



INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH

6935 Laurel Avenue, Suite 201
Takoma Park, MD 20912

Phone: (301) 270-5500
FAX: (301) 270-3029
e-mail: ieer@ieer.org
<http://www.ieer.org>

*IEER Conference: Nuclear Disarmament, the NPT, and the Rule of Law
United Nations, New York, April 24-26, 2000*

Legality of laser fusion under the Comprehensive Test Ban Treaty (CTBT)

Hisham Zerriffi
Institute for Energy and Environmental Research
April 25, 2000

My name is Hisham Zerriffi, and I am a senior scientist at the Institute for Energy and Environmental Research. The title of my talk today is "The Legality of Laser Fusion Under the CTBT." I am going to draw upon a few things that Chris Paine touched on in his talk, including the stockpile stewardship program, the fact that there is no definition of a nuclear explosion in the Comprehensive Test Ban Treaty (CTBT) and the new facilities that are part of the stockpile stewardship program and how they fit within the CTB treaty.

Let me make a couple brief introductory remarks about the stockpile stewardship program. The Administration has placed the stockpile stewardship program at the center of its CTBT compliance, as a necessary condition for CTBT compliance, and as necessary for maintaining the nuclear weapons arsenal for the indefinite future. This raises a lot of doubts, because the program is not completely in place yet. As Chris Paine correctly noted, an alternative program based on maintenance, some refurbishment and similar activities is in place, or could be in place very soon. It is also important to note that the new facilities being constructed, including the National Ignition Facility and the Dual Access Radiographic Hydrodynamic Test (DARHT), are really upgrades or more powerful versions of previous facilities that were used as part of the weapons design program. There is a continuum between weapons design facilities and programs and stockpile stewardship facilities and programs that must be kept in mind. And there are clear statements of intention to continue to design new nuclear weapons even if there are no current military requirements or no requirements for new designs and no concrete plans to put these new designs into the arsenal.

I would like to focus on one particular facility within this program, called the National Ignition Facility, and its French counterpart, Laser Mégajoule. So I don't have to keep referring to both, please understand that, when I say the National Ignition Facility (NIF), it means Laser Mégajoule as well, because they are essentially the same facility. For those of you who are not familiar with these two facilities and what they are, let me give a brief description of them. The facility is the

size of a football stadium with roughly 200 high-powered laser beams focused on a small pellet, which is made up of two isotopes of hydrogen: deuterium and tritium. This is called a fusion fuel pellet. The idea is to focus these laser beams onto this little pellet and compress it in order to reach the temperatures, pressures, and conditions for fusion within this pellet. This fusion reaction will start at the center of the pellet and grow until there is essentially a small thermonuclear explosion. While the energies released are much smaller than in a thermonuclear weapons explosion, parameters such as temperature, pressure, and energy density are very close, so it gives you a lot of information about fusion reactions, how the fusion reaction might work in a weapon.

This is obviously a rough simplification of the whole process and of the goals of the facility. One goal of this facility is to better understand fusion, how it works and how it might work in weapons. Another goal is to maintain the scientific workforce, which is a key component in the nuclear weapons design infrastructure, by providing them with a very intriguing and exciting scientific challenge or problem. What is that problem? It is, quite simply, to achieve what is known as ignition - to get more fusion energy out of the little pellet than is put into the pellet by the lasers, which is known as "gain." A gain of 1, for example, is when the same amount of laser energy that has been put into the pellet comes out as fusion energy.

The ability to achieve ignition of fusion fuel in an explosive manner has never been done outside of a weapon, or a weapons experiment underground, which uses plutonium and highly enriched uranium, the primary of a weapon. So the National Ignition Facility will provide a key new capability to achieve ignition outside of the context of a nuclear weapon, outside of the Nevada Test Site, in a laboratory above ground. It's repeatable and measurable. Therefore, scientists can gain a lot of information. This is really what makes the National Ignition Facility different from previous facilities of the same nature that used lasers and these little pellets and got fusion reactions. Those facilities did achieve fusion reactions, but they did not achieve ignition.

What does this mean? There was no definition of a nuclear explosion integrated into the Comprehensive Test Ban Treaty. Article I simply says there shall be no nuclear explosions. So how does one understand this in the context of the National Ignition Facility? At the negotiations of the CTBT, there was a lot of talk about an upper limit to nuclear explosions. Eventually, the President of the United States decided that the U.S. would pursue a zero-yield test ban. In a lot of ways, this was the key factor in getting a zero-yield test ban. But during the negotiations, there was a lot of debate concerning hydro-nuclear explosions and other explosions. Four pounds of TNT became a sort of defining limit. This was consistent with what is contained within the Department of Energy's orders as a definition of a nuclear detonation: any nuclear reaction that occurs very rapidly and that releases more than four pounds of TNT. With this definition, there's a very clear limit to a fission explosion: it must be much less than four pounds of TNT, preferably zero-yield. However, it becomes difficult to define and measure zero-yield. And, of course, you get into verification issues as well.

What about the National Ignition Facility? The National Ignition Facility is designed to achieve thermonuclear explosions in the tens of pounds of TNT - 10, 20, 30 for high-gain - but certainly more than what is clearly understood for fission explosions. Therefore, it is of great concern because if pure thermonuclear explosions, fusion explosions, are permitted without any limit,

then there really is no limit to the CTBT. Then perhaps 100 pounds, 500 pounds, 1000 pounds might be okay, as long as it isn't bomb-like, or whatever interpretation is running through the U.S. government as to what a nuclear explosion is. So this becomes a very clear threat to the Comprehensive Test Ban Treaty, to a zero-yield CTBT, because it eliminates any limit, essentially, to these explosions.

IEER has developed a definition of a thermonuclear explosion that is quite clear and technically consistent: the definition of a nuclear explosion is ignition. Ignition achieves something analogous to criticality in a fission explosion and more energy is released than has been put in. It's not a perfect definition, perhaps, but certainly the best one we've seen because it is very difficult to define a nuclear explosion exactly.

What is the danger of achieving a thermonuclear explosion? In addition to the fact that the CTBT is being undermined by these explosions above ground, in the laboratory, with no limit set to them other than perhaps a technical one at the moment, the danger is that these explosions will lead to the development of pure fusion weapons. The concept of a pure fusion weapon has been around for a long time and it has been a goal of weapons designers for quite a while. The National Ignition Facility plays an important role in the potential future of these types of weapons because there are two feasibility tests for a pure fusion weapon. One is the issue of scientific feasibility: is it scientifically feasible to have a pure fusion weapon? Can you get more fusion energy out than you put in without using other nuclear materials, such as plutonium or highly enriched uranium? The other test is technical feasibility: can a pure fusion weapon actually be made? Can you turn this into a weapon? The National Ignition Facility is not a weapon. It can't show the technical feasibility of making a weapon, but what it does show is the scientific feasibility of making such a weapon, because if it works, it will get more fusion energy out than was put in by the lasers. This will start us down a very dangerous path toward new types of weapons that could have a very large range in their yield, no fallout as we understand it currently, and perhaps be much more useable than current nuclear weapons.

So what's the U.S. government's and the French government's response to all this? How do they justify having these facilities that are seemingly illegal under the CTBT, are unnecessary for maintaining the current weapons arsenal, and could lead down a path towards new types of weapons? Well, the answer to the last part is very simple. They say the National Ignition Facility is not a weapon and never will be a weapon and the only way it could be a weapon is to drop it on somebody. Well, that's ridiculous. We are talking about what the research could be used for in the future. As for the second part, NIF's role within the stockpile stewardship program, unfortunately the Administration has hung its hat on the full stockpile stewardship program with these complicated physics facilities that are really unnecessary. I urge you to read NRDC and IEER materials on this topic.

How does the U.S. administration address the core issue of the legality of these facilities under the CTBT? The Administration has done something very interesting: it has gone back to the Nuclear Non-proliferation Treaty. The State Department has said that this issue has been addressed already in the context of the NPT, that it was addressed in 1975 during the first review conference, in which the States Parties decided that laser fusion facilities did not contravene the NPT, that they were not nuclear explosive devices as understood under the NPT. This misses a

very key point, which is rather striking for the State Department considering that it is responsible for these treaties, that the NPT and the CTBT are different treaties with different prohibitions for different countries. The NPT has a certain set of prohibitions for the non-nuclear weapons states and a different set for the nuclear weapons states: the non-nuclear weapons states give up any idea of developing nuclear weapons and the nuclear weapons states eventually are going to disarm. The NPT also has a different idea of what is the key technical issue involved. The NPT bans the non-nuclear weapons states from having nuclear explosive *devices*, essentially something that looks like a bomb.

The CTBT doesn't say anything about nuclear explosive devices. It says no nuclear *explosions*, period, end of sentence, end of argument, end of discussion, nothing beyond that. No nuclear explosions. It doesn't say that some forms of nuclear explosion are okay for the nuclear weapons states, but not for the non-nuclear weapons states, or that there are a different set of prescriptions for one versus the other. No. It says no nuclear explosions by ANY state no matter what their current nuclear status. Whether they have nuclear weapons or not, they are not allowed to have nuclear explosions. The argument that the NPT has already addressed this question doesn't hold water. We have two different treaties that say two different things and one activity could be perfectly legal under one treaty and be illegal under the other treaty. The National Ignition Facility, under the NPT, doesn't seem to pose a problem other than indicating a desire to maintain nuclear weapons for the indefinite future, which some people would argue goes against Article VI, but that's another point. But it is very clear that, under the CTBT, these facilities do appear to be illegal. It's an issue that needs to be addressed because otherwise there will be no limit to nuclear explosions. It will be difficult to actually hold up the CTBT and say, "This treaty stops nuclear explosions."

I would like to end on an interesting note. Senator Harkin of Iowa sent a letter to Energy Secretary Richardson last November that raised a lot of these questions. He asked, how is it that fission explosions are banned but fusion explosions are not, how is it that the NPT is being used exactly to justify this? What does this mean for developing nuclear weapons? As of yet, there has been no response from the Department of Energy or the State Department other than one. When asked about this by the *New York Times*, a senior State Department official, John Holum, said that he believed this issue was dealt with in the CTBT, but it was still a fair question to ask, and so it should be asked. We would hope that other countries would start asking it as well, because there needs to be a resolution on this issue, so that the CTBT can come into force as a strong treaty with no exceptions for any state for any type of nuclear explosion.

Thank you.