

Fusion: the power source of the future

by M. Simon, retired Aerospace electronics consultant



Fusion is the power source of the future, goes the old saw. And for fifty years, it has always been "fifty years in the future." That may be changing with a number of new small fusion projects in the works or doing actual experiments.

Let me mention first the ITER experiment (a tokamak design) which is the fusion project every one knows about. Currently it is delayed. Plus it is costing about \$1 billion a year to get it going with an estimated date of first operation of around 2018. Not only that, it has a number of known problems for power plant use. One is that it generates a LOT of neutrons and those neutrons have to be captured in a Lithium blanket in order to breed Tritium. The design margin for the Tritium breeding is only 10% and even that number has not been proved. In addition there are a number of plasma instabilities (one type is called ELMs - edge localized modes) which could ruin the reactor in relatively short order. And then there is the problem that a full scale power reactor would cost a lot making the electricity produced very high cost. Plus the power output would be on the order of 20 GW. Utilities have no use for that much power in one spot.

As Plasma Physicist Dr. Nicholas Krall said, "We spent \$15 billion dollars studying tokamaks and what we learned about them is that they are no damn good."

So what would a viable power plant look like? Vincent Page of GE has some things to say about that.

<http://iecfusionechnology.blogspot.com/2007/07/fusion-symposia.html> [1]

All is not lost (or forever fifty years in the future) however. There are a number of low cost experiments going on that could get us to viable fusion in two to ten years. My favorite is Polywell Fusion which is funded by the US Navy. Experimenter Rick Nebel says that we will know in two years (at a cost of less than \$20 million) if this approach is viable. It may be possible to use Boron 11 fuel in the Polywell which is a low neutron producing fuel. At least thousandth as many neutrons for a given power

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output as ITER and possibly as little as a millionth as many neutrons.

<http://iecfusiontech.blogspot.com/2009/05/we-will-know-in-two-years.html> [2]

You can go to the link below to see Dr. Bussard give his famous (among fusion aficionados) Google Talk. It is about an hour and a half and it is a delight.

<http://iecfusiontech.blogspot.com/2009/01/easy-low-cost-no-radiation-fusion.html>
[3]

Another approach is the z-pinch machine being done by Focus Fusion. They claim that they could make electricity for less than 1/2 cent a KWh. The design is another one that uses Boron 11 as fuel. The advantage of Boron 11 is that the output of the reaction is high energy alpha particles that could be fed into a direct conversion electrical generator eliminating the steam plant and giving about 80% conversion efficiency from fusion output to electricity.

<http://focusfusion.org/> [4]

The General Fusion reactor is a rather strange device. It is a steam driven fusion reactor. Don't laugh. My back of the envelope calculations show that it just might work. The Canadians designing it have taken what they learned from designing ink jet printers and applied it to designing a fusion reactor.

<http://www.generalfusion.com/> [5]

Tri-Alpha energy is another Boron 11 burner being funded by Paul Allen of Microsoft.

<http://nextbigfuture.com/2007/06/tri-alpha-energy-raises-40-million-in.html> [6]

Helion Energy uses what is called a Field Reversed Configuration (Tri Alpha is working with that design as well) that burns Deuterium and Tritium.

<http://www.helionenergy.com/> [7]

Now I admit I have been light on details and have used shortcuts in the above descriptions (i.e. burn instead of fusion) but there are enough details and links so that you can do your own research and come to your own conclusions.

M. Simon is a retired aerospace electronics consultant with diverse interests. He is available if you need help on a project.

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Links:

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- [4] <http://focusfusion.org/>
- [5] <http://www.generalfusion.com/>
- [6] <http://nextbigfuture.com/2007/06/tri-alpha-energy-raises-40-million-in.html>
- [7] <http://www.helionenergy.com/>