VI. HUMAN CASUALTIES

"One can categorize the casualties from military strikes against Iran's nuclear facilities into three groups of victims. The first group would be those exposed to the physical and thermal impact of the blasts. The second group would be those exposed to the chemical consequences of the military strikes, primarily due to release of lethal chemical compounds, toxic plumes and dusts. A third group would be those exposed to the radiological consequences of military strikes, more specifically, should operational nuclear reactors be targeted."

CIVILIAN CASUALTIES

Figure 39: Chernobyl Victims after thyroid cancer surgery (Photo: Gerd Ludwig, National Geographic)

Isfahan:

The probability of an attack on the Isfahan Uranium Conversion Facility is high. Among the 2,000 workers we estimate 1,000 casualties resulting from a military strike. In addition, the casualties resulting from exposure to toxic plumes could range between 5,000-70,000.

Natanz:

The probability of an attack on a Natanz is high. With 2,000 total workers onsite, we estimate 1,000 casualties resulting from a strike. In addition, the casualties from toxic plumes in the Natanz rural region could range between 1,700-7,000 people.

Arak:

The likelihood of an attack against this facility is high. We estimate 500 onsite casualties. Additional casualties would be of serious concern should and if the Heavy Water Reactor becomes operational for an extended length of time prior to strikes. Such events would result in the release of fissile and transuranic materials with both short-term and chronic radiation complications effecting Khondab, the small town with 72,000 residents within 3.4 km of the site. We estimate casualties from exposure to radiation at between 500 and 3,600 people.

Bushehr:

We predict 3,000 casualties at the site in the event of an attack. With prevailing winds in the area blowing Northwest toward Bushehr, a city with a population of 240,000 just 10 km away, an attack against the Bushehr nuclear power plant could potentially expose this population to dangerous radiation pollution. If only 1-5% of the population of Bushehr get exposed to radiation, the casualties can range between 2,400 to 12,000 people.

Beyond Iran, strikes against Bushehr could potentially wreak havoc on the Arabian side of the Persian Gulf coast, where countries like Kuwait, Saudi Arabia and the United Arab Emirates rely heavily on sea water desalination, a process extremely susceptible to and unprotected against radiation pollution.

Totals: Physical, Chemical and Radiological Exposures

5,500 people would be killed or injured from the direct impact of the bombing of the four sites.

5,000 to 70,000 people in Natanz and Isfahan could be killed or injured as a result of exposure to toxic plumes.

3,000 to 15,000 people in Bushehr and Arak, after the heavy water reactor is operational, could be killed or injured as a result of exposure to radiation.

Total Casualties:

Total casualties at all four sites could range from 5,500 to 85,000.

Other Casualties: Beyond casualty rates among those close to specific nuclear sites, there are professions and populations that would be particularly vulnerable in the event of military strikes. Although we have not included them in our estimates, these groups deserve as much consideration as the inhabitants of Isfahan, Natanz, Arak, and Bushehr, since they will assume a disproportionate share of the risks associated with the destruction of Iran's nuclear program.

MILITARY PERSONNEL

As with the Iran-Iraq war, it is almost certain that a high percentage of soldiers near these highly contaminated combat zones will develop symptoms from exposure to the cocktail of complex toxins and radioactive agents released from the smoldering sites. Although the Iranian government has not published any estimates on the impact of nuclear attacks on Iran's nuclear sites on the military or developed the medical infrastructure to treat soldiers in the aftermath of exposure to what amounts to nuclear folly, it is certain that casualty rates among Iran's armed forces and Revolutionary Guards will be exceptionally high. As with the veterans of the Iran-Iraq war, the Arab-Israeli wars, and the Gulf wars, it is soldiers who will absorb the brunt of any attack on Iran's nuclear sites as well as the burden of civil defense, while policymakers gamble with their lives from safe bunkers.

Figure 40: Iran-Iraq War: Victim of Chemical Warfare (Photo: www.iranvision.com)

Even in situations where there is a great level of protection, casualty rates among soldiers and first responders can be exceptionally high. For example, according to the U.S. Department of Veterans Affairs, at least one-fourth of the 697,000 veterans who served in the Gulf War suffer from a complex of concurrent symptoms. These range from persistent memory and concentration problems to chronic headaches, widespread pain, gastrointestinal problems, and other abnormalities that have persisted for 17 years.[155] This should come as no surprise to Iranians, as many veterans and their families continue to suffer from the health effects and social and financial costs of the Iran-Iraq war more than 20 years later. One can assume an equally high percentage of Iranian soldiers near these highly contaminated combat zones will develop symptoms from chemical exposures. For the purposes of this study we have restricted our focus on damage to civilians, and have not attempted any estimates of the damage to Iranian, American, or Israeli armed forces.

RESCUE AND RECOVERY WORKERS

One can expect a disproportionately high level of exposure to radiation and other chemical toxins among soldiers sent into the nuclear sites to rescue, contain, seal, and recover the sacrificial zone. It is highly unlikely that the soldiers dispatched to secure the sites would have the specialized training, equipment, leadership, and coordination for nuclear disaster management. Rescue and recovery workers are the first to arrive at the scene of an attack and the last to leave it. Even absent a radiological threat, exposure to dust from a conventional attack can put their health in jeopardy. One does not need to look far to understand the threat. The 2010 annual report on 9/11-related health by the World Trade Center Medical Working Group of New York City documents the health impact the 2001 terrorist attack on the Twin Towers had on rescue and recovery workers. The group's review of nearly 250 studies published from 2001-2010 found that "thousands of individuals—including rescue, recovery, and clean-up workers and people who lived, worked or went to school in Lower Manhattan on 9/11—have developed chronic, and often co-occurring mental and physical health conditions."[156] A study of 12,781 New York fire department employees present at the World Trade Center from September 11-24, 2001, found that 18% of firefighters had lung problems in the first year after the 2001 attacks and 13% continued to have lung problems seven years after the attacks.[157] According to Philip Landrigan, dean of Global Health at Mount Sinai Medical School, their lungs aged 12 years from one week of exposure to the dust cloud.[158]

The Zadroga 9/11 Health and Compensation Act covering health care costs for 9/11 rescue workers called for the provision of $3.2 billion dollars over eight years to monitor and treat injuries stemming for exposure to toxic dust and debris at ground zero.[159] A major study conducted by the Mount Sinai Hospital World Trade Center and Screening Program, the largest of its kind, found that the 40,000 Ground Zero workers exposed to toxic dust following the al-Qaeda strikes on the Twin Towers were exposed to health problems that were "more widespread and persistent than previously thought" and "likely to linger into the future."[160] The study found that roughly 70% of the nearly 10,000 workers tested from 2002 to 2004 reported new or

155 "Gulf War Illness and the Health of Gulf War Veterans: Scientific Findings and Recommendations," Research Advisory Committee on Gulf War Veterans' Illnesses, November 2008.

156 "2010 Annual Report on 9/11 Health," World Trade Center Medical Working Group of New York City: 3, September 2010.

157 T.K. Aldrich, et al., "Lung Function in Rescue Workers at the World Trade Center," New England Journal of Medicine 362 (14):1263–1272.

158 "Nine Years Later: Health Effects in World Trade Center Responders, with Philip Landrigan, dean of Global Health at Mt. Sinai Medical School," Environmental Health Perspectives, 1 September 2010, <http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.trp090110>.

159 Raymond Hernandez, "House Passes 9/11 Health Care Bill," New York Times, 29 September 2010. Note: The bill also set up $4.2 billion dollars to reopen the Sept. 11 Victim Compensation Fund to provide compensation for any job and economic losses.

160 Anthony De Palma, "Illness Persisting in 9/11 Workers, Big Study Finds," The New York Times, 6 September 2006.

substantially worsened respiratory problems while or after working at ground zero.[161] Dr. Phillip J. Landrigan, an author of the Mount Sinai study, said that "the toxic nature of the World Trade Center dust had led doctors to conclude that there would be serious health issues for years to come, especially for workers who were exposed to the heaviest concentration in the early days of the terrorist attacks."[162] According to Landrigan, "this was extremely toxic dust" and "samples had shown it to be as caustic as drain cleaner, with innumerable shards of glass, which could get lodged in the lungs, and a stew of toxic and carcinogenic substances, like asbestos and dioxin, that could cause cancer years from now."[163]

Earth-penetrating bunker-buster bombs designed to pierce through layers of concrete and travel deep into the earth before they explode release massive amounts of toxic dust. It is estimated that more than 44 GBU-28 bunker buster bombs would be needed to ensure the destruction of Iran's underground nuclear facility at Natanz. With Natanz's surface area at approximately 646,000 square feet, the military strikes would cover a much larger surface area than that occupied by the Twin Towers with an explosive force much greater than the civilian aircraft used in 9/11. The amount of toxic dust released from an attack on the Natanz nuclear facility alone could exceed the dust released on 9/11 by a factor of 10, if not greater.

While the chemical composition of the toxic dust is much more dangerous than 9/11, the thermal impact of the bombs combined with the pulverized concrete and chemicals in the plants would guarantee the creation and release of highly toxic dust. It would be fair to assume that at least 70% of rescue and recovery workers dispatched to save the people trapped in the smoldering remains of Iran's nuclear plants would inhale dusts as caustic as drain cleaner, as well as a slew of carcinogenic substances. Like the 40,000 or so ground zero workers in New York City, they would suffer from serious respiratory, gastrointestinal, and mental health problems over the course of their lives. The difference would be that Isfahan, Natanz, Arak, and Bushehr lack the medical resources of New York City. While we are confident that tens of thousands of Iranian recovery and rescue workers — firemen, policemen, medics, and volunteers—would be exposed to toxic dust, we do not have access to reliable sources to make estimates about the number of casualties among rescue and recovery teams.

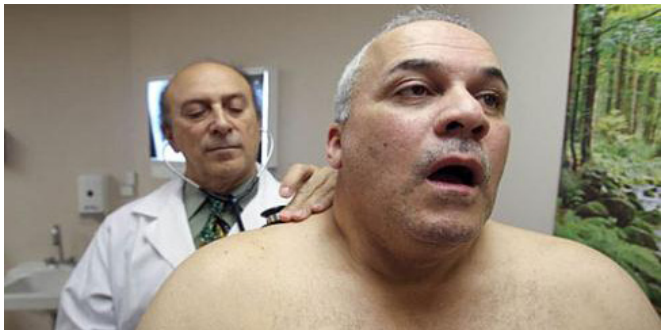

Figure 41: 911 rescue and recovery workers suffering from respiratory ailments (Photo: Time Magazine)

161 Ibid.

162 Ibid.

163 Ibid.

LIQUIDATORS AND CLEAN-UP CREWS

It is not clear whether Iran's Atomic Energy Organization has a properly trained and equipped crew to cleanup the contamination at the plants and surrounding areas in the aftermath of military strikes. Yet, as with rescue and recovery workers, in the event of an attack on Bushehr, a sizeable percentage of clean-up crews sent to Iran's nuclear sites can suffer from exposure to fallout. According to the International Atomic Energy Agency's staff report, many of the 700,000 liquidators involved in the Chernobyl clean-up, among them firefighters, soldiers, and miners, suffer from social and psychological consequences of their work. While the Chernobyl Forum—a group of specialists including representatives of the IAEA and the World Health Organization—presented a report on the health effects of the Chernobyl accident which estimated that 4,000-9,000 people died or will die from radiogenic cancer, that figure was contested by Greenpeace and others as too low.[164] The Chernobyl Union, as association of liquidators, put the death toll at 60,000 dead and 165,000 disabled liquidators. Radiobiologist Edmund Lengfelder of the University of Munich estimated the number of dead liquidators at between 50,000 to 100,000.[165] Even if one assumes that 10% of the liquidators involved in Iran's nuclear sites would die and 50% would be exposed to dangerous levels of radiation, the number of casualties among liquidators, especially at Bushehr, could be on a similar order of magnitude.

Whether it is the Iran-Iraq war, Chernobyl or Hurricane Katrina, the weaker and more marginal elements of society are those least able to escape manmade and natural disasters. Segments of the Iranian population—pregnant women, children, the elderly, the poor, as well as rural and traditional populations living close to Iran's nuclear sites—will be at greater risk than those capable of moving to safer locations. Children and the elderly have weaker and more susceptible immune systems; rural populations have inadequate access to specialized and extensive medical care, and are also more susceptible due to their greater dependence on land, agriculture, and local economies. Finally, the poorer and more traditional sectors of society have a much tougher time relocating due to constraining social, economic and cultural factors. We have not addressed the long-term costs and consequences of strikes.

PSYCHOLOGICAL CONSEQUENCES

Finally, a significant percentage of populations exposed to military strikes will suffer from psychological illnesses such as post-traumatic stress disorder (PTSD), depression, anxiety and panic attacks. Studies of 9/11 victims have found that 11% of ground zero workers had PTSD and 62% had substantial mental stress.[166] As many as 4%

164 "Chernobyl Catastrophe—Consequences on Human Health," Green Peace (study), <http://www.greenpeace.org/international/en/publications/reports/chernobylhealthreport/>.

165 Ibid.

166 Jeanne Mager Stellman, et al., "Enduring Mental Health Morbidity and Social Function Impairment in World Trade Center Rescue, Recovery and Cleanup Workers: The Psychological Dimension of an Environmental Health Disaster," Environmental Health Perspectives, Vol. 116, No. 9: 1248-1253, 2 October, 2008, <http://www.medscape.com/viewarticle/580678>.

CIVIL DEFENSE TABLE*				
Location	Isfahan	Natanz	Arak	Bushehr
Air Defense	Iran Army Air Forces, Isfahan Base. Revolutionary Guard Air Defense, 10 Sky Guards Ineffective against strikes	Iran Army Air Forces, Isfahan Base. Revolutionary Guard Air Defense, 10 Sky Guards Ineffective against strikes	Iran Army Air Forces, Isfahan Base. Revolutionary Guard Air Defense, 10 Sky Guards Ineffective against strikes	Iran Army Air Forces, First base. Planned purchase of S-300 Missiles from Russia Ineffective against strikes
Civil Defense	Capable in general, but not capable of nuclear response	Capable in general, but not capable of nuclear response	Not capable, have some logistic capacity	Near full activation
Civil Defense Budget	$20 million USD (Shared with Natanz)	$20 million USD (Shared with Isfahan)	$6 million USD	$10 million USD
Hospital Beds	5,200[171]	71[172]	1,033[173]	590[174]
Hazard Management	Poor	Poor	Poor	Moderate
Public Awareness	Poor	Poor	Poor	Poor

*Table 8: *Note: Based on best available estimates and data*

of Americans were suffering from 9/11-related post-traumatic stress disorders, including 11.2% of New Yorkers.[167] Almost half of the Latvian liquidators—the nuclear janitors and cleaners—involved in the Chernobyl clean-up had psychosomatic disorders. And a large number of people exposed to fallout developed symptoms related to the fear of contamination.[168] While we expect strikes to cause tremendous mental stress, we have not made any estimates about the psychological, emotional, or social impact of military strikes on the Iranian people. It is fair to assume that strikes would impact similar percentages, and traumatize a substantial percentage of the population.

The extent of civilian casualties from exposure to lethal chemical fumes, toxic dusts leads, depleted uranium and other radioactive material leads us to conclude that military strikes against nuclear and chemical plants can be construed as an illegal form of chemical warfare that is banned under the Geneva Conventions.. The protection of civilians in war remains one of the bedrock principles of the United Nations Charter. Eroding this norm to justify pre-emptive attacks on nuclear facilities of any state establishes a dangerous precedent that puts civilians everywhere, especially in urban areas close to nuclear facilities, at grave risk. As Mohamed El-Baradei and others have pointed out, "The need to prohibit armed attacks on all nuclear facilities and the urgency of concluding an international agreement relating thereto seems to be generally recognized."

167 Jeffrey Klurger, "Charting the Emotions of 9/11 — Minute by Minute," Time, 3 September 2010.

168 "Treatment of Nuclear and Radiological Casualties," Military Manual distributed to the departments of the Army, the Navy, the Air Force, and Commandant, Marine Corps: 95, 20 December 2001.

169 Mohamed El-Baradei, Edwin Nwogugu and John Rames, "International Law and Nuclear Energy: Overview of the Legal Framework," IAEA Bulletin, March 1995.

170 Ibid.

171 <http://mihanfa.com/culture-art/introduction-of-hospital/>< http://www.tebyan.net/newindex.aspx?pid=21821>

172 Ibid.

173 <http://www.tebyan.net/newindex.aspx?pid=38129>

174 <http://www.tebyan.net/mobile.aspx/index.aspx?pid=21824>