**Consequences of Nuclear Conflicts**

The Natural Resources Defense Council (NRDC) has nuclear experts evaluate the unthinkable, using state-of-the-art nuclear war simulation software for assessing crisis in case of nuclear attack and fallout. The following scenario is derived from such a simulation.

The months-long military standoff between India and Pakistan intensified several weeks ago when suspected Islamic militants killed more than 30 people at an Indian base in the disputed territory of Kashmir. As U.S. diplomatic pressure to avert war intensifies, Secretary of Defense Donald Rumsfeld is going to India and Pakistan this week to discuss with his South Asian counterparts the results of a classified Pentagon study that concludes that a nuclear war between these countries could result in 12 million deaths.

Prior to this recent crisis two nuclear scenarios were calculated. The first assumes 10 Hiroshima-sized explosions with no fallout; the second assumes 24 nuclear explosions with significant radioactive fallout. Below is the account of the two scenarios in detail and an exploration of several additional issues regarding nuclear war in South Asia.

**Indian and Pakistani Nuclear Forces**

It is difficult to determine the actual size and composition of India's and Pakistan's nuclear arsenals, but NRDC estimates that both countries have a total of 50 to 75 weapons. Contrary to the conventional wisdom, we believe India has about 30 to 35 nuclear warheads, slightly fewer than Pakistan, which may have as many as 48.

Both countries have fission weapons, similar to the early designs developed by the United States in the late 1940s and early 1950s. NRDC estimates their explosive yields are 5 to 25 kilotons (1 kiloton is equivalent to 1,000 tons of TNT). By comparison, the yield of the weapon the United States exploded over Hiroshima was 15 kilotons, while the bomb exploded over Nagasaki was 21 kilotons. According to a recent NRDC discussion with a senior Pakistani military official, Pakistan's main nuclear weapons are mounted on missiles. India's nuclear weapons are reportedly gravity bombs deployed on fighter aircraft.

NRDC's Nuclear Program initially developed the software used to calculate the consequences of a South Asian nuclear war to examine and analyze the U.S. nuclear war planning process. We combined Department of Energy and Department of Defense computer codes with meteorological and demographic data to model what would happen in various kinds of attacks using different types of weapons. The June 2001 report, ‘The U.S. Nuclear War Plan: A Time for Change,’ is available at http://www.nrdc.org/nuclear/warplan/index.asp.

**Scenario 1: 10 Bombs on 10 South Asian Cities**

The first scenario uses casualty data from the Hiroshima bomb to estimate what would happen if bombs exploded over 10 large South Asian cities: five in India and five in Pakistan. (The results were published in ‘The Risks and Consequences of Nuclear War in South Asia,’ by NRDC physicist Matthew McKinzie and Princeton scientists Zia Mian, A. H. Nayyar and M. V. Ramana, a chapter in Smitu Kothari and Zia Mian (editors), "Out of the Nuclear Shadow" (Dehli: Lokayan and Rainbow Publishers, 2001).)

The 15-kiloton yield of the Hiroshima weapon is approximately the size of the weapons now in the Indian and Pakistani nuclear arsenals. The deaths and severe injuries experienced at Hiroshima were mainly a function of how far people were from ground zero. Other factors included whether people were in buildings or outdoors, the structural characteristics of the buildings themselves, and the age and health of the victims at the time of the attack; the closer to ground zero, the higher fatality rate. Further away there were fewer fatalities and larger numbers of injuries. The table below summarizes the first nuclear war scenario by superimposing the Hiroshima data onto five Indian and five Pakistan cities with densely concentrated populations.

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| **Estimated nuclear casualties for attacks on 10 large Indian and Pakistani cities** | | | | |
| City Name | Total Population Within 5 Kilometers of Ground Zero | Number of Persons Killed | Number of Persons Severely Injured | Number of Persons Slightly Injured |
| **India** | | | | |
| Bangalore | 3,077,937 | 314,978 | 175,136 | 411,336 |
| Bombay | 3,143,284 | 477,713 | 228,648 | 476,633 |
| Calcutta | 3,520,344 | 357,202 | 198,218 | 466,336 |
| Madras | 3,252,628 | 364,291 | 196,226 | 448,948 |
| New Delhi | 1,638,744 | 176,518 | 94,231 | 217,853 |
| Total India | 14,632,937 | 1,690,702 | 892,459 | 2,021,106 |
| **Pakistan** | | | | |
| Faisalabad | 2,376,478 | 336,239 | 174,351 | 373,967 |
| Islamabad | 798,583 | 154,067 | 66,744 | 129,935 |
| Karachi | 1,962,458 | 239,643 | 126,810 | 283,290 |
| Lahore | 2,682,092 | 258,139 | 149,649 | 354,095 |
| Rawalpindi | 1,589,828 | 183,791 | 96,846 | 220,585 |
| Total Pakistan | 9,409,439 | 1,171,879 | 614,400 | 1,361,872 |
| **India and Pakistan** | | | | |
| Total | 24,042,376 | 2,862,581 | 1,506,859 | 3,382,978 |

As in the case of bombs dropped on Hiroshima and Nagasaki, in this scenario the 10 bombs over Indian and Pakistani cities would be exploded in the air, which maximized blast damage and fire but creates no fallout. On August 6, 1945, the United States exploded an untested uranium-235 gun-assembly bomb, nicknamed ‘Little Boy,’ 1,900 feet above Hiroshima. The city was home to an estimated 350,000 people; about 140,000 died by the end of the year. Three days later, at 11:02 am, the United States exploded a plutonium implosion bomb nicknamed ‘Fat Man’ 1,650 feet above Nagasaki. About 70,000 of the estimated 270,000 residents died by the end of the year.

Ten Hiroshima-size explosions over 10 major cities in India and Pakistan would kill as many as three to four times more people per bomb than in Japan because of the higher urban densities in Indian and Pakistani cities.

**Scenario 2: 24 Ground Bursts**

In January, NRDC calculated the consequences of a much more severe nuclear exchange between India and Pakistan. This scenario calculated the consequences of 24 nuclear explosions detonated on the ground -- unlike the Hiroshima airburst -- resulting in significant amounts of lethal radioactive fallout.

Exploding a nuclear bomb above the ground does not produce fallout. For example, the United States detonated ‘Little Boy’ weapon above Hiroshima at an altitude of 1,900 feet. At this height, the radioactive particles produced in the explosion were small and light enough to rise into the upper atmosphere, where they were carried by the prevailing winds. Days to weeks later, after the radioactive bomb debris became less ‘hot,’ these tiny particles descended to earth as a measurable radioactive residue, but not at levels of contamination that would cause immediate radiation sickness or death.

Unfortunately, it is easier to fuse a nuclear weapon to detonate on impact than it is to detonate it in the air -- and that means fallout. If the nuclear explosion takes place at or near the surface of the earth, the nuclear fireball would gouge out material and mix it with the radioactive bomb debris, producing heavier radioactive particles. These heavier particles would begin to drift back to earth within minutes or hours after the explosion, producing potentially lethal levels of nuclear fallout out to tens or hundreds of kilometers from ground zero. The precise levels depend on the explosive yield of the weapon and the prevailing winds.

For the second scenario, the fallout patterns and casualties were calculated for a hypothetical nuclear exchange between India and Pakistan in which each country targeted major cities. Targets chosen were cities throughout Pakistan and in northwestern India to take into account the limited range of Pakistani missiles or aircraft. The target cities, listed in the table below, include the capitals of Islamabad and New Delhi, and large cities, such as Karachi and Bombay. In this scenario, we assumed that a dozen, 25-kiloton warheads would be detonated as ground bursts in Pakistan and another dozen in India, producing substantial fallout.

The devastation resulting from fallout would exceed that of blast and fire. NRDC's second scenario would produce far more horrific results than the first scenario because there would be more weapons, higher yields, and extensive fallout. In some large cities, we assumed more than one bomb would be used.

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| --- | --- | --- | --- |
| **15 Indian and Pakistani cities attacked with 24 nuclear warheads** | | | |
| **Country** | **City** | **City Population** | **Number of Attacking Bombs** |
| Pakistan | Islamabad (national capital) | 100-250 thousand | 1 |
| Pakistan | Karachi (provincial capital) | > 5 million | 3 |
| Pakistan | Lahore (provincial capital) | 1-5 million | 2 |
| Pakistan | Peshawar (provincial capital) | 0.5-1 million | 1 |
| Pakistan | Quetta (provincial capital) | 250-500 thousand | 1 |
| Pakistan | Faisalabad | 1-5 million | 2 |
| Pakistan | Hyderabad | 0.5-1 million | 1 |
| Pakistan | Rawalpindi | 0.5-1 million | 1 |
| India | New Dehli (national capital) | 250-500 thousand | 1 |
| India | Bombay (provincial capital) | > 5 million | 3 |
| India | Delhi (provincial capital) | > 5 million | 3 |
| India | Jaipur (provincial capital) | 1-5 million | 2 |
| India | Bhopal (provincial capital) | 1-5 million | 1 |
| India | Ahmadabad | 1-5 million | 1 |
| India | Pune | 1-5 million | 1 |

NRDC calculated that 22.1 million people in India and Pakistan would be exposed to lethal radiation doses of 600 rem or more in the first two days after the attack. Another 8 million people would receive a radiation dose of 100 to 600 rem, causing severe radiation sickness and potentially death, especially for the very young, old or infirm. NRDC calculates that as many as 30 million people would be threatened by the fallout from the attack, roughly divided between the two countries.

Besides fallout, blast and fire would cause substantial destruction within roughly a mile-and-a-half of the bomb craters. NRDC estimates that 8.1 million people live within this radius of destruction.

Most Indians (99 percent of the population) and Pakistanis (93 percent of the population) would survive the second scenario. Their respective military forces would still be intact to continue and even escalate the conflict.

**Thinking the Unthinkable**

After India and Pakistan held nuclear tests in 1998, experts have debated whether their nuclear weapons contribute to stability in South Asia. Experts who argue that the nuclear standoff promotes stability have pointed to the U.S. - Soviet Union Cold War as an example of how deterrence ensures military restraint.

NRDC disagrees. There are major differences between the Cold War and the current South Asian crisis. Unlike the U.S.-Soviet experience, these two countries have a deep-seated hatred of one another and have fought three wars since both countries became independent. At least part of the current crisis may be seen as Hindu nationalism versus Muslim fundamentalism.

A second difference is India and Pakistan's nuclear arsenals are much smaller than those of the United States and Russia. The U.S. and Russian arsenals truly represent the capability to destroy each other's society beyond recovery. While the two South Asia scenarios we have described produce unimaginable loss of life and destruction, they do not reach the level of "mutual assured destruction" that stood as the ultimate deterrent during the Cold War.

The two South Asian scenarios assume nuclear attacks against cities. During the early Cold War period this was the deterrent strategy of the United States and the Soviet Union. But as both countries introduced technological improvements into their arsenals, they pursued other strategies, targeting each other's nuclear forces, conventional military forces, industry and leadership. India and Pakistan may include these types of targets in their current military planning. For example, attacking large dams with nuclear weapons could result in massive disruption, economic consequences and casualties. Concentrations of military forces and facilities may provide tempting targets as well.