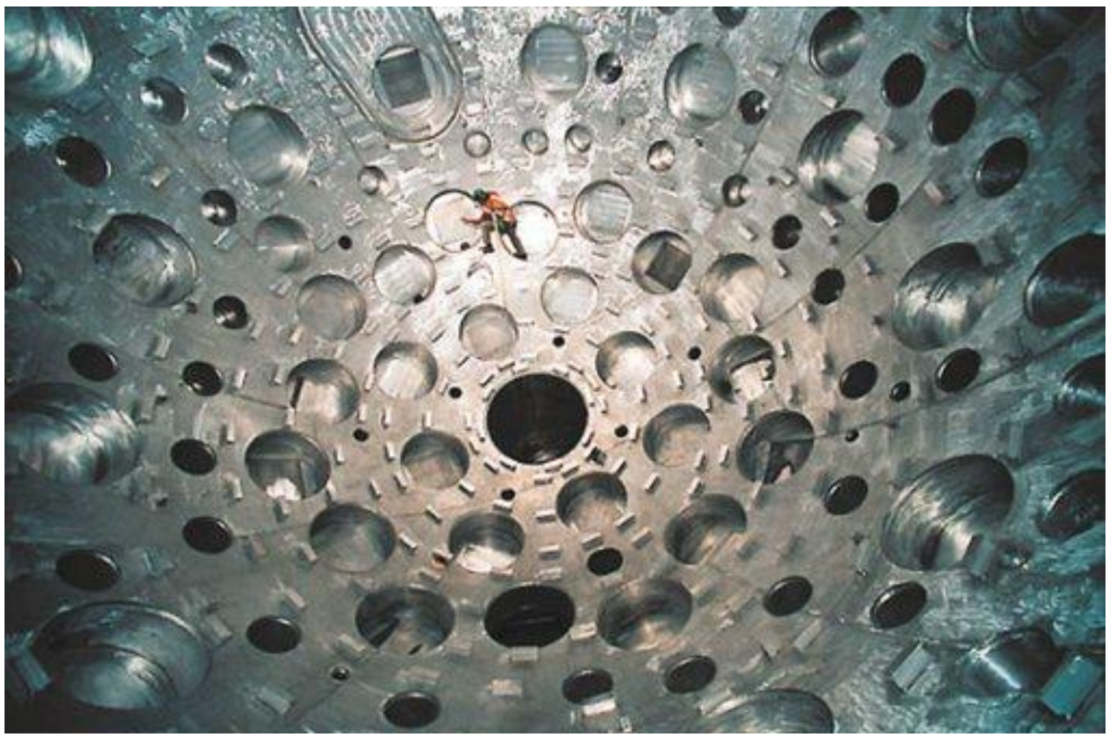
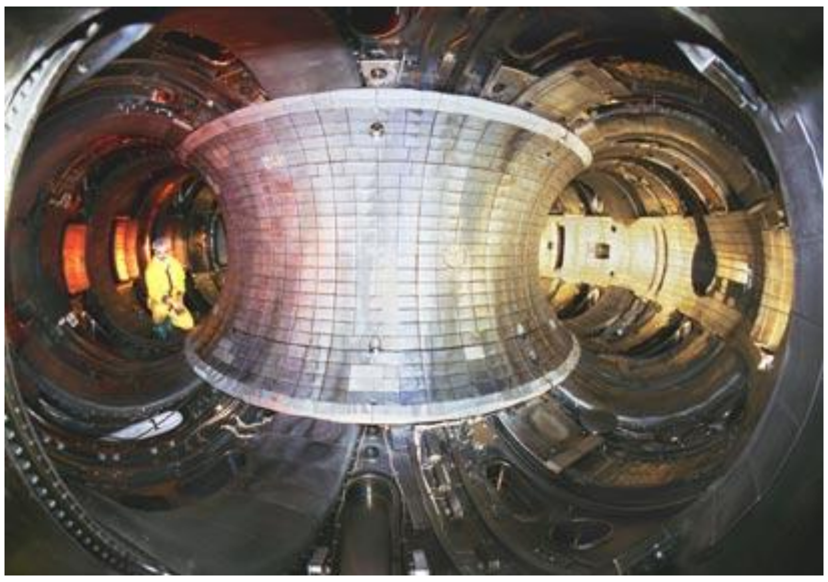
NUCLEAR FUSION
the grand dreaming



Inertial Confinement (Laser) Fusion (NIF) Target Chamber



Magnetic Confinement (TFTR) Fuison (PPPL) Reactor Chamber

Two types - laser nuclear fusion and magnetic nuclear fusion
two grand failures

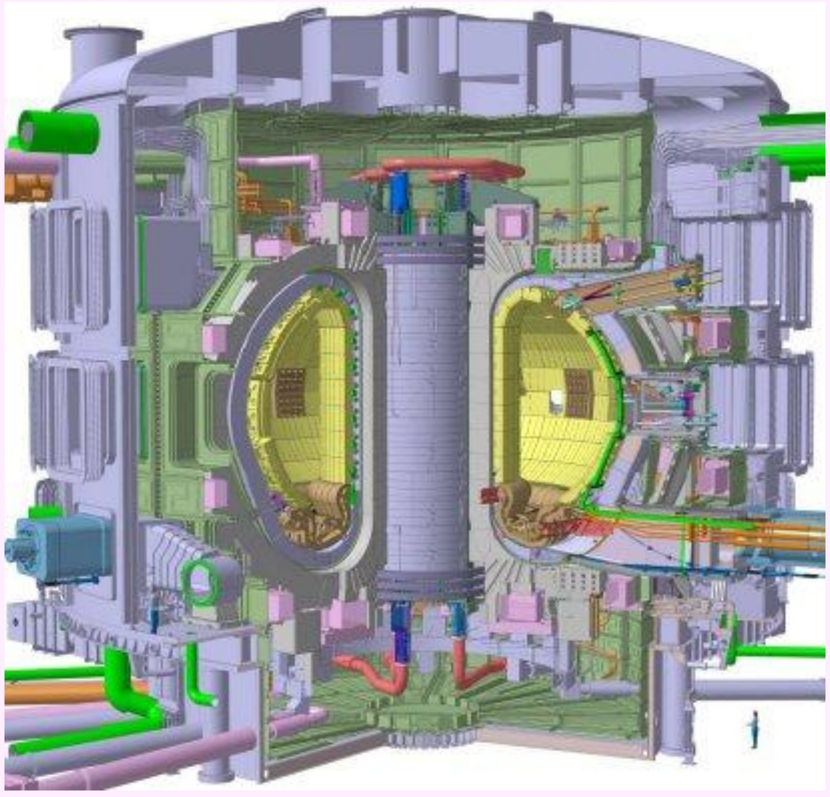
Foolish for meeting the New Ice Age Ahead

Both types of nuclear-fusion power experiments require giant machines

There are two types of fusion experiments being pursued. One is centered on creating large electric plasma currents that are magnetically confined inside a vacuum chamber. The plasma is then heated up. In the range of hundreds of millions of degrees, nuclear fusion actually does takes place and produces a burst of power. However, as soon as the fusion starts it blows itself out, typically within milliseconds. For this millisecond experiment a machine has been built the size of a 5-story house (TFTR at PPPL). The world record in fusion burn endurance is half a second (Joint European Torus (JET)).

The International Thermonuclear Experimental Reactor: ITER

What once began small in the magnetic fusion-power quest, with the TFTR at PPPL (Princeton Plasma Physics Lab, is becoming gigantic. Since the world-record burn-time and negative power gain turned out to be a dismal failure in terms of actual power production, a vastly bigger machine is now being planned that will be powerful enough to hopefully contain its fusion burn for a thousand seconds (ITER). The new machine is planned as an international effort. When it is completed in a dozen years, it will be a quarter as height as the Great Pyramid in Egypt, and will weigh three times the weight of the steel of the Eiffel Tower. Because of the scale of the actor to required for achieving energy gain, the project has become international is scope. The project's members are the European Union, Japan, China, the United States, South Korea, India and Russia. The EU as host for ITER will contribute 45% of the cost, with the other parties contributing 9% each.

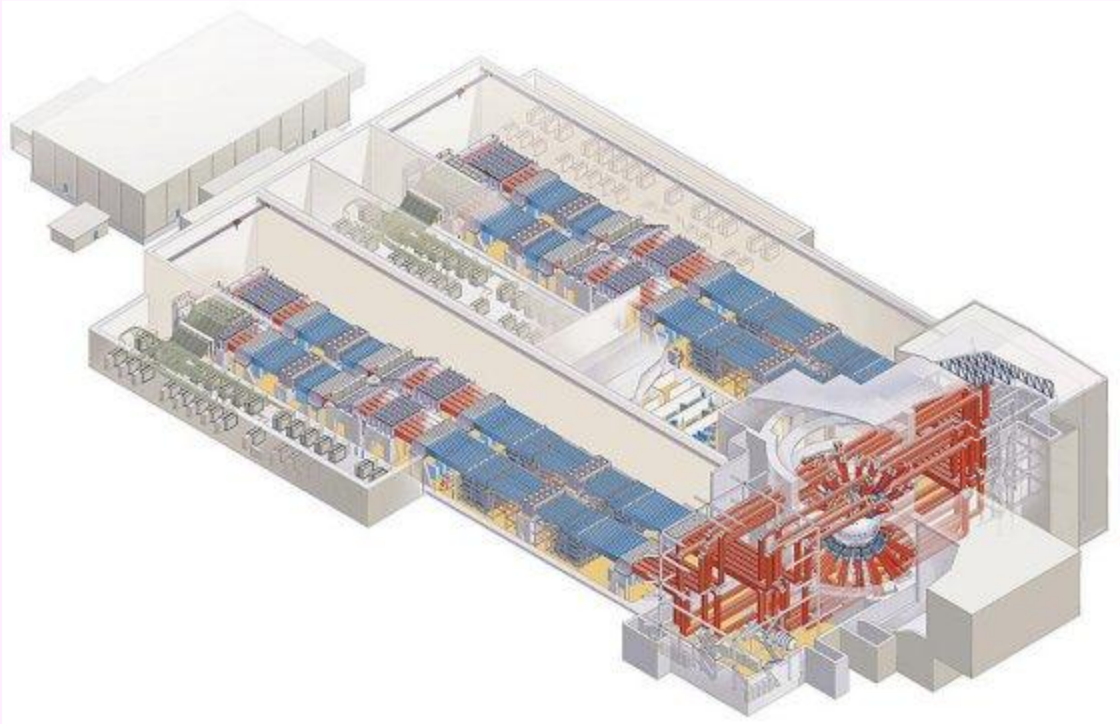


International Thermonuclear Experimental Reactor (ITER)

And when this giant machine is operating, at a construction and startup cost of app. $30 billion by 2020, it is believed that it might serve as a model for an eventual power plant some time half a century from now. On the ITER model that is hoped will generate 200 Megawatts of power, provided that the process will work as expected and can be made to operate continuously rather than for the projected 15-minute fusion burn that ITER aims to achieve, and provided that the metals of the containment vessels will remain intact sufficiently for long-term operation, a power plant could be build. However, this kind of huge effort that is required, based on the ITER model, and for so little in return, will never be a practical path to efficient power production. A power plant build on the ITER model, at current construction costs, would cost $150 billion for a 1,000 MW plant. Windmills are 30-times more efficient than that. A standard current power plant of 1,000 MW capacity would be a 100-times more efficient. What the ITER project appears to demonstrate is, that the door to this process for practical power generation is already closed.

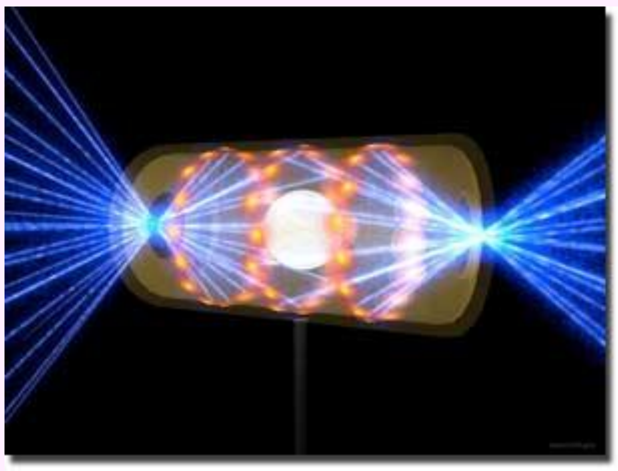
The National Ignition Facility NIF

The second type of fusion process that is being pursued is laser-ignited fusion. For this experiment the gigantic National Ignition Facility has been built that is three times as large as sports stadium and may have cost close to $10 billion to build.

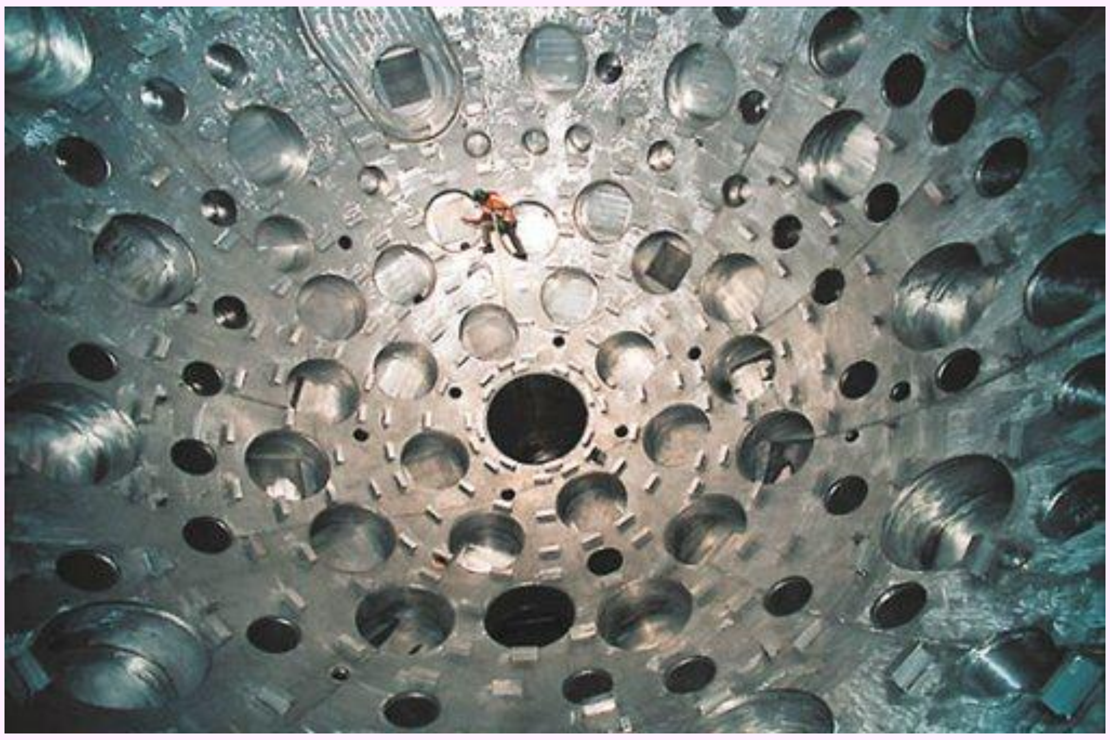


http://en.wikipedia.org/wiki/National_Ignition_Facility

The facility houses a whopping 196 giant lasers that have their light energy combined into 48 huge beam lines that then deliver the light energy focused onto a target half the size of a pea that is positioned inside a ten-meter wide target chamber. What is being achieved there is a technological miracle. Just imagine, focusing 500 trillion watts of light from 48 different directions onto a capsule made of gold, the size of a bean, through two holes the size if a matchstick, onto a tiny object the size of a pea, and then to get this tiny object to absorb all of this huge energy and turn it into a compression heat-wave that implodes the fuel, heats it, and causes its atoms to fuse.



And this actually works. In the hohlraum the light is converted to x-rays that couple with the exterior of the fuel capsule. The absorbed energy creates a shockwave that compresses the fuel to roughly 75 times the density of lead and causes a fusion explosion with an energy release up to 11 Kg of TNT - one thousands of the energy level of the Hiroshima bomb, but only for an extremely short timeframe in the order of a few billionth of a second. The resulting explosion takes place inside a 30 foot wide target chamber. - Note the construction worker.



When ignition is achieved (2012), the 365 megajoules (MJ) of electrical energy that powers the over 8,000 flash bulbs by way of 216 giant capacitor banks, and whatever additional energy is required to amplify the laser light, is expected to produce about 20 MJ of fusion energy with a 15-fold energy loss. The current hohlraum design is rated at 13MJ, but will likely be increased to 20 MJ. For the NIF, the baseline design allows for a maximum of about 45 MJ of fusion energy release, due to the design limits of the target chamber. If the maximum limit was achieved, the result would nevertheless amount to a nearly 7-fold net energy loss.

Indeed, this technological miracle has been achieved. However, the project is also a flop, by its very design, . It was expected from the outset to take 17 times as much energy to cause the fusion to happen, than the fusion gives back. In addition it takes a day for the heat that is generated in the laser system that produces the light, to dissipate before the next ignition can be achieved. The expected fusion-power output that will thereby be achieved is roughly equal to 16 horsepower-hours in automotive terms. For this minuscule power output, which is the equivalent of what it takes to power a lawn mower for an hour, a facility is needed that is three times as large as a football stadium.

Grand dreams are dreamed along this line. One is centered on a fast ignition process where a funnel made of gold is attached to the fuel pellet with its end at the center of the fuel pellet. The idea is that the fuel will be somewhat less intensely heated and compressed, while in the process of it being heated, a petawatt laser beam is channeled, by means of the golden funnel, deep into the center of the compressed fuel to start an electron shower there that will start the fusion from the center, called Fast Ignition. The proposed European **H**igh **P**ower laser **E**nergy **R**esearch project - HiPER will utilize the fast ignition process. The PETAL laser facility for it is a high energy multi-petawatt laser, which is able to generate pulses of up to 3.5 kJ energy with a duration of 0.5 to 5 ps. This petawatt laser will be coupled with the high power laser LIL. PETAL will act as a demonstrator of physics and laser technology for the subsequent facility named HiPER. For a 500MW output (200MW electricity) a commercial plant would require a repetition rate of 300 fusion ignitions per minute, of 100MJ fuel capsules (the theoretical maximum - current 13 MJ). The required size of the fuel capsule, its rate of replenishment with the needed precision alignment in the super-hot environment of nuclear explosions is presently achievable only in dreams, and so the repetition rate of the ignition lasers. The current repetition rate at NIF is 1 ignition per 24 hours (30/month). It takes this long for the heat build-up in the laser and optical system to cool. It is hoped that improvements can be applied to increase the ignition rate to 700/month. That's still a long way off from the needed 300/minute, and this too, at the very best, would only produce 200MW of electricty.

The fast ignition process too, has been demonstrated to work. However, it still requires ten times more energy to ignite the fusion than the fusion gives back, and this is ten-fold negative gain is currently the world record.

Great hope is being expressed that the inherent efficiency in the processes can be improved, perhaps over the next fifty to a hundred years, to get us to the break-even point, and even beyond it, and that this being repeated 10 times a second so that an actual commercial power plant can be constructed. And that's the very best the most able pioneers in the field hope to achieve after a hundred years of further development, with facilities larger than a sports stadium. And even this most optimistic view, still involves a whole lot of dreaming that can never come true. Considering the current cost for constructing the NIF complex, a complex of 5 reactors of 200MW, for a 1,000 MW capacity, build on the NIF model would cost app. $50 billion. In comparing the costs (in billions of dollars) 2-5 for conventional and nuclear power, 6 for wind-power, 7-9 for solar-power, the laser fusion-power at 50, if it miraculously became possible, puts the laser fusion option far out of the range of practicality.

Nuclear-fusion power, a dead-end pursuit

Six strikes against nuclear-fusion power

The political driver for dead-end fusion-power

The nuclear-fusion energy is destructive

The paradox of the nuclear-fusion fuel

The paradox of nuclear-fusion power

MSR/LFTR Liquid Fluoride Thorium Reactor

Also see:

2011 - NAWAPA

2011 - Industrial Revolution

2011 - Free Electric Energy

2011 - Nuclear Fusion Power Delusion

2011 - Ice Age anew and Renaissance

2011 - Universal Love

2011 - Empire Religion

2011 - Empire Wars

2011 - Christian Science

2011 - New Science

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