An American company thinks it can have a commercial reactor ready and working within a decade

ONE of the clichés of nuclear-power research is that a **commercial** fusion reactor is only 30 years away, and always will be. Hence a flurry of interest—and not a little disbelief—when in October news **emerged** that Lockheed Martin, a big American engineering and defence company, has a new design for a fusion reactor that it believes could be up and running within a decade. A team at Lockheed's renowned Skunk Works, where its wilder (and often secret) ideas are **developed**, reckons fusion is **ripe** for a rethink.

Attempts to **harness** the types of reaction that power the sun and hydrogen bombs in order to generate electricity go back to the 1950s. The latest, a **device** called ITER, is under **construction** in France. Fusion is attractive **in principle**. It does not **generate** the same amount of nasty, long-lived radioactive **waste** that its cousin nuclear fission does. Its principal **fuel** is deuterium, an isotope of hydrogen that is found in water and is thus in **limitless** supply. And a fusion reactor would be **incapable** of having a meltdown. But it is hard in practice. Reactors like ITER, known as tokamaks, are huge and **temperamental** undertakings. Even when they work as prototypes, they do not look the stuff of commercial power generation.

A tokamak works by heating light atoms (deuterium and a second hydrogen isotope called tritium) in a doughnut-shaped containment **vessel**, to the point where the atoms' electrons fly off and a soup of free electrons and naked atomic nuclei, called a plasma, **results**. This plasma is both confined within the **vessel** and heated by magnetic fields. Heat the confined plasma enough and the nuclei within it will **merge** when they hit each other, creating helium nuclei and free neutrons. The neutrons then carry **further** heat generated by this fusion reaction out of the plasma, and that heat can—in principle—be used to generate electricity.

As Tom McGuire, who is leading the Lockheed team, notes, **however**, the circular magnetic fields which coil around a tokamak's doughnut become **unstable** if the plasma's **pressure** is too high. Those instabilities permit the plasma to touch the reactor wall, at which point it cools and the whole thing shuts down. The plasma's pressure has therefore to be kept low, which **reduces** the rate at which nuclei **encounter** each other, and with it the **rate** of fusion. This means even the best tokamaks produce only about as much power as they **consume.**

Dr McGuire's **compact** reactor has a different field design. Its field actively **strengthens** as the plasma gets closer to the wall, meaning it can be **maintained** at much higher pressures. This makes the reactor more **efficient** and allows it to be much smaller for a given power output.

That matters. ITER, when it is finished, will weigh 23,000 tonnes and stand almost 30 metres (98 feet) tall. This is a giant **undertaking**, and yet another reason to **doubt** the tomahawk approach's commercial viability. Dr McGuire, though, thinks his design could deliver a 100MW reactor (able to power 80,000 homes) of about 7 metres in diameter, weighing less than 1,000 tonnes. Indeed, smaller **versions** might fit on a large lorry.

Dr McGuire's design is, however, just that—a design. And therein lies the rub. Lockheed says it plans to have a working **prototype** running in five years and the first operational reactors in ten. For that to happen, Dr McGuire and his colleagues need the help of other fusion experts, which is why the firm has gone public. Nevertheless, **though** ten years is not 30, it is still quite a long time. Those who think commercial fusion really does have a future should not hold their breath.

Adapted from: The Economist