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New Developments in NPP

Floating Nuclear Power Plants: Option for Coastal Regions?

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SYNOPSIS

In 2020, Russia launched its first Floating Nuclear Power Plant — the Akademic Lomonosov. Two years on, we are now seeing more manufacturers jumping on this bandwagon. Will floating nuclear power plants (FNPP) be a new platform for the deployment of nuclear energy?

COMMENTARY

SINCE 2001, the world was on the trajectory to a 'nuclear renaissance' owing to rising oil and gas prices as well as efforts to curb carbon emissions. Several countries in Asia had harboured ambitious plans to put new reactors on their grids to expand their economies. Nuclear energy was the viable option to address the twin challenges of energy security as well as climate change.

However, the Fukushima Nuclear Power Plant (NPP) accident in 2011 had not only put several national plans on the backburner, but also shelved the nuclear option completely. Germany had decided to phase out its entire nuclear fleet, while new reactors in China had not come online as planned. Delays in the construction of large-scale conventional NPPs had resulted in massive overruns of the initial budgets. Furthermore, the production of shale-gas had led to a downfall in gas prices. All these factors had undermined the economic attractiveness of nuclear power.

Comeback of Nuclear Energy

Recently, nuclear energy is crawling back into the scene in the form of Small Modular

Reactors (SMRs) that are designed with advanced safety features. The International Atomic Energy (IAEA) sees a wider range of civilian applications of nuclear energy with the advent of SMRs.

Nuclear energy is not only advocated as an outright replacement for baseload power from fossil fuels, but also working alongside renewables as a low-carbon technology that can help nations transit to a more sustainable environment.

SMRs are trending among several member states as they address the factors that had dented the nuclear renaissance — being safe and economical. But is there any compelling advantage for SMRs to be built on a floating platform?

The United States mooted the concept of Floating Nuclear Power Plants (FNPP) for large-scale civilian application, particularly spurred by the negative public perception in selecting suitable sites for its land-based conventional NPPs along its coastlines.,

Genesis of Floating NPPs

FNPP is not a new concept. The first FNPP was built in the 1960s under the US Army Nuclear Power Programme as a mobile reactor to provide electricity to remote sites. In 1968, a 10MW reactor was put onboard a *Liberty* class ship and towed to the Panama Canal to replace a hydropower station and supplied electricity to the zone.

FNPPs, which would be factory-manufactured and placed on top of floating barges, would be considerably cheaper than constructing NPPs on land, with the latter having to withstand seismic and other natural hazards. However, several regulatory and environmental concerns led to the demise of FNPP in the 1970s.

The Russians revived the concept based on the reactors used by their icebreakers and aimed to build a fleet of FNPPs to access remote sites. The first FNPP, the *Akademik Lomonosov*, is now operating at the remote city of Pevek, and has been supplying power to the local community which otherwise had limited access to energy from fossil fuels.

Renewable energy is untenable in the harsh Arctic conditions. The two SMRs onboard the FNPP will be able to supply 70KW of electricity for a 12-year cycle period, before returning to the shipyard for its scheduled maintenance.

Is FNPP Safe?

Most of the reactors currently in operation throughout the world are based on Light Water Reactor (LWR) technology, which uses water as both a coolant and a moderator for the fission process. Hence, water is a critical component which is the reason why most NPPs are sited along coastlines.

Therefore, an FNPP that runs on LWR technology should be intrinsically safe as the availability of water as a large heat-sink will minimise any design risks that could result in a release of radioactivity sources into the atmosphere.

However, safety is not the only constraint on the design of the FNPP. The *Akademik*

Lomonosov operating in the Arctic region will face a different operational challenge if it is deployed in a busy channel, such as the Straits of Malacca.

Currently, the IAEA is working together with the International Maritime Organisation (IMO) to develop guidelines for the transportation of FNPPs in the high seas. At the local level, more agencies will have to be equipped with the relevant skillsets to ensure the safe operation of an FNPP.

An old school thinking is that a mobile system is always more dangerous than its stationary counterpart, so if a fixed land-based NPP is already an unsafe asset, how much more can one expect from a mobile reactor like the FNPP?

One should perhaps adopt an alternative viewpoint from risk management, whereby a mobile system can offer more flexibility in terms of risk mitigation. The Fukushima NPP could not avoid the wrath of the tsunami because it remained stationary, but had it been built on a floating platform, could it have avoided the disaster?

Booming Market

The operational challenges and international guidelines will adapt to the changing platforms of technology. The FNPP was developed to overcome challenges of fixed land-based NPP, i.e., to provide power to remote islands that are not plugged into the national grids. Its capacity as an SMR will also be adequate for the cogeneration of electricity and potable water.

Contrary to the thinking that FNPPs are unsafe, the general narrative is that FNPP will have lesser footprint in a densely populated region. Against the backdrop of climate change awareness, we are likely to see FNPPs deployed to advanced densely populated communities along the coasts.

As such, the change in risk perception and growing demands for clean energy have led several developers of SMRs to partner with ship-building companies to deploy FNPPs in the future.

China is developing FNPPs based on Russian design, while South Korea’s KEPCO is partnering with Hyundai Heavy Industry to develop an FNPP with a 60 -year operating life. Danish start-up, Seaborg, is working with Samsung Heavy Industries that will run a compact molten salt reactor (CMSR) on a barge.

Even NuScale, the leading developer of SMRs in the US, has signed a Memorandum of Understanding with Prodigy of Canada to roll out FNPPs in the near future. All we know is that Russia is not the only one in this competition.

Southeast Asia, with its coastal archipelagic geography, sees a high prospect of FNPPs operating in the region. Vietnam had recently concluded a study with Seaborg and had identified potential sites for the deployment of FNPPs. A paradigm shift is needed to incorporate the flow of FNPPs transiting through the Southeast Asian region, because a mobile Nuclear Power Station is no longer a localised issue.

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