A future energy giant? India's thorium-based nuclear plans

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As part of an ambitious three-stage plan to fulfil its nuclear vision and desire for energy security, India could find itself a leading global exporter of an alternative nuclear technology that is more efficient than today's uranium-plutonium fuel cycle.

In October's Physics World - having toured through India's nuclear labs with a British High Commission team -- science writer Matthew Chalmers details India's vision of a secure nuclear-energy future based on thorium technology.

With 40% of its population not yet connected to the electricity grid and an economy growing by about 8% each year, India's need for a bold energy strategy is apparent. While India already has 19 operational pressurized heavy water reactors (PHWRs), the government is planning

to increase its nuclear contribution from its current 5GW to 28GW in the next 10 years and to a huge 270GW by 2050.

India's three-stage vision was first set out in the 1950s by the father of the country's nuclear programme, physicist Homi Bhabha. On returning from his studies at Cambridge University in the UK, Bhabha conceived a nuclear strategy that would work around India's rather meagre resources of uranium, the fuel powering current commercial reactors. Instead, he sought to exploit the country's vast reserves of thorium, which - if bathed in an external supply of neutrons - can be used a nuclear fuel.

The first stage of India's grand plan is based around the country's fleet of PHWRs and state-of-the-art research facilities, which have proceeded steadily despite the country being isolated for more than 30 years from the international uranium community after it detonated a nuclear device in 1974.

But following a landmark agreement with the US in October 2008 on civil nuclear co-operation, India can now, in principle, import fuel and reactors, while building more of its own, indigenous PHWRs. These reactors burn uranium while irradiating thorium oxide to produce uranium-233.

Stage two, which seeks to plug India's energy deficit by 2050, involves using reprocessed plutonium to fuel "fast reactors" that breed further uranium-233 and plutonium from thorium and uranium.

In stage three, advanced heavy-water reactors will burn uranium-233 while converting India's thorium reserves into further uranium in a sustainable "closed" cycle. All three stages are running parallel and each has been demonstrated on a laboratory scale.

The UK is also getting on India's thorium plans, with five nuclear-

research proposals worth more than £2m being jointly funded by the UK's Engineering and Physical Sciences Research Council and by India's Department of Atomic Energy. One of the grant holders is Mike Fitzpatrick from the Open University, who has already visited India's Bhabha Atomic Research Centre in Mumbai and claims to be "amazed at the ambition and resource behind India's nuclear programme, and how much UK researchers could benefit from being associated with it".

India's energy future doesn't however end with thorium. As Chalmers writes, "In a modern context, Bhabha's nuclear vision is part of a wider goal for clean, affordable energy also in form of solar, wind and hydroelectricity - all of which India is investing in heavily.

"India's nuclear programme could even one day encompass nuclear fusion, with the country already a partner in the ITER project currently being built in France, "

More information: www.physicsworld.com/

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