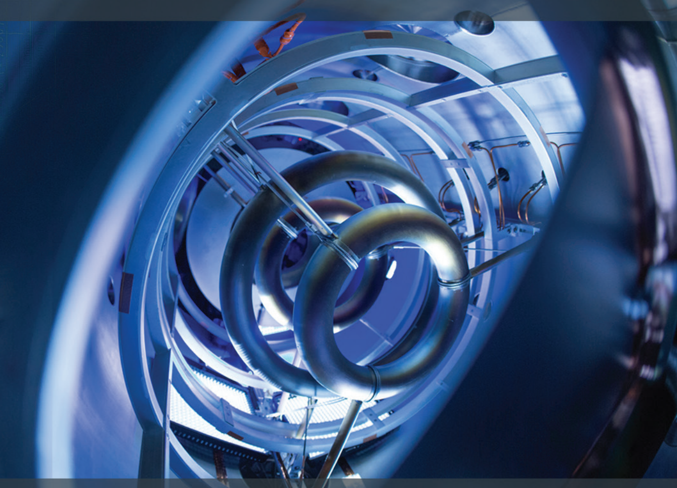
WE'RE ENGINEERING A BETTER TOMORROW

COMPACT FUSION

BEING SMALL IS A BIG DEAL



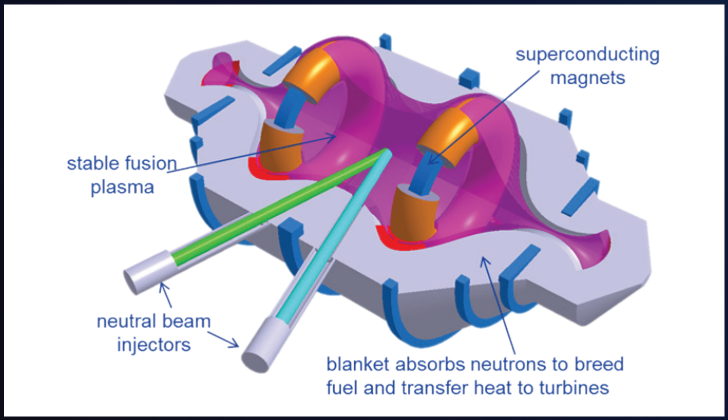
The magnetic coils inside of the compact fusion (CF) experiment are critical to plasma containment.

As energy drives our standard of living, industrial output and food production, global energy security becomes an increasingly important problem. No stranger to tackling complex challenges, the Lockheed Martin Skunk Works® is using its resources to develop a viable, sustainable source of infinite energy – compact nuclear fusion.

HOW A COMPACT FUSION REACTOR WORKS

Nuclear fusion is the process by which atoms combine into more stable forms, releasing excess energy in the process. Fusion fuel starts as a gas injected into an evacuated containment vessel. Energy is added and the gas breaks into ions and electrons, forming plasma. This hot plasma is prevented from touching the vessel by strong magnetic fields. If the confinement of the plasma is good enough, the ions can overcome their mutual repulsion, collide, and fuse. When they fuse, new particles are created and they fly apart at high speed, carrying the released energy kinetically. Some of these particles are neutrons and pass through the confining magnetic fields. These neutrons hit the wall and deposit their energy as heat, which can then be used to drive turbine generators by replacing the combustion chambers with simple heat exchangers. The turbines would generate electricity or the propulsive power of ships and airplanes.

Building on the scientific progress of 60+ years of fusion research and investment, the Skunk Works is using a new magnetic field geometry which offers a 10x reduction in size compared to the mainstream tokamak fusion efforts.



A notional 100 MW compact fusion reactor is shown above, which would be roughly 10 meters by 7 meters in diameter. The superconducting coils produce a border magnetic field that contains the hot fusion plasma. Neutral beams injectors ignite a burning plasma and the device then runs in steady-state. Neutrons from fusion reactions deposit their heat in the reactor wall and that heat is carried to turbine generators to generate power or propulsive thrust. Tritium fuel is continually bred in the wall and fed back into the reactor along with deuterium gas to sustain the reactions.

FAQs

WHY ARE YOU CHOOSING TO SPEAK ABOUT THIS EFFORT NOW?

As we gain confidence and progress technically with each experiment, we are looking to build our team. We are looking for partners to work on the project and support it. We think it is important for the public and decision makers to understand the real promise that compact fusion has for our nation and the world as a near-term solution to our energy needs.

WHERE ARE YOU IN TERMS OF DEVELOPMENT?

We are currently running experiments to prove the performance of our novel confinement approach. While it is still early in the process, the preliminary results are promising and there are several patents pending that cover our approach and many of the concept's subsystems. We have shown that we can complete a design/build/test cycle in as little as a year, which is one of the strongest attributes of the compact approach to fusion.

It could take at least five of these one-year cycles to develop an operational prototype. This time frame is dependent on a variety of factors including funding and a motivated team to move the program along at this pace.

WHAT APPLICATIONS DOES COMPACT FUSION HAVE?

Our 100 MW compact fusion reactor design would power 80,000 homes and could be aggregated to power large cities. A compact fusion system would be ideal for safely powering naval vessels, providing unlimited range. Compact fusion could be made small and light enough to fit on a large airplane, eliminating the need to refuel and giving unlimited range. A 100 MW system would only burn less than 20 kg of fuel in an entire year of operation. Small fusion reactors could generate significantly cheaper electricity than current technologies, bringing the cost of desalination down to the point where it could be more widely deployed in water scarce regions of the US and the world. Compact fusion would be an ideal technology to power our future electric-based transportation systems.

WHY IS THE SKUNK WORKS TRYING TO DEVELOP THIS TECHNOLOGY?

As a global defense company, Lockheed Martin takes a comprehensive approach to solving global energy and climate challenges, delivering solutions in the areas of energy efficiency, smart energy management, alternative power generation and climate monitoring. Our work in compact fusion is part of that bigger equation to provide the world with an unlimited supply of clean energy; effectively removing energy scarcity as a source of conflict. If anyone can solve a problem as hard as this, it's the Skunk Works.

WOULD A COMPACT FUSION REACTOR GENERATE RADIOACTIVE WASTE?

The waste footprint is orders of magnitude less than coal plants, which require huge landfills to contain the toxic ash and sludge wastes. The first generation of fusion reactors will run on deuterium-tritium fuel but successive generations would use fuels that could eliminate the radioactivity altogether.

The levels of radioactivity are benign compared to fission reactors. At the end of useful life, most of the material in the heat transfer blanket can be recycled and used in new reactors.

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