Proliferation And Weapon Design – How Important?

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Introduction

Last June headlines blared "Nuclear ring had advanced design", "Smugglers had design for advanced warhead", etc., repeating the circus of American armed guards carting Libya's Chinese atomic bomb design blueprints with great fanfare to put it under lock-and-key in Washington, thus saving the world from this forbidden-fruit type of knowledge.

The recent claim was that the advanced design on Swiss smuggling Tinner family PC's is very compact, a copy of the Pakistani warheads tested in 1998, thus allowing delivery by unsophisticated, low throw-weight rockets such as Nodong, Shahab-3, and so on.
The Swiss government, in a laughable panic to avoid airing Tinner's CIA connection, destroyed the information under the watchful eyes of the IAEA, repeating the worn-out mantra "so it won't fall into the hands of terrorists"……

Analysis…

"It's The Fissile Material, Stupid!"

History suggests that the whole hoopla is politically motivated, since as we all know, one needs the materials, Plutonium or highly enriched Uranium to make a fission type nuclear weapon. The scientific knowledge, whether blueprints, theoretical calculations, and/or computer programs are rather mundane and cannot really be kept secret from inquiring minds, to wit-high school students and first year university students [1] coming up with plausible implosion weapons designed free-hand [2], and furthermore, all the detailed information is in many open publications, books, scientific journals, and the web [3].

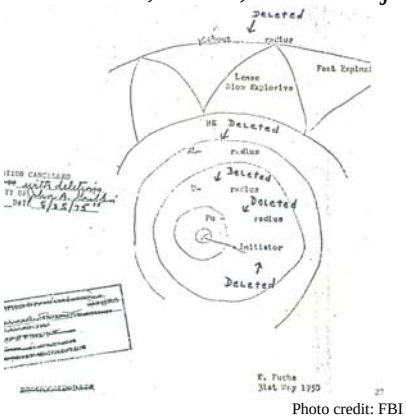

Photo credit: FBI

Fig. 1 K. Fuchs Drawing: Cross-section of Fat Man

In the case of the Soviet Union, they got through Klaus Fuchs [4] and their extensive spy

network detailed blueprints and calculations on the US Fat Man plutonium implosion bomb. It still required a bankrupt and war ravaged USSR a massive effort to build the Plutonium production reactors and separation facilities, and a cadre of world-class production scientists and engineers to duplicate the Fat Man.

UK had its top physicists participate in the form of British Mission to Los Alamos, and who contributed to the critical implosion bomb design [5]: James Tuck and the concept of explosive lenses, Rudolph Peierls and Klaus Fuchs in the implosion theory and calculations, Klaus Fuchs design of the Po-Be initiator (together with R. Sherr), and W. Penney in shock hydrodynamics and explosion effects. Yet, with all the detailed design information, it took UK seven years, until 1952 to build the reactors, separation plants, and assemble the first Fat Man copy shown in Fig. 2 ("The Blue Danube").

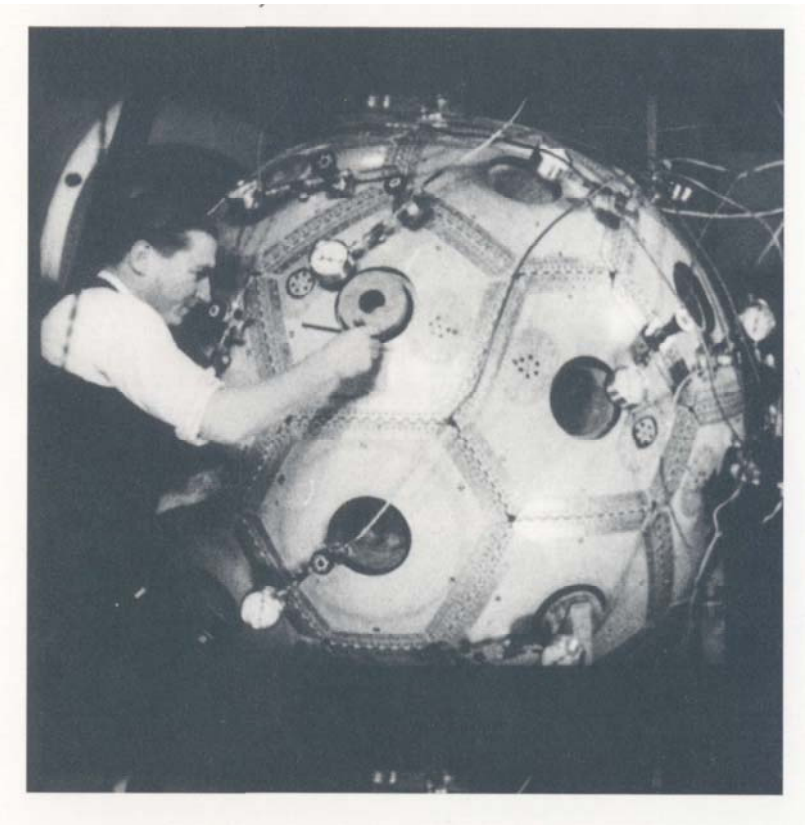

Photo credit: AWE plc

Fig. 2 UK Copy of Fat Man: Lens Assembly

All the other proliferants (China, France, India, Israel, S. Africa, Pakistan, N. Korea) had generally ready access to weapons design blueprints, either through direct assistance from US or USSR, through espionage, or both. Still, they had to spend years in building production facilities to make the fissile material.

For a proliferant state, having the design on a piece of paper also requires somebody who can understand what it describes, and has the ability to translate the information into actual machined metal or explosive components, construct the electronics for firing the detonators and possibly an external neutron generator. Again, this requires factories to

make these parts, whether machine shops, electronics shops, etc., and again, this takes time.

The inescapable conclusion is that having the detailed design information will save a proliferant country at most a couple of months of work out of 3 to 7 years nuclear weapon production infrastructure construction timeframe.

How Widespread Is The Design Information?

The theory of nuclear fission explosives is similar to that of "fast reactors", so one can take the same university courses, and use the same computer programs to calculate the fissile core size and efficiency of the bomb.

In addition, there is a tremendous amount of declassified information from the US, USSR (now Russia) and UK on the key nuclear and compressibility properties of Plutonium and Uranium. Some of the countries that had illicit nuclear weapons programs like Sweden and Switzerland, published weapon design and expected performance data in scientific journals [6] as part of their effort to come clean.

And finally, budget cuts in the Big 5 nuclear weapons labs made it difficult to retain high caliber personnel without giving people a chance to be recognized by their peers, so weapons designers were encouraged to be involved in similar work that was "open", such as Laser or Ion-driven Inertial Confinement Fusion (ICF) or one point safety tests. This resulted in published papers and public patents describing in excruciating details the design and operation of "microfission" and "microfusion" pellet reactors, with very sophisticated coupled neutronic-hydrodynamic computer program codes [7][8].

An example is the publication of the first authoritative design of a thermonuclear warhead, the UK Trident, which is believed to be an "anglicized" version of US W76 warhead [9][10]. Fig. 3 illustrates the primary, secondary, interstage, and aft assembly.

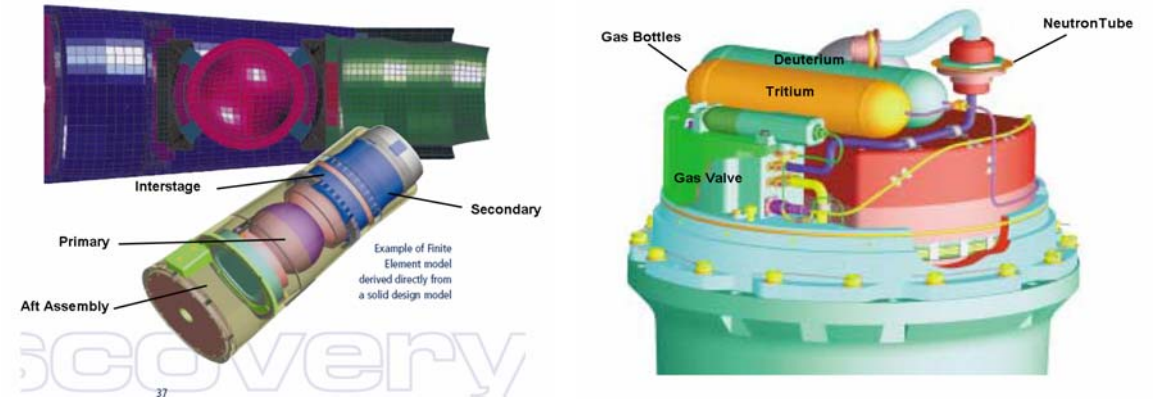

Photo credit: AWE plc

Fig. 3 UK Trident Thermonuclear Warhead and Aft End Assembly

The AWE plc web site illustrates the "guts" of the Trident "sealed pit" primary as part of one point safety tests called Tamper Movement Trial [11], while the AWE 2002 annual report has a photo of the actual primary from a retired comparable bomb, the WE177 (Fig. 4), with the hand of a worker providing an idea of its size [12].

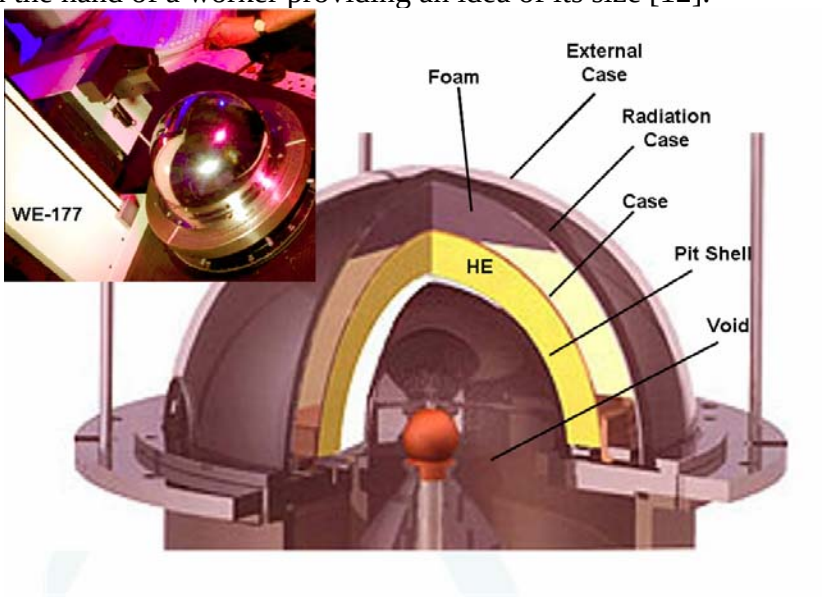

Photo credit: AWE plc

Fig. 4 UK Trident Sealed Pit "Primary" Cross-section

So how long will it take to duplicate this possible W76 knock-off warhead? You must have the materials, the electronics, the plants to assemble the parts, non destructive testing, etc. This was a trick "rhetorical" question, since this is a highly optimized warhead, with a small radiation case (to increase energy density) and interstage coupling between the primary and secondary (to provide primary pulse shaping for isentropic compression [13]) which requires esoteric materials fabrication …again illustrating that having a paper design is a microscopic part of the enormous industrial production infrastructure required….

The UK Trident information is not unique; similar information and photos are available on many warheads and components from Sandia Lab News, Y-12 plant news, LLNL S&TR journal, NNSA plant brochures, etc.

Conclusions

You need fissile material. The actual design of a simple fission explosive is trivial for 1 to 2 kT yields, without the need for computer codes or detailed blueprints….For highly enriched Uranium (HEU), it is simply dropping a piece of slightly subcritical HEU on top of another piece of HEU… For larger yields, in addition to fissile material, one will need slightly more sophisticated technical infrastructure for external neutron initiation and high explosive initiation design for highly symmetric, high compression implosions.

Thermonuclear weapons production, even with blueprints and computer codes, are impossible without having the fissile and thermonuclear fuels materials. The ancient multi-megaton thermonuclear weapons of the 1950's were very simple robust devices. Today's highly miniaturized and optimized TN weapons are a totally different matter. The information describing high yield, optimized fusion "capsule" and radiation case (hohlraum) designs are published widely as part of Inertial Confinement Fusion programs, as there are the laser and heavy ion indirect drive computer codes [14][15]. While intellectually stimulating and exciting, they are absolutely worthless without the materials.

The inescapable conclusion is that both states and terrorists can build a primitive fission explosive without any blueprints if they have fissile materials. The states with sufficient technical resources can do better in terms of yields, size and reliability, but in both cases, you need the fissile material. Thus, the absolute need to take seriously safeguarding fissile materials. This is a political issue that most governments, like an ostrich with the head in the sand, are just paying lip service.

Unfortunately, the US 9/11 commission recommendations are falling on deaf ears…we waste our money on cheap propaganda measures, like easily bypassed radiation detectors at ports and highways rather than tackle the sealing a very porous 2000+ mile border with Mexico, bend the NPT provisions for India, and avoid unpalatable negotiations with various unstable countries with nuclear weapons and fissile materials…so when we get a mushroom cloud in New York or London, we will have another commission to make another set of recommendations…But the victims are not going to be around…

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