India’s Submarine Deterrent and Asian Nuclear Proliferation

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India has become a more or less accepted member of the global nuclear order, but the state’s emerging undersea deterrent continues to be a source of concern. Its efforts to create nuclear-armed submarines began in the 1980s, and technical progress was slow during the project’s first three decades. India has recently made some bold strides, however, and in 2009 unveiled its first nuclear submarine, INS Arihant. The boat is now undergoing sea trials, and is scheduled to be introduced into the Indian Navy by early 2015. Several similar vessels are under construction: New Delhi plans to field a fleet of between four and six nuclear-armed submarines by the end of the decade.

The project presents three challenges to the nuclear non-proliferation regime. The first of these relates to naval propulsion systems based on highly enriched uranium (HEU), a substance that is comparatively easy to use in weapons manufacturing. Indeed, the nuclear weapons India tested in May 1998 used HEU ostensibly produced for its naval programme. This danger is compounded by a weak verification regime: both the Nuclear Non-Proliferation Treaty (NPT) and the proposed Fissile Material Cut-Off Treaty allow states to pursue uranium enrichment for naval nuclear reactors without safeguards.

Secondly, as India prepares to equip its nuclear submarines with ballistic and cruise missiles, doubts are being voiced over the effectiveness of
its warhead designs. The alleged failure of the 1998 tests, which partly concerned miniaturisation, makes it unclear whether India has created nuclear warheads small enough to fit into the missile tubes of a nuclear submarine. New Delhi will face immense pressure from within its strategic community to conduct further tests to allay such doubts.

Lastly, the disruption caused by the introduction of the *Arihant* is likely to affect India’s strategic rivalries with China and Pakistan, which could feel compelled to ensure that Islamabad maintains parity with the new nuclear force. In light of such dangers, New Delhi must act cautiously if the *Arihant* is to support both Indian and global security.

**India’s naval nuclear ambitions**

India’s undersea deterrent has become the symbol of both its great-power status and its increasing technological prowess. In a July 2009 address to mark the unveiling of the *Arihant*, a product of the Advanced Technology Vessel project, then-Prime Minister Manmohan Singh congratulated India’s navy and scientific community, and reserved special praise for Russia, whose assistance was critical. The speech neatly summarised the project’s development trajectory. A team drawn from the Indian navy and the Indira Gandhi Centre for Atomic Research at Kalpakkam, part of the Department of Atomic Energy, named the programme to develop the *Arihant*’s reactor the ‘Plutonium Recycle Project’. India’s Defence Research and Development Organisation designed the ballistic missiles for the submarine. One is a short-range ballistic missile, initially called ‘K-15’ and recently renamed ‘BO-5’, which has an effective range of 750 kilometres. The second, the K-4/K-X intermediate-range missile, has a range of 3,000km, and was tested in March 2014. It borrows heavily from technology developed under the *Agni* missile project, and is based on the *Agni*-3.

Singh did not address the initial source of India’s interest in nuclear submarines, however, and its timing remains unclear. One source claims that the idea originated in advice given to Indian diplomatic and naval officers by Soviet Admiral Sergey Gorshkov in 1968. In any case, a strong motivator for the submarine project was America’s deployment of the nuclear-armed USS *Enterprise* carrier group to the Bay of Bengal during the 1971 India–Pakistan
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War.⁹ The prospective Indian nuclear submarine was thus, as Ashley J. Tellis writes, ‘originally intended as an attack boat capable of stalking superpower fleets operating in the Indian Ocean’.¹⁰ Most analysts argue that Indian research on, and development of, naval nuclear propulsion began in the early 1980s, with the launch of the Advanced Technology Vessel project.¹¹ The Bhabha Atomic Research Centre at Mumbai, India’s leading nuclear-research institution, was entrusted with delivering a functioning reactor for the submarine, while the navy was given oversight of the project.

The programme faced difficulties from its inception, as the centre failed to produce a reactor that was sufficiently small, safe and robust.¹² With the institution’s limited technology, enriching uranium to fuel the reactor was also a problem.¹³ Moreover, bureaucratic tension arose between the centre and the navy, with the latter frustrated by its partner’s halting technological progress.¹⁴

Facing these limitations, and unwilling to forgo the domestic secrecy surrounding the project to draw on broader indigenous expertise and resources, New Delhi turned to Moscow. The subsequent Soviet and Russian assistance to India’s submarine project has come in various forms. The eventual design of the Arihant’s reactor benefitted from Russian technical expertise, and the submarine is thought to have been modelled on the Soviet Charlie-class vessel.¹⁵ India also leased nuclear attack submarines from Russia to train Indian Navy personnel.¹⁶ This is the only instance in which a state outside the NPT has operated a nuclear submarine of a country covered by the treaty.

The secrecy surrounding the Arihant project was pervasive, and it was not until 1999 that the existence of the initiative was publicly acknowledged, with a reference to a nuclear triad in India’s 1999 draft doctrine. Further details came with the 2003 formation of the Nuclear Command Authority, which granted equal representation to all three military services.¹⁷ The navy began emphasising nuclear assets in its doctrines in 2004.¹⁸

After overcoming delays to the Advanced Technology Vessel project caused by poor management and stringent secrecy, the miniaturised naval reactor went critical in November 2003. Work on its integration with a submarine hull then began at a secret location on India’s eastern coast, near
Visakhapatnam.\textsuperscript{19} The challenges faced by the programme have generated widespread uncertainty about New Delhi’s naval and nuclear intentions, and the secrecy has continued, with the Indian leadership even refusing to discuss the details of the Advanced Technology Vessel project with members of parliament.\textsuperscript{20}

The HEU conundrum

Minimising the use of HEU has attracted much international attention in recent years, as could be seen in the discussions on reducing global stockpiles at the 2010 and 2012 nuclear-security summits organised by US President Barack Obama, held in Washington and Seoul respectively.\textsuperscript{21} These meetings accelerated states’ conversion of research reactors to run on low-enriched uranium (LEU), and joint technological development for producing medical and other radioisotopes based on LEU rather than HEU.\textsuperscript{22}

There is a mismatch, however, between this zeal for reducing the use of HEU in civilian nuclear activities and the enthusiasm with which it is employed in the military domain, especially in naval nuclear propulsion. Most states’ nuclear submarines require HEU-based fuel.\textsuperscript{23} The United Kingdom and United States use 90\% HEU for their naval reactors, while Russia uses 40–45\% HEU. Only France and China use LEU to fuel their submarines.\textsuperscript{24}

This critical gap in the non-proliferation regime has important consequences. Article III of the NPT mandates International Atomic Energy Agency (IAEA) safeguards for the nuclear activities of all non-nuclear-weapons states. However, INFCIRC/153, the IAEA’s standard text on these safeguards, does not proscribe states from engaging in uranium enrichment for naval nuclear propulsion.\textsuperscript{25} As Greg Thielmann and Serena Kelleher-Vergantini have argued, this ‘minimal legal framework’ makes it ‘very difficult for the IAEA to achieve a timely detection of any nuclear weapons-related use of fissile material designated for naval nuclear propulsion’.\textsuperscript{26} Compounding this weakness, the proposed Fissile Material Cut-Off Treaty, mandated in 1994 by the Conference on Disarmament, avoids confronting the challenge posed by naval reactors.\textsuperscript{27} Although the treaty endeavours to freeze production of all fissile material for weapons purposes, its framework also allows states to pursue uranium enrichment for naval propulsion.\textsuperscript{28} All
major states that advocate a ban on the future production of fissile material have been silent on the issue.29

Discouraging naval propulsion based on HEU is therefore extremely important to non-proliferation and nuclear-security initiatives. Yet the emergence of the Arihant suggests that such efforts are failing.

India’s undersea deterrent
Brazil, Argentina and Iran are among several states with active nuclear-submarine projects.30 As these countries have signed the NPT as non-nuclear-weapons states, the IAEA is permitted to supervise their enrichment programmes, albeit in a limited capacity. Accordingly, the real concern for the non-proliferation community should be states that have not signed the treaty but have shown an interest in naval nuclear-propulsion technology, such as India and Pakistan.31

The appeal of nuclear submarines is that they are hard to detect and destroy, guaranteeing the survivability of nuclear forces in the event of an otherwise incapacitating first strike on land-based forces. Several Indian analysts contend that their country’s nuclear-submarine force will have a positive influence on stability in South Asia.32 They argue that it will reinforce India’s second-strike capability, thereby allowing the state to deter adversaries with a small number of nuclear weapons, and will be consistent with its force posture of no first use.33

India operates two HEU-production facilities, both based on gas-centrifuge technology.34 One is a pilot project at the Bhabha Atomic Research Centre. The second is the large-scale Rare Materials Plant at Rattehalli, which began producing HEU in the early 1990s.35 This facility provides the fuel for India’s nuclear-submarine project, producing 20–40% enriched uranium.36 It appears that HEU from the plant was used in the 1998 nuclear-weapons tests, including in the fission-boosted nuclear device.37 According to analyst M.V. Ramana, the Rattehalli plant currently has a capacity of 4,500 separative work units per year, and is capable of producing 22 kilograms of 90% enriched uranium or 40–70kg of 45% enriched uranium.38 These figures are rather conservative, however, compared to a 2006 estimate by David Albright and Susan Basu.39 According to this latter report, India
has both improved its centrifuges and installed more of them. Albright and Basu suggest that the state runs 2,000–3,000 centrifuges, with a combined capacity of 9,600 separative work units, enough to produce 45–50kg of 90% HEU every year.40

As India prepares to deploy a fleet of nuclear submarines, its demand for uranium enrichment will increase further. Meeting such demand has been made easier by the US–India civil nuclear agreement, which allows New Delhi to import uranium for its civilian energy projects, freeing up domestic production for military applications.41 The deal also opened the international nuclear-technology market to India, which may help it to acquire more sophisticated enrichment systems.42 Furthermore, it missed an opportunity to safeguard India’s HEU cycle, which is not covered by the accord that state signed with the IAEA in 2008.43

But the US–India agreement is not entirely to blame for heightened proliferation risks. Given the importance of the submarine project to Indian security policy, New Delhi would have continued its quest for uranium enrichment without the deal. And India would not have signed an accord that mandated safeguards on its HEU cycle. The Indian scientific community considers its HEU technology (alongside its fast-breeder reactors) to be an important strategic asset that it would not permit to be sidelined in the name of international cooperation.44

Test reliability
As well as complicating the Fissile Material Cut-Off Treaty and efforts to convert nuclear-submarine fuel from HEU to LEU, the Arihant has increased domestic pressure to test India’s nuclear warheads. The miniaturisation process has required the development of devices with a more distant relationship to their progenitors of 1998, strengthening support for a new round of testing. More importantly, doubt over the reliability of the weapons has stemmed from uncertainty about the success of the 1998 tests.45 A former chief of the Indian Navy has argued:

All that remains to be tested is how the K-15’s nuclear warhead will fare during its hypersonic flight and white-hot re-entry into the atmosphere;
and the kind of explosive yield that its nuclear blast will deliver. However, the last bit may remain an unknown, in view of India’s self-imposed 1998 test-moratorium and the Comprehensive Test-Ban Treaty.\textsuperscript{46}

New Delhi’s ostensible confidence had led it to adopt a moratorium on further nuclear tests and a plan to sign the Comprehensive Test-Ban Treaty.\textsuperscript{47} When doubts about the 1998 tests were echoed by foreign strategists, the Indian government attested to their success.\textsuperscript{48}

In recent years, however, scientists and military officers have begun to question the government’s reluctance to address lingering concerns. At a major nuclear-policy conference in August 2009, K. Santhanam, project director of the 1998 tests, publicly declared that the thermonuclear device was a ‘fizzle’.\textsuperscript{49} This sparked a fierce public debate, fuelled by Santhanam’s claim that he had broken his silence only because the Obama administration had pressed New Delhi to sign the Comprehensive Test-Ban Treaty.\textsuperscript{50} Despite the assurances provided by Singh and senior Indian scientists, concerns about weapons reliability have also made New Delhi more reluctant to publicly discuss India’s future approach to the Comprehensive Test-Ban Treaty.\textsuperscript{51}

**Submarine proliferation in South Asia**

The arrival of the *Arihant* may worsen another traditional problem for international non-proliferation efforts: the nuclear relationship between China and Pakistan. India’s introduction of the *Arihant* suggests that it has mastered an aspect of nuclear technology that Pakistan is unable to replicate indigenously. Beijing has often helped Islamabad to bridge such gaps, and China’s growing emphasis on nuclear submarines as a foundation of its own nuclear deterrent increases the likelihood that it will do so in this case. This shift of focus was highlighted by China’s introduction of a fleet of *Jin*-class ballistic-missile submarines, following decades of reliance on long-range, land-based nuclear missiles.\textsuperscript{52}

Beijing has long assisted Islamabad’s missile programmes, beginning with the rocket project of the Pakistani Space and Upper Atmosphere Research Commission in the late 1980s. This cooperation led to the creation
of the short-range Hatf-1 and Hatf-2 missiles, intended as counterparts to India’s Prithvi missile. Beijing also sold 34 M-11 missiles, along with supporting technology, to Pakistan in 1992. Pakistani scientists developed the Hatf-3 using their newfound knowledge of the M-11.53

Chinese nuclear aid to Pakistan has included HEU and warhead designs, the latter of which were peddled by Abdul Qadeer Khan’s proliferation network. China’s desire to enhance its partner’s nuclear programme has therefore had a significant effect on international security and non-proliferation initiatives. The problem persists: both the US director of national intelligence and the chairman of the Indian National Security Advisory Board have recently commented that public and private Chinese organisations still provide Pakistan with technology relating to nuclear, chemical and biological weapons, as well as missiles.54

Pakistani officials have signalled their intention to develop a fleet of ballistic-missile submarines in response to the Arihant. A May 2012 press statement from Pakistan’s Directorate for Inter-Services Intelligence depicted a new naval headquarters as the ‘custodian of the nation’s 2nd strike capability’, despite Islamabad’s lack of a seaborne nuclear deterrent. This followed remarks made in February 2012 by the chief of Pakistan’s navy, who acknowledged the emergence of the Arihant and affirmed that Pakistan was ‘taking necessary measures to restore the strategic balance’.55

Yet only Britain, China, France, India, Russia and the US have managed to build nuclear-armed submarines. The possibility that China will bridge the gap between Pakistan’s intentions and its technical capabilities is a growing source of concern for Indian strategists:

> Ever since India’s successful launch of the nuclear-powered submarine, INS Arihant, and the lease of another nuclear submarine, INS Chakra, from Russia, Pakistan has been pressing for a similar deal from China. Going by the record of China’s expansive nuclear cooperation with Pakistan, it is bound to happen sooner rather than later.56

New Delhi should heed such concerns, and implement new efforts to reduce nuclear risk. These could include a drive to verify HEU stocks and
resistance to domestic pressure for new nuclear tests. India’s leadership on these issues would improve its standing within the global non-proliferation regime, which it could leverage to raise the political costs for Beijing and Islamabad of developing Pakistani ballistic-missile submarines.

The responsibilities of a nuclear-weapons state
To further reduce the risks created by the introduction of the Arihant, New Delhi should reconsider its policy on using HEU for naval nuclear propulsion, and go to greater lengths to deny this capability to potential proliferators. There is a new opportunity for Indian movement on these issues. Following the 1998 tests, India’s stance on the non-proliferation regime changed from one of extreme hostility to one of overt support. Since 2000, New Delhi has shown considerable interest in strengthening the NPT as a bulwark against nuclear proliferation, particularly in light of the nuclear activities of China and Pakistan. Although India is likely to remain formally outside of the NPT, encouraging the closure of naval-reactor loopholes in the treaty would be in its strategic interest, and would strengthen its claim to being a responsible nuclear-weapons state.

India’s naval nuclear programme is likely to emerge as a prime concern of the global non-proliferation regime, and to fuel greater international scepticism about the country’s stated commitment to non-proliferation. Such doubt has had important consequences in the past, as was evident in the significant international resistance faced by a 2008 proposal to exempt India from the Nuclear Suppliers Group’s export-control measures. In that case, it was only diplomatic pressure from Washington that finally persuaded states such as Japan, New Zealand and the Netherlands to approve the exemption.

India certainly seeks the status of a leader in global nuclear security. It was a prominent member of the 2010 Nuclear Security Summit. In the run-up to the second summit, India hosted diplomatic meetings to form a consensus for the meeting’s agenda. During a nuclear-security meeting hosted by the IAEA in July 2013, India’s delegate declared that ‘maintaining effective nuclear security will require continuous national efforts facilitated by international cooperation undertaken on a voluntary basis by all states.'
India could improve its international image by supporting campaigns to limit the use of HEU, regarded as the most pressing issue in nuclear security, and reviewing the ways in which it could reconcile this position with the Arihant’s reliance on the substance. Although switching to LEU for naval propulsion would help to improve India’s reputation, this route poses significant problems for the state as it would require a major redesign of its nuclear-submarine fleet. Having invested vast amounts of time and resources in the current designs, it is unlikely that India will remodel the reactors in this way. A second issue is the effects of LEU on submarine performance: HEU fuel not only prolongs the life of the reactor core, but also drastically decreases the noise produced by the submarine, making it harder to track. It is for these reasons that the British and US fleets still run on 90% enriched uranium.

A more realistic way for India to address the issue of HEU use would be to encourage the development of a verification mechanism under the supervision of the IAEA. The International Panel on Fissile Materials has proposed a plan for such a mechanism, within which a state’s naval HEU stocks would be placed under IAEA safeguards. The organisation would permit HEU to be taken from the safeguarded facility as required, verifying the volume of fissile material removed and comparing it with that used in naval nuclear reactors using radiation spectrometry. This would not only reduce the chance of nuclear material being diverted to weapons production and third parties, but would also prevent irradiated fuel, rich in fissile plutonium-240, from being used in the state’s nuclear weapons. At the end of each cycle, the irradiated fuel would be returned to the IAEA.

In considering the pressure that the introduction of the Arihant places on India’s unilateral testing moratorium, New Delhi must balance its technical requirements against the likely international repercussions of conducting a new round of tests. Any such tests would give Islamabad a reason and political cover to follow suit. Indeed, given that Pakistan’s nuclear-weapons technology relies on HEU and the state has no thermonuclear devices, this would provide an opportunity for it to test plutonium-based fission systems,
and to develop weapons based on such technology. New tests would also help Islamabad to miniaturise warheads for its tactical nuclear weapons. Such developments would have grave consequences for India’s nuclear and conventional security, as well as its reputation.

India should realise that its acceptance into the international nuclear order is incomplete. The state’s quest to gain membership of export-control organisations such as the Nuclear Suppliers Group and the Missile Technology Control Regime still faces international resistance. Much of this opposition has come from states that view India as lacking in its commitment to the non-proliferation regime. By resisting the temptation to conduct further tests and at least signing, if not ratifying, the Comprehensive Test-Ban Treaty, New Delhi would do much to answer the remaining questions about its commitment to arms control and disarmament. This would stand in sharp contrast to the stance of Pakistan, winning India greater international support and increasing condemnation of Beijing and Islamabad.

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New Delhi should recognise that the Arihant poses significant challenges to the global non-proliferation regime and India’s regional security. The submarine contributes to the partly unsafeguarded proliferation of HEU stocks, and its requirement of new, miniaturised warheads amplifies existing domestic pressure for further nuclear tests. Acceding to this pressure in the name of building a reliable fleet of ballistic-missile submarines will greatly damage the international norm against nuclear testing and the future of the Comprehensive Test-Ban Treaty regime, along with India’s international image. The creation of a significant nuclear-technology gap between India and Pakistan could lead to a new round of Chinese technological support and thus contribute to an era of naval nuclear competition in Asia.

New Delhi should anticipate such consequences, adopting measures to reduce their potential effects and counter the international criticism that the Arihant will likely attract. New Delhi’s interests in non-proliferation should prevent it from succumbing to temptation by conducting new nuclear tests, and help it to recognise the high security and reputational costs that they
would carry. Such restraint would also enhance the multilateral pressure it could bring to bear on China, should it assist Pakistan in developing an undersea nuclear deterrent.

Acknowledgments

The authors would like to thank the UK Economic and Social Research Council for funding this research, and Rajesh Rajagopalan, Harsh V. Pant, Mark Fitzpatrick, Timothy Westmyer and Kapil Patil for their comments on the essay.

Notes


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19 Rohit, ‘India Built N-sub in Kalpakkam under Codename “PRP”’. 


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28 Ibid.

29 Harvey, ‘At Sea Over Naval HEU’.

30 Thielmann and Kelleher-Vergantini, ‘The Naval Nuclear Reactor Threat to the NPT’.


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40 Ramana, ‘An Estimate of India’s Uranium Enrichment Capacity’, p. 120; Albright and Basu, ‘India’s Gas Centrifuge Enrichment Program’, p. 9.


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