I will address this question first by discussing facts relative to Uranium enrichment technology, atomic bomb design and Israel’s geography and population. Second, I will of necessity provide speculation as to Iranian governance and objectives, and Israeli defenses against various modes of nuclear attack. From these remarks I expect that the reader will be able form a sound opinion on this crucial question.

Natural Uranium is .71 weight percent the readily fissionable isotope U235, a trace of the isotope U234 and the rest the fertile isotope U238. In most power reactors Uranium is enriched to 3-5% U235. The Uranium used in the Hiroshima atomic bomb was enriched to ~83% U235. The two enrichment technologies used extensively to date, gaseous diffusion and centrifuge separation, make use of the small mass difference of molecules of Uranium hexafluoride (UF6) containing U235 versus U238. The effectiveness of a particular process in transforming a mass of feed stock (UF6 gas) of a given U235 enrichment to a desired product of higher enrichment, plus tails (of lower enrichment then the feed stock), is characterized by a parameter, the Separative Work Unit (SWU). Algorithms for SWU calculation can be found on the internet (see for example the Wise Uranium Project).

Iran claims that it is pursuing centrifuge enrichment for peaceful purposes. They now are operating their first commercial nuclear power plant, Bushehr I, a 1000 megawatt electric Pressurized Water Reactor (PWR). It was built by Russia, and Russia is supplying its initial fuel loadings. For Iran to fuel Bushehr themselves they will need to produce ~30 metric tonnes (MT) of Uranium, enriched to 3.6% U235, per year. This will require enrichment facilities that can provide 133,000 SWUs per year. Given the reported range of capability of the centrifuges Iran is deploying (.7-5 SWU/yr.) it is obvious that large facilities will be required to meet a “peaceful uses” goal. As enrichment of an isotope which starts at a very low weight percent will require processing a large amount of “feed” material, it is not surprising that enrichment plants that support commercial power reactors are huge. However, if one starts with power reactor grade Uranium (e.g. 3.6%U235) the SWUs needed to get to bomb grade enrichment is much reduced. To produce the Hiroshima bomb loading, 64 Kilograms(kgs) of 83% enriched U, from natural U requires 11,320 SWUs, starting with 3.6% enriched U requires 4,054 SWUs. In this later case one would start with 1.6MT of “feed”. So clearly if Iran can construct enrichment facilities to support power reactor fueling, they can divert a modest amount of reactor grade Uranium to a fraction (~3%) of their centrifuges to rapidly produce bomb grade, highly enriched, Uranium.
Above I have referred to the bomb dropped on Hiroshima, *Little Boy*, because it is a conservative starting point for discussing what kind of nuclear weapon Iran might be able to produce with a source of highly enriched Uranium. *Little Boy* was designed without computers and with limited basic nuclear data. No prototype was tested, unlike for the Plutonium bomb, *Fat Boy*, dropped on Nagasaki. The admittedly brilliant scientists and engineers of the Manhattan Project were so confident that *Little Boy* would work that they shipped the final Uranium components to Tinian to complete its assembly. It was then loaded on the B29, *Enola Gay*, and dropped on Hiroshima with an explosive force of ~20,000 tons of TNT, annihilating this city of 350,000.

Today Iranian nuclear engineers have lap-tops more powerful than the super computers used in US weapons laboratories to design thermo-nuclear bombs. All the relevant nuclear data is available on line. Iran has highly trained nuclear engineers and others with applicable skills. Before the Iranian revolution nuclear engineering departments in the US educated many Iranians. MIT had a special arrangement providing ~40 slots per year. Since 1979, educational opportunities have continued to exist in Iran itself and in at least the EU, Russia and Pakistan.

Given Iranian talent and technology, a much more efficient (less Uranium and lighter) bomb than *Fat Boy* can be readily developed. In an enriched Uranium bomb one needs to assemble the Uranium in a *prompt super critical* (*psc*) configuration as quickly as possible. In a reactor Uranium fuel, structure and coolant are assembled to produce a sustained chain reaction, enough neutrons are released in fissions to overcome losses and continue to initiate additional fissions, all at a constant rate. Over 99% of neutrons released in fission are released instantaneously. They are referred to as *prompt* neutrons. Less than a percent of fission neutrons are released with the decay of fission products over a few milliseconds after a fission event. They are thus *delayed* neutrons. A reactor is *critical* when it can sustain a steady state chain reaction, accounting for both *prompt* and *delayed* neutrons. In a fission bomb a configuration must be obtained that yields an accelerating (*super critical*) chain reaction dependent only on *prompt* neutrons. If assembly of the “configuration” is too slow a chain reaction may start prematurely and enough fission energy could be released to disrupt the assembly process. Such a “bomb” would be referred to as “fizzle.” The second requirement for a successful fission bomb is that the *psc* configuration be maintained long enough to allow the number of fissions to take place to produce the bomb’s design yield, as noted above, for *Little Boy* the equivalent of 20,000 tons of TNT. Satisfactory “assembly” was achieved in *Little Boy* by firing a cylindrical hollow annulus of enriched Uranium down a gun barrel on to a fixed solid cylinder on enriched Uranium, just filling the hollow annulus. The resulting right circular cylinder was the desired *psc* configuration.

A schematic of *Little Boy* can be found in a Wikipedia article on atomic bomb development;
Little Boy's right circular cylinder psc configuration is not optimum. A sphere, which has the lowest possible surface to volume ratio, would require approximately two thirds the enriched Uranium. Given the limited enrichment capability of the Manhattan Project and their time constraints, it made sense to construct the enriched Uranium components of simple pieces, cylindrical disks and rings. The last of these were only ready for shipment to the Pacific for final bomb assembly.

In the early 1940s, Plutonium (Pu239) could be produced by the transmutation of U238 in a large natural Uranium-fueled, Graphite-moderated reactor (in Hanford, WA), much faster than Uranium could be enriched to bomb grade levels. The Manhattan Project focused their efforts on a spherical psc Pu239 configuration, with "rapid assembly" achieved through the use of shape charge explosives to produce a super high density Pu239 sphere, i.e. Fat Boy. Since the second world war this technology has been perfected for Uranium bombs as well. In 1995 The National Resources Defense Council published a paper, The Amount of Plutonium and Highly Enriched Uranium needed for pure fission nuclear weapons, by Thomas B. Cochran
and Christopher E. Paine. They state that a “high tech.” effort could produce a 20 Kiloton bomb with 5 Kgs of 90% enriched Uranium, and the same yield could be achieved with 16 Kgs by a “low tech.” effort. Whether Iran is high or low tech., it is clear that they could rapidly produce a significant number of bombs making use of a small fraction the enrichment facilities required to support fueling their existing commercial power reactor. If such facilities are not completed, they could devote existing centrifuges to bomb production. Enriching reactor grade fuel (3.6% U235) to yield 16Kgs of 90% U235 +10% U238 requires only ~1100 SWUs. It should also be noted that shape charge explosives development and the electronics for precisely timed ignition have greatly advanced since 1945. The heavy “gun barrel” design of Little Boy can be replaced by a much lighter, more compact compressed sphere design.

In addition, Iran has been constructing a heavy water research reactor, which is well suited to produce bomb grade Plutonium (Pu239 with little Pu240). A high tech Plutonium bomb only requires 3 Kgs of Pu239. As part of on going negotiations with the “6 World Powers” work on this reactor has been suspended, as has been the installation of additional centrifuges. Existing centrifuges can be repaired. There are reports that as many as 30% of these centrifuges were damaged by the Stuxnet computer virus. Thus Iran’s capability to produce bombs is improving during talks, while their “peaceful” goal of supporting power production is not.

Israel is a small country, 8,000 square miles (~New Jersey), with a population of 7.8 million. 76% are Jews who mostly live in urban centers; Tel Aviv – Yafo 3.2M, Haifa 1M and West Jerusalem .77M. Tel Aviv and Haifa are ports and Jerusalem is only forty miles from the coast. Fission bombs of Little Boy yield detonated in each of these locations would effectively destroy Israel as a Jewish State. (A bomb in Jerusalem would have to be exploded to the West, where most Jews live, to minimize damage to the Old City and the Dome of the Rock.) Given the small size and weight of modern fission bombs, multiple delivery options exist. The possibility of suicide missions, clearly expands the choices. Planes, ships, small submarines, well shielded shipping containers, missiles of various kinds; form a list that comes readily to mind.

Without access to the knowledge of key intelligence agencies, one is forced to speculate on the nature of Iranian governance and Israeli defense.

The Islamic Republic of Iran is a theocracy with a cleric, Ali Khamenei, as Supreme Leader. He is appointed by a Guardian Council. There is an elected President and Parliament, with candidates vetted by the Guardian Council. The Supreme Leader appoints many important leaders of the judiciary, the armed forces and the Revolutionary Guards (a powerful supplement to the armed forces). While the Supreme Leader has said that Iran has no interest in nuclear weapons, the Nation (at whose direction?) continues to push an enrichment program that makes no economic sense. Both the Supreme Leader and the recent President, Mahmoud Ahmadinejad, have repeatedly proclaimed that the world would be a better place
with Israel destroyed. The newly “elected” president, Hussan Rouhani, while proclaimed by some to be a moderate, is cut from the same cloth. He is a cleric who has been in the top ranks of the regime for three decades. Would these men be willing to martyr some fraction of the Iranian population to achieve Israel’s destruction? We need to remember that people did not believe Hitler’s Mein Kampf. Even as the allies pressed towards victory in 1944, Hitler and his minions devoted major resources to the destruction of Jews; consider the fate of Hungarian Jews at that time. More recently it has been reported\(^1\) that during the Cuban missile crises, Fidel Castro considered a sacrifice of the Cuban people for a nuclear strike on the United States would be most worthwhile for humanity. Can we ignore the possible impact of a maniacal leader (e.g. Osama bin Laden) today?

\(^1\) The Soviet Cuban Missile Crisis by Sergo Mikoyan 12/28/2012

Israeli military and intelligence institutions earned outstanding reputations in the first thirty five years of their existence; the 1948 war of independence, the Suez crisis of 1956 and the 1967 six day war. The surprise achieved by Egypt and Syria in launching the 1973 Yom Kippur war called into question the competency of Mossad and Aman (military intelligence). The armed forces, however, recovered and performed well in ’73. Subsequent incursions into Lebanon; 1982 and 2006 (versus Hezbollah), did no go as expected. The reputation of the army thus suffered. On the other hand, Israeli military technology has continuously advanced, e.g. the Arrow and Iron Dome anti-missile systems.

To the layman the unanswerable questions are: what does Israel know of Iranian capabilities and intentions, and how impenetrable are Israel’s defenses against the multiple ways that modern fission bombs could be delivered?