

STS 152: Nuclear Weapons, Risk and Hope

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Handout #1, September 21, 2010

Reading for next class

Read these notes. Unless otherwise noted, links to other resources are optional.

Read “[Soaring, Cryptography and Nuclear Weapons](#).” That article was written two years ago and needs an update that will be provided later. It takes 10-15 minutes to read.

Optional (5 minutes): Read my web site’s [home page](#).

Required: Watch the video on that page “[Attack on Pelindaba](#).” (12:43)

Notes for first class meeting, September 20, 2010

This first class meeting summarizes what we will cover in regard to the two basic questions we will address in this seminar:

How great is the risk of relying on nuclear weapons?

Is there any hope of reducing that risk?

Risk in turn has two components:

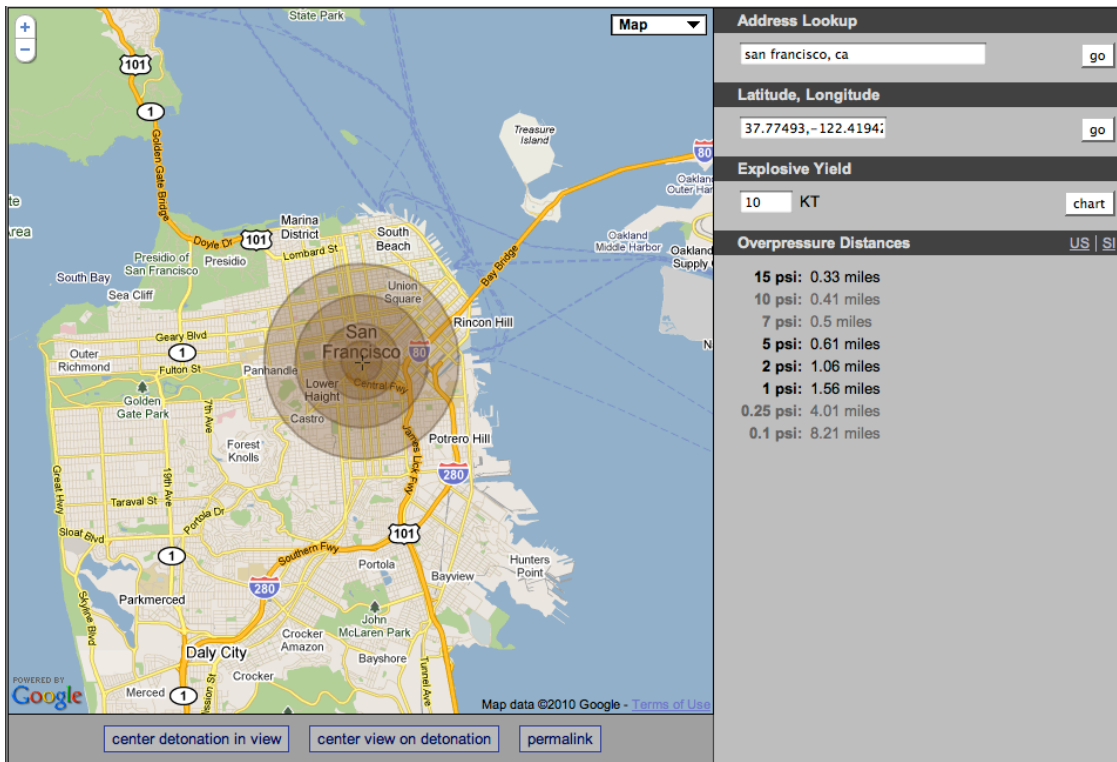
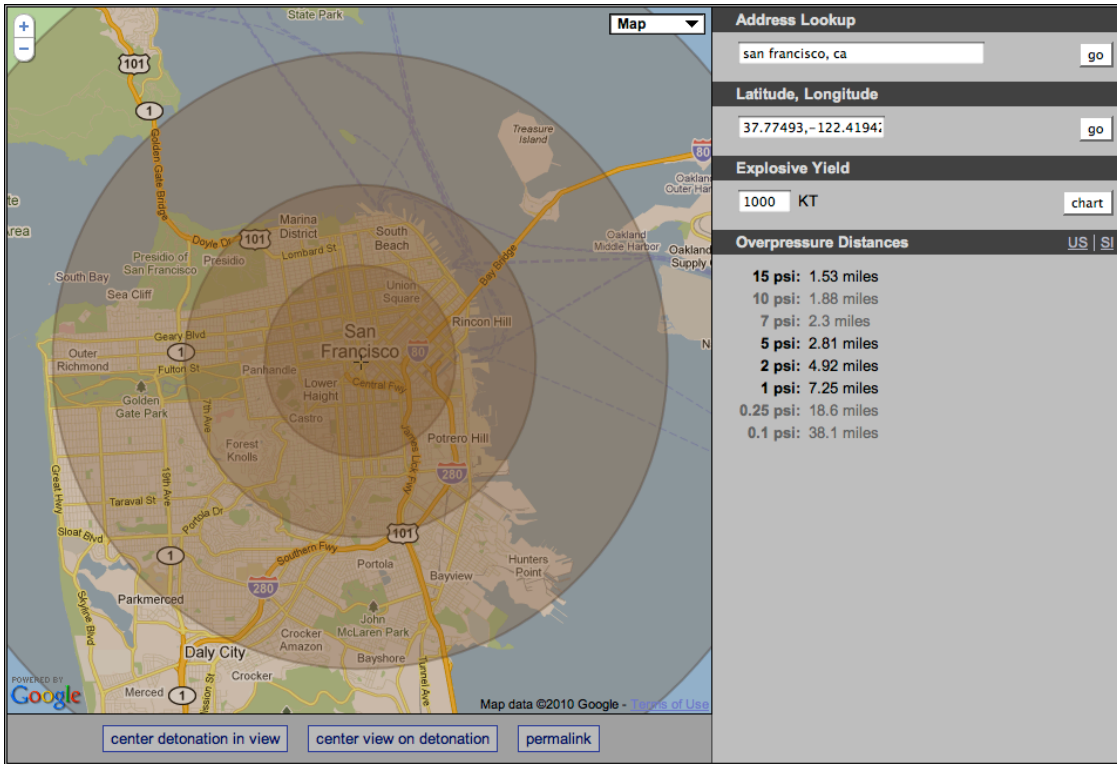
How destructive are nuclear weapons?

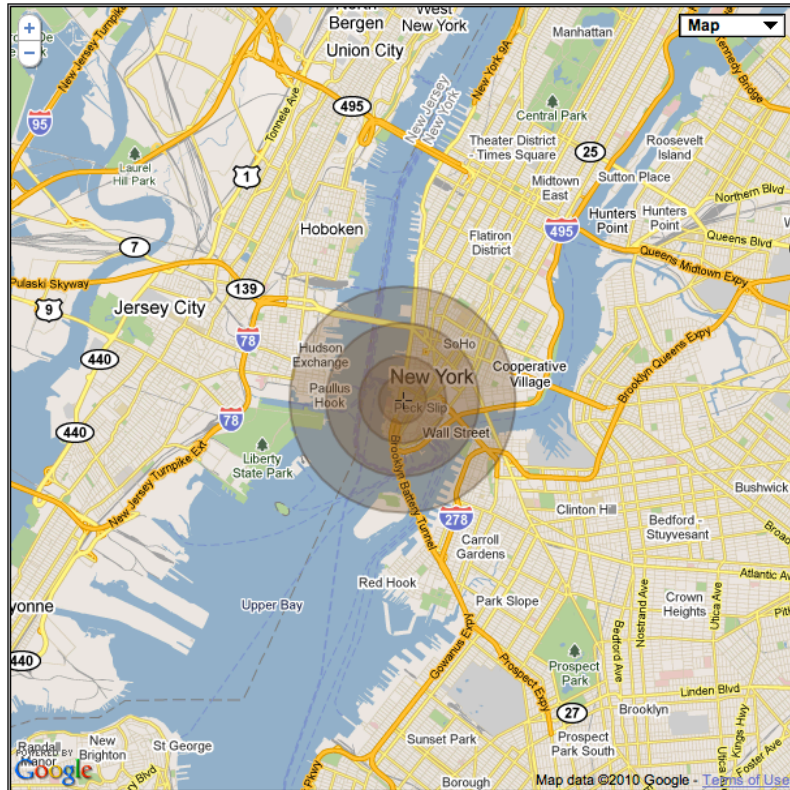
How likely is it that they will be used?

This class meeting focused on the question, “How destructive are nuclear weapons?”

How destructive are nuclear weapons?

There is an [online tool](#) for seeing the damage that would occur for different size detonations on different locations. The ones I showed in class are on the next pages. The innermost circle shows 15 psi overpressure, causing complete destruction even of reinforced concrete structures, such as skyscrapers. The second circle shows 5 psi overpressure, causing complete destruction of ordinary houses. The third circle shows 2 psi overpressure, enough to cause severe damage to ordinary houses, and light to moderate damage to reinforced concrete structures. The fourth circle (which extends almost to the limits of the first picture, so look carefully) shows 1 psi overpressure, which will cause light damage to all structures, and light to moderate damage to





Address Lookup

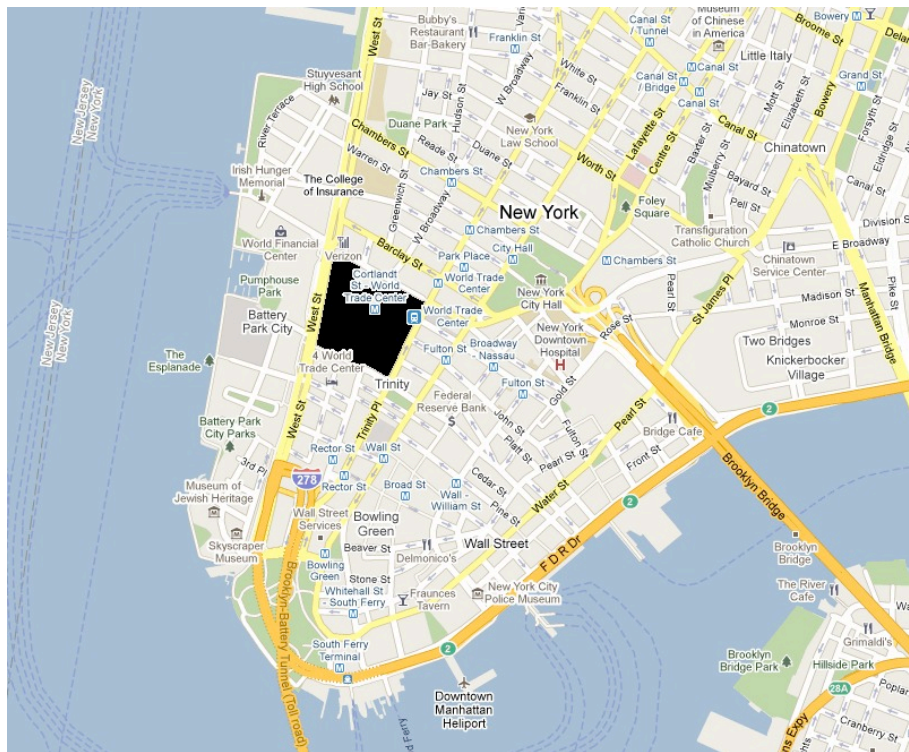
Latitude, Longitude

Explosive Yield

Overpressure Distances [US](#) | [SI](#)

- 15 psi: 0.33 miles
- 10 psi: 0.41 miles
- 7 psi: 0.5 miles
- 5 psi: 0.61 miles
- 2 psi: 1.06 miles
- 1 psi: 1.56 miles
- 0.25 psi: 4.01 miles
- 0.1 psi: 8.21 miles

[center detonation in view](#) [center view on detonation](#) [permalink](#)



ordinary houses. To put “light damage” in context, only 0.25 psi overpressure is required to shatter most glass surfaces, such as windows, some with enough force to cause injury. The fourth picture (the second one on page 3) shows the extent of the damage caused by the terrorist attacks of 9/11. While the 1 megaton blast makes the 10 kiloton ones look small, they are still huge compared to the damage caused by the 9/11 attacks (the black area on that picture).

Terrorists probably would detonate a weapon at a more central location, such as Grand Central Station, wreaking even more havoc. By way of comparison, the weapon used on Hiroshima had a yield of approximately 15 kilotons, in the same ballpark as the *smaller* weapons shown above. On this and the next page are two pictures showing the physical and human devastation wreaked by that one, relatively primitive weapon (Tibbetts piloted the plane that dropped the bomb).





What is hard to comprehend is that so much destruction can be wrought by a relatively small device. While the Hiroshima bomb was much larger, over time we learned how to miniaturize these weapons to the point that by the late 1950's they were "suitcased" sized as shown in this picture of the Davy Crockett nuclear gun.



A [short video](#) of an above ground nuclear test adds another perspective and is required “reading.”

All of the above was focused on a single nuclear detonation, as in a terrorist attack. If India and Pakistan were to use even their relatively small arsenals (about 150 weapons in total) in a war, recent research has indicated the possibility of a nuclear Autumn, in which the firestorms caused in those nations’ megacities would put massive amounts of smoke into the stratosphere, where it would remain for years. (More normal fires don’t reach that altitude and their smoke dissipates much more rapidly.) Computer modeling estimated a billion deaths worldwide due to starvation as agriculture collapsed due to the reduced sunlight reaching the earth. While this was a model and could overlook factors that would change the results, prudence would seem to dictate paying more attention to this threat and trying to reduce its risk.

A full-scale nuclear war is almost beyond imagination and conjures up mythic analogies. In a 1961 speech to a Joint Session of the Philippine Congress, General Douglas MacArthur, stated, “Global war has become a Frankenstein to destroy both sides. ... If you lose, you are annihilated. If you win, you stand only to lose. No longer does it possess even the chance of the winner of a duel. It contains now only the germs of double suicide.”

In 1986, former Secretary of Defense Robert McNamara expressed a similar view: “If deterrence fails and conflict develops, the present U.S. and NATO strategy carries with it a high risk that Western civilization will be destroyed” [McNamara 1986, page 6]. In January 2007, George Shultz, William Perry, Henry Kissinger and Sam Nunn echoed those concerns when they quoted President Reagan’s belief that nuclear weapons were “totally irrational, totally inhumane, good for nothing but killing, possibly destructive of life on earth and civilization.” [Shultz 2007]

DoD and related studies, while couched in less emotional terms, still convey the horrendous toll that a full-scale nuclear war would exact: “The resulting deaths would be far beyond any precedent. Executive branch calculations show a range of U.S. deaths from 35 to 77 percent (i.e., from 79 million to 160 million dead) ... a change in targeting could kill somewhere between 20 million and 30 million additional people on each side ... These calculations reflect only deaths during the first 30 days. Additional millions would be injured, and many would eventually die from lack of adequate medical care ... millions of people might starve or freeze during the following winter, but it is not possible to estimate how many. ... further millions ... might eventually die of latent radiation effects.” [OTA 1979, page 8]

The same 1979 OTA report also noted the possibility of serious ecological damage [OTA 1979, page 9], a concern that assumed a new potentiality when the “TTAPS Report” [TTAPS 1983] noted that the ash and dust from so many nearly simultaneous nuclear explosions and their resultant firestorms might usher in a “nuclear winter” that could erase *homo sapiens* from the face of the earth, much as many scientists now believe the dinosaurs were wiped out by an “impact winter” caused by ash and dust from an asteroid impacting the Earth 65 million years ago. The TTAPS report produced a heated debate, and there is still no scientific consensus on whether a nuclear winter would follow a full-scale nuclear war.

In summary, a full-scale nuclear war would almost surely destroy civilization, and there a possibility that no human beings would survive.

References

[McNamara 1986]: Robert S. McNamara, *Blundering Into Disaster*, Pantheon Books, New York, 1986.

[OTA 1979]: Office of Technology Assessment, "The Effects of Nuclear War," May 1979. Available from NTIS, order #PB-296946. Also accessible [online](#).

[Shultz 2007]: George Shultz, William Perry, Henry Kissinger, and Sam Nunn, "A World Free of Nuclear Weapons," *The Wall Street Journal*, January 4, 2007, Page A15. Accessible [online](#).

[TTAPS 1983]: Turco, R.P., Toon, A.B., Ackerman, T.P., Pollack, J.B., and Sagan, C., "Nuclear Winter: Global Atmospheric Consequences of Nuclear War," *Science*, vol. 222, 1983.