destroyed or damaged beyond use.	Mostly destroyed or damaged beyond use.	Partially damaged; not ruptured.	Partially damaged; not ruptured.
14	Overhead electric power lines-poles, wire, and transformers.	Destroyed	Destroyed or severely damaged	Poles, mostly usable; wires, broken by falling or flying objects; transformers, short-circuited.	Poles, mostly intact; wires, broken by falling or flying objects; transformers, may be short-circuited.
15	Underground electric power lines.	Intact except where join overhead lines or enter transformer or power stations; some may be short-circuited if conduits flood.	Intact except where join overhead lines or enter transformer or power stations; some may be short-circuited if conduits flood.	Not damaged; some may be short circuited if conduits flood.	Not damaged; some may be short circuited if conduits flood.
16	Telephone poles and overhead wires.	Destroyed	Destroyed or severely damaged.	Poles, mostly usable; wires, broken by falling or flying objects.	Poles, mostly intact; wires, broken by falling or flying objects.
17	Radio and TV towers	Destroyed	Some destroyed	Some destroyed	Partially damaged but may be operable.

we do not know what size bomb an enemy might use, these errors do not seem critical to civil defense planning. With these errors in it the making of the graph much larger and more finely subdivided would be undesirable and unjustified because such a larger graph would appear to be much more accurate than it actually is and would probably be misleading.

The graph refers simply to blast damage and does not include effects of thermal or of nuclear radiation of any sort. It also disregards the effect of distant radioactive fallout. While the graph covers a range of bomb sizes between 2(X) and 2,000(X), this is no indication that bombs which may be dropped will be of sizes between those limits, nor even that this upper limit will be closely approached, nor that any particular burst-height relation will be used by the enemy.

Recommended Policy

Although various other bomb size estimates have been made by individual writers, State and local civil defense officials should base their planning on the bomb size estimates consistent with current OCDM planning assumptions.

Familiarization

Each civil defense director should familiarize himself with the use of this graph by working out practical examples. By applying the information in it to selected points in critical target areas, he can estimate the damage which would be caused by a nuclear bombing attack of types described in OCDM planning assumptions. (See FCDA (OCDM) Advisory Bulletin 204.)

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