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RUSSIA'S HYBRID FUSSION – FISSION REACTOR AMBITION

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On October 15, 2014 reports came in that Russia was developing hybrid nuclear reactor that would incorporate both fission and fusion reactors.[1] In recent times, development of hybrid nuclear reactors has become a burning issue since once it is successfully developed it is indeed going to be a state-of-art technology in nuclear science. In hybrid reactors, the neutrons of 14MeV are generated by the fusion reactor to burn up the waste produced by fission reactor in order to generate minimal radioactive waste. It is a branch of sub-critical reactor technology since in hybrid technology; fission chain reaction cannot be sustained unless enough neutrons are produced by the fusion core.

It is a well known fact that the global fusion reactor technology the International Thermo Nuclear Experimental Reactor (ITER) project under the European Union, China, India, Japan, Russia, the United States, and South Korea which started in 2006 had suffered delays due to the rise in the cost to develop the reactor, followed by construction delays and also environmental disasters like the 2011 earthquake in Japan. Considering these issues, the then outgoing director general of the ITER project in July 2014 had stated that a fully functional fusion reactor[2] is only possible by 2027.[3]

Considering delays in this ambitious project and Russia's desire to expand its nuclear energy program, the hybrid project would be a "stepping stone to building a true nuclear fusion reactor"[4] and also "improve the efficiency of nuclear energy."[5]This kind of

technology is expected to generate more power and at the same time considered less hazardous since the output of the power generated can be controlled through fission reaction.[6] A fission-based nuclear reactor on the other hand, is said to generate radioactive "transuranic" waste which are heavier than uranium. This waste also includes plutonium which can be used in the development of nuclear weapons. Fusion reactors result in release of tritium which is highly radioactive and "difficult to contain."[7] Nuclear fusion reactors also result in production of nuclear sludge waste which is a difficult to destroy in fission reactors but can be easily destroyed in hybrid reactors.[8]Thus, Hybrid nuclear technology would indeed be a nuclear renaissance and a move towards "green nuclear power."[9] Also, fusion reactor is not economical since this type of reactor must achieve high energy breakeven unlike in hybrid reactors where the energy breakeven by fusion reactors to sustain fission reaction is very low.

The report published on October 15 2014, also stated that Moscow had invited China to join this endeavour. This is not surprising given China's long standing cooperation with Russia in matters pertaining to nuclear technology. Moreover, Chinese scientists themselves have struggled with this technology as a part of its national program ever since 1986.[10] Also, it cannot be eschewed that Russia does realise the folly it committed during the Cold War era of choosing to stay in isolation which kept it bereft of availing sophisticated technology pertaining to nuclear safety and security leading to the Chernobyl crisis. In fact, according to President Gorbachev, the Chernobyl was a more vital factor for the downfall of the Soviet Union than perestroika.[11] Moreover there is also the economics side to this. Russia is willing to "strengthen nuclear cooperation"[12] as China has world's second largest nuclear energy demand after the United States.[13] In addition, both Russia and China can share the cost of developing this kind of technology rather than Russia having to bear the burden on its own.

Fukushima disaster has raised the concerns for enhancement of nuclear safety measures.

Hence, China clearly vouches for nuclear safety and security measures as reflected in President Xi Jinping's statement at the Nuclear Security Summit in March 2014, "without

effective safeguards for nuclear safety and without an adequate response to the potential risks of nuclear materials and safety, such a bright future [nuclear energy] will be overshadowed by dark clouds or even ruined by resulting disasters."[14]

Another noteworthy point is that this hybrid reactor technology limits the scope of development of nuclear weapons. Given the dual use nature of nuclear technology, it has always been saddled with the problem of nuclear proliferation. Proliferation resistant technologies, therefore, could be the best way to prevent nuclear proliferation. Hybrid reactors make the process of enrichment and reprocessing, which could have otherwise led to the development of nuclear weapons[15] difficult. This is due to the fact that the concentration of fissile fuel is in sub-critical form. Hence the country to which the fissile fuel is proliferated would require very advanced enrichment technologies to produce nuclear weapons from this fissile fuel.

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However, it should be noted that building a hybrid reactor technology is a complicated process which involves developing a fusion reactor inside a nuclear fission reactor and hence, would require considerable expertise in nuclear technology.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

End Notes

[1] "Russia develops hybrid fusion-fission reactor, offers China," *RT.com,* October 15, 2014, *at* http://rt.com/news/196088-russia-hybrid-nuclear-reactor/

[2] That is not just the demonstration of the first plasma but also after the effective operation of the deuterium-tritium plasma.

[3] Elizabeth Ginny, "Five-year delay would spell end of ITER," *Nature.com,* July 31, 2014, *at* http://www.nature.com/news/five-year-delay-would-spell-end-of-iter-1.15621

[4] n.1

[5] Quoted Mikhail Kovalchuk, The Russian Head of the National Research Centre Kurchatov Institute, "Russia and China conducted nuclear reactor project hybrid," *La Info.es*, October 14, 2014, *at* http://lainfo.es/en/2014/10/14/russia-and-china-conducted-nuclear-reactor-project-hybrid/

[6] Thus in case of environmental disasters, they would pose lesser threats of nuclear hazards by simply turning off the fusion core.

[7] "Nuclear Fusion Power," *World Nuclear Association*, Updated February 2014.

For this reason there are efforts now given to continue work on deuterium-deuterium fusion process.

[8] Melania Macfarlane, "Fission-Fusion hybrid mops up nuclear," *Cosmos, at* http://cosmosmagazine.com/news/fission-fusion-hybrids-could-mop-nuclear-waste/>

[9] See Robert Arnoux, "Velikhov sees hybrids as key to "Nuclear Renaissance," *ITER*, December 3, 2012, *at* http://www.iter.org/newsline/248/1413

[10] Yican Wu, Jieqiong Jiang, and Yungqing bai and FDS Team, "Fusion Fission Hybrids Driven Research in China," *at* http://web.mit.edu/fusion-fission/HybridsWhite/White_Paper_Wu.pdf, 2009.

[11] "Chernobyl Accident 1986," *World Nuclear Association*, Updated April 2014, *at* http://www.world-nuclear.org/info/Safety-and-Security/Safety-of-Plants/Chernobyl-Accident/

[12] Quoted Gennady Sakharov, RUSATOM director for capital investments, "Russia to study nuclear proposal in NE China," *China Daily*, August 12, 2014, *at* http://www.chinadaily.com.cn/china/2014-08/12/content_18295931.htm

[13] "Russia to study nuclear proposal in NE China," *China Daily*, August 12, 2014, *at* http://www.chinadaily.com.cn/china/2014-08/12/content_18295931.htm

[14] H.E. Xi Jinping statements made at the Nuclear Security Summit in March 2014, *Ministry of Foreign Affairs of the People's Republic of China*, March 25, 2014, *at* http://www.fmprc.gov.cn/mfa_eng/wjdt_665385/zyjh_665391/t1140583.shtml

[15] "A non-proliferation strategy for fusion and fusion/fission hybrid energy systems," *at* http://web.mit.edu/fusion-fission/HybridsWhite/Lehman.pdf

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