Survival 101-Fallout Fundamentals
Courtesy Ken Seger's BBS
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Fallout consists of dust particles that have been coated with radioactive by-products from atomic explosions. This occurs when the nuclear or atomic blast is a ground rather than air-burst (air-burst meaning that the fireball is far enough from the earth's surface that there is no ground material uptake into the high temperature portion of the mushroom cloud). In an air-burst the particles condensate into such very small particles that they are aloft for such a long time that they are most non-radioactive by the time they come down. The fission process gives off dozens of different radioactive elements and isotopes. The fussion portion of nuclear bombs is clean and gives off only helium, the atomic bomb trigger (fission) which starts the nuclear bomb (fussion) is the portion of the bomb that leaves radioactive by-products.

These by-products can be classified by their characteristics. One characteristic is half-life. The half-life is the length of time it takes for a given quanity of an element to give off one-half of its radioactivity. An unstable isotope only emits radioactivity when one atom decays to another isotope or element (which may or not be stable, stable being non-radioactive). Therefore the portions of the element that are not decaying are not giving off any radioactivity. If you have Avagadro's number of atoms (1 mole) of a radioactive element if you have a short half-life like Iodine 131 of 8 days most of the radioactivity (99+%) will be emitted in two months. In a long half-life like plutonium 239 of 24,400 years 1 mole the amount would be less than 4/1,00th of 1%.

Another characteristic is the type of radiation given off, Alpha, Beta, Gamma, or neutron radiation. Alpha radiation (helium nucleus, 2 protrons and 2 neutrons) , like from plutonium, can be shielded with one layer of Cellophane or newspaper or several inches of air. Beta radiation(an electron) can be shielded say a layer of drywall, or several feet of air. Gamma radiation is electromagnetic radiation. Neutron radiation is a neutron. Gamma and neutron are harder to stop, you need several feet of dirt or concrete to absorb them.

One factor that most people don't realize about fallout is how fast it decays. Fallout follows the t-1.2 law which states that for every sevenfold increase in time since detonation there is a tenfold drop in radiation output.

This is accurate for 2,500 hours following the explosion, thereafter the dose is lower than t-1.2 would predict. Example, if a dose rate of 100 REM/hr was found at 1 hour after detonation(this assumes all significant fallout from the bomb has fallen, therefore starting with the seven hour point is probably more realistic) would be 10 REM/hr at 7 hours, 1 REM/hr at 49 hours(~2 days), .1 REM/hr at 343 hours(~2 weeks), .01 REM/hr at 2401 hours (14 weeks). A "survival safe" dose of radiation (this being defined as no short term effects or disability) is 3 to 12 Rads/day. This would occur (assume 6 Rads/day) in this example at 150 hours for 24 hour exposure, or 49 hours for a 6 hours per day outside of shelter. If you increase the radiation by a factor of 10 for another example where you would have 1,000 Rem/hr at 1 hr, 100 Rem/hr at 7 hrs. , 1 Rem/hr at 343 hrs., .1 Rem/hr at 2401 hrs. the 24 hour exposure would be at 1,000 hours(41 days) and 6 hour work day outside of shelter at 300 hours(12 days).

For shelter from Gamma radiation the standard rule of thumb is 150 pounds of mass per square foot of cross section of shelter wall yields a protection factor of 40. This means if you had two shelters on a flat contaminated field one had walls of one layer of cellophane and the other of walls and ceiling of something that had for its thickness 150 lbs/sq. ft.(note this would be a thickness of 2.5" of lead, 4" of steel, 12" of concrete, 18" of soil, 30" of water, 200' of air) you would recieve 1/40th the dose in the 150 lb/sq.ft. walled shelter. This effect can be multiplied. If the sq. ft. cross section was 300 lbs. that would be 1/40th of 1/40th or 1/1,600th of a dose.

Take for example a dose rate starting at 100 Rem/hr at 1 hr.,1 Rem/hr at 49 hours, etc. If exposure started at 1 hour the total dose would be 240 R in 1 day, 310 R in 1 week, 350 R in 4 weeks. The same in a PF 40 shelter would be 6 R in 1 day, 7.7 R in 1 week, 8.7 R in 4 weeks.

Another example with a dose rate starting at 1,000 Rem/hr at 1 hr., 10 Rem/hr at 49 hours, etc. If exposure started at 1 hour the total dose would be 2,400 R in 1 day, 3,100 R in 1 week, 3,500 R in 4 weeks, 3,900 R in 15 weeks. This in a 40 PF shelter would be 60 R in 1 day, 77 R in a week, 87 R in 4 weeks. In a 1,600 PF shelter this would be 1.5 R in 1 day, about 2 R in 2 weeks, about 2.5 R in 15 weeks.