CHRONOLOGICAL DEVELOPMENT OF UNDERGROUND BURST

100 KILOTON SHALLOW UNDERGROUND BURST--2 SECONDS

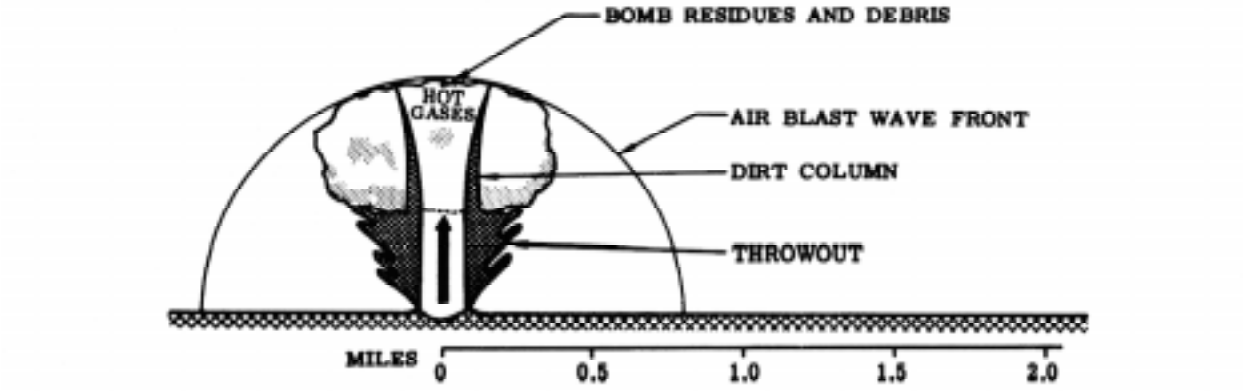

Figure 2.93a. Chronological development of a 100-kiloton shallow underground burst: 2.0 seconds after detonation.

When a nuclear explosion occurs at a shallow depth underground, the fireball breaks through the surface of the earth within a fraction of a second of the instant of detonation. The intensely hot gases at high pressure are released and they carry up with them into the air large quantities of soil, rock, and debris in the form of a hollow column. For a burst at a shallow depth, the column tends to assume the shape of an inverted cone which fans out as it rises, to produce a radial throw-out. A highly radioactive cloud, which contains large quantities of earth, is formed above the throw-out as the hot vapors cool and condense. Because of the mass displacement of material from the earth's surface, a crater is formed. For a 100-kiloton weapon exploding 50 feet beneath the surface of dry soil, the crater would be about 120 feet deep and 720 feet across. The weight of the material removed would be over a million tons.

In addition to the shock (or pressure) wave in the ground, somewhat related to an earthquake wave, the explosion is accompanied by a blast wave in the air. At 2 seconds after the explosion, the blast wave front in air is about 3/4 mile from surface zero.

100 KILOTON SHALLOW UNDERGROUND BURST--9 SECONDS

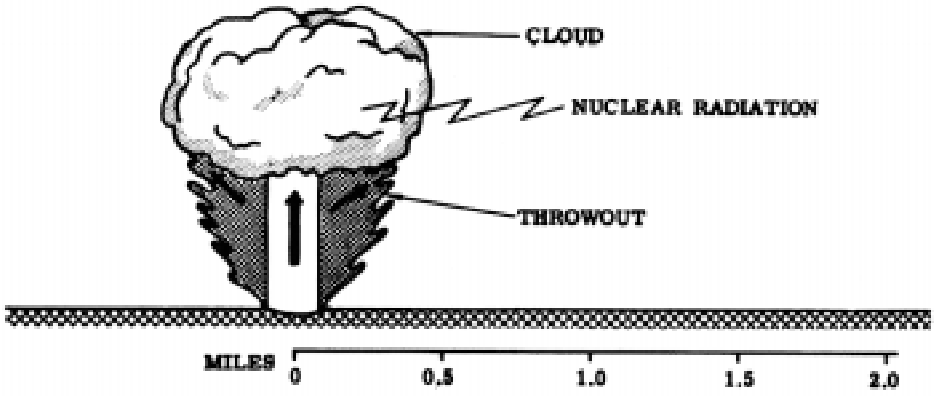

Figure 2.93b. Chronological development of a 100-kiloton shallow underground burst: 9.0 seconds after detonation.

The radioactive cloud continues to rise, giving off intense nuclear radiations which are still a hazard on the ground at 9 seconds after the detonation. At this time, the larger pieces of rock and debris in the throw-out begin to descend to earth.

100 KILOTON *SHALLOW UNDERGROUND BURST--45 SECONDS*

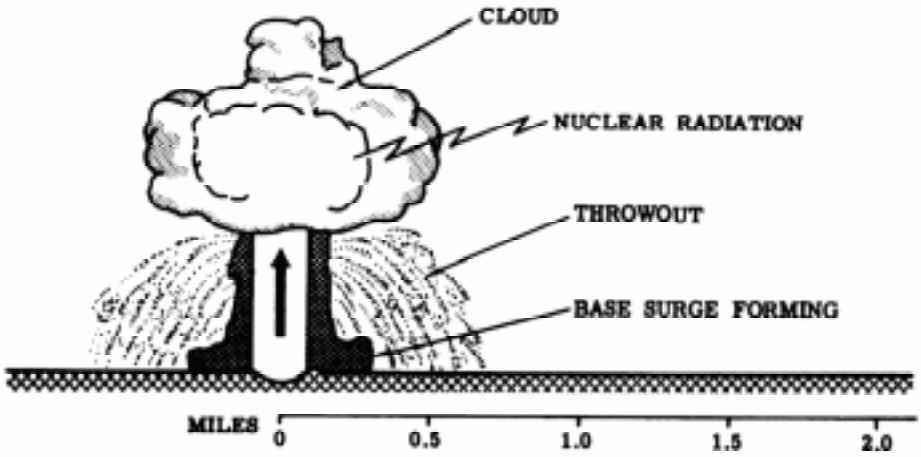

Figure 2.93c. Chronological development of a 100-kiloton shallow underground burst: 45 seconds after detonation.

As the material from the column descends, the finer soil particles attain a high velocity and upon reaching the ground they spread out rapidly to form a base surge similar to that in an underwater explosion. The extent of the base surge, which is likely to be radioactive, depends upon many factors, including the energy yield of the explosion, the depth of burst, and the nature of the soil. It is believed that a dry sandy terrain would be particularly conducive to base surge formation.

100 KILOTON SHALLOW UNDERGROUND BURST--4.5 MINUTES

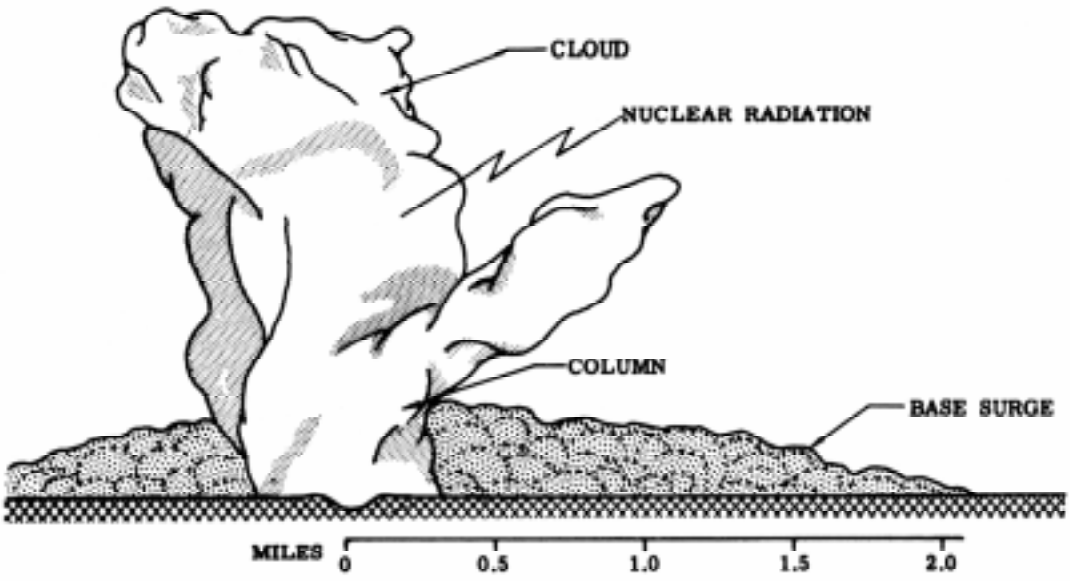

Figure 2.93d. Chronological development of a 100-kiloton shallow underground burst: 4.5 minutes after detonation.

The base surge increases in height and area and soon begins to merge with the radioactive cloud of weapon residues, etc., part of which descends and spreads out under the influence of the prevailing winds. In due course, the radioactive clouds disperse, but the contaminated particles descend to earth to produce a hazardous fallout over a large area, especially in the downwind direction, during the course of a few hours.

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