***Diabologic: Skunk Works***
by Frank Dolinar

The name of the critter we call a skunk was derived by early American settlers from the Algonquin Indian seganku.

According to Newton's Telecom Dictionary, the term "Skunk Works" is typically applied to any "usually-secret high-pressure/high-tech research group in a company or government, often populated by people who don't see much sunlight or soap. Hence the name, skunkworks."

In modern parlance, Skunk Works is a registered trademark of and the general reference for the Lockheed Martin Advanced Development Program. It's a program with an enormous technical reputation, responsible for many high-technology developments in the realm of aerospace and defense, most notably the U2 spy plane, the SR-71 Blackbird, and the F-117 stealth fighter.

Like the old commercials about E.F. Hutton, when the Skunk Works speaks, people listen. In October of 2014, a research team announced new details on an ongoing research project to create a design for a Compact Fusion Reactor (CFR). The announcement generated world-wide attention.

For over 50 years, we've been using nuclear reactors to provide electrical energy. There are some problems, however. Fission reactors, the ones currently used by power utilities, are large, expensive, have a surprisingly short lifespan, and generate radioactive wastes that must be safely disposed of. Because of these issues, many hoped for applications of the technology were never achieved.

Fusion reactors, on the other hand, have no radioactive waste products. Unfortunately, to date, fusion reactors have proven more difficult to engineer and build – with breakthroughs predicted for about ten years in the future… always ten years in the future.

Instead of using the same design that everyone else is using – the Soviet-derived *tokamak*, a torus in which magnetic fields confine the fusion reaction with a huge energy cost and thus little energy production capabilities – the Skunk Works' Compact Fusion Reactor has a radically different approach to anything people have tried before.

The tokamak designs are huge, like the gigantic International Thermonuclear Experimental Reactor (ITER), currently being built in France. According to Dr. Thomas McGuire, the leader of Skunk Work's Revolutionary Technology division: "*[The traditional tokamak designs] can only hold so much plasma, called the beta limit. [Their plasma ratio is] 5% or so of the confining pressure. [...] We should be able to go to 100% or beyond."*

The Lockheed architecture allows the reactor to be one-tenth the size of the ITER and produce the same power output, which is expected to generate 500 megawatts in the 2020s. This is crucial for the use of fusion in all kinds of applications, not only in giant, expensive power plants.

Lockheed's approach is not a brand new development. Research into fusion as a potential energy source has been ongoing since the 1920s, when it was postulated that fusion powers the stars. McGuire says "I studied this in graduate school where, under a NASA study, I was charged with how we could get to Mars quickly," says McGuire, who earned his Ph.D. at the Massachusetts Institute of Technology. Scanning the literature for fusion-based space propulsion concepts proved disappointing. "That started me on the road and [in the early 2000s], I started looking at all the ideas that had been published. I basically took those ideas and melded them into something new by taking the problems in one and trying to replace them with the benefits of others. So we have evolved it here at Lockheed into something totally new, and that's what we are testing," he adds.

Assuming this potential breakthrough can be turned into reality, how could it be used?

First, instead of building huge power plants for cities with populations in the millions, these reactors could be built assembly-line fashion and delivered to small towns with populations of 100,000 or less. Distributed energy generation, connected via a smart grid, reduces the need for the big plants, and makes the energy grid more secure.

Second, the US Department of Defense is intensely interested in CFR, for use on aircraft carriers and other ships of the fleet, submarines, and large aircraft. The CFR would eliminate the need for fission reactors and their attendant fuel supply and disposal problems.

Third, efficient power generation can be used on spacecraft, providing, for example, energy for continuous thrust to make the trip from Earth to Mars in a month, a fraction of the time currently required for the trip.

If the CFR does work as projected, it could dramatically change the world for the better.

The announcement in October 2014 was a declassification of a secret project and is an attempt to build a larger research team and find partners, presumably for commercialization of the technology.

For more information, a web search using the phrase "Skunk Works Fusion" will reveal many articles with differing viewpoints. Or check out those I've included at the end of this article. The Lockheed article for which I've included a link below has a very nice video narrated by Dr. McGuire.

Historical summaries of Lockheed S.W. from General History of the Skunk Works
Perhaps one of the most frequently asked questions about the Skunk Works is the meaning of its name. Its name originated from cartoonist Al Capp's L'il Abner comic strip, featuring an outdoor still called "the skonk works" in which "Kickapoo joy juice" was produced from old shoes and dead skunks. Johnson's elite engineering group was originally housed in a rented circus tent adjacent to a smelly plastics factory. One day an aircraft designer answered the phone and said, "skonk works." The name stuck, and later became today's Skunk Works -- a registered trademark. However, the formal name of the Skunk Works is "Lockheed Martin Advanced Development Program."

Lockheed Martin http://www.lockheedmartin.com/us/products/compact-fusion.html
Aviation Week http://aviationweek.com/technology/skunk-works-reveals-compact-fusion-reactor-details
Bloomberg http://www.bloomberg.com/news/2014-10-15/lockheed-skunk-works-team-tackling-nuclear-fusion-reactor.html
MIT Technology Review
http://www.technologyreview.com/news/531836/does-lockheed-martin-really-have-a-breakthrough-fusion-machine/
Physics Today http://scitation.aip.org/content/aip/magazine/physicstoday/news/10.1063/PT.5.8077
Science AAAS http://news.sciencemag.org/physics/2014/10/lockheed-looks-partners-its-proposed-fusion-reactor-0