

BY GREG THIELMANN,
SENIOR FELLOW
with WYATT HOFFMAN
JULY 26, 2012

Submarine Nuclear Reactors: A Worsening Proliferation Challenge

A long submerged flaw in the nuclear Non-Proliferation Treaty (NPT) surfaced conspicuously in June when Iran announced its intent to build a nuclear-powered submarine. The treaty does not ban a non-nuclear weapons state's production of weapons-grade uranium if it is to be used to power a naval reactor. What many now consider a proliferation loophole in the NPT was first seen as theoretical because only nuclear weapons states had nuclear-powered submarines when the treaty was negotiated. Now, as more and more countries initiate or announce intentions to initiate nuclear-powered submarine programs, this excuse for enriching uranium to levels beyond the needs of civilian power reactors intensifies the challenge of achieving U.S. nonproliferation goals.

HIGHLIGHTS

- With Iran's June announcement that "preliminary steps in making an atomic submarine have started," suspicions were raised that Tehran will use the need for naval nuclear reactor fuel as an excuse for producing highly enriched uranium (HEU).
- That the NPT allows non-nuclear-weapons-state members to produce and stockpile HEU for submarine reactors is an increasingly problematic "loophole" in the treaty as more and more countries announce intentions to develop nuclear-powered submarines.
- That the United States and the United Kingdom use weapons-grade uranium in their naval nuclear propulsion systems will further handicap efforts to limit the nuclear weapons capability of Iran and others and inhibit efforts to shrink HEU stockpiles worldwide.
- The United States Government last analyzed the issue of using naval reactors fueled by low enriched uranium (LEU) in 1995 when it decided to endorse current practices.
- Given the increased importance of combating nuclear proliferation and enhancing nuclear security, and in the light of the capabilities demonstrated by France's LEU-fueled submarines, it is time for the United States to take another look at the issue before it finalizes the design for the Ohio-class SSBN follow-on.
- The House Armed Services Committee has called for such an analysis in its report on the Defense Authorization Bill. The Senate and the administration should enthusiastically support this initiative and work to tighten NPT allowances for submarine reactor fuel.

Iran takes the plunge?

Abbas Zamini, Deputy Commander of Iran’s navy was quoted by the Fars News Agency on June 12 as saying: “Preliminary steps in making an atomic submarine have started and we hope to see the use of... nuclear submarines in the navy in the future.”¹ For good measure, an Iranian parliamentary committee approved a bill a few days later that would require the government to design nuclear-powered merchant ships and provide them with nuclear fuel.

Atomic Energy Organization of Iran (AEOI) Director Fereydoun Abbasi said on July 22 that if his government made a decision to pursue maritime reactors, his agency would have “no problem”² in doing so. Abbasi also said that if a higher than 20 percent level of enrichment were needed to fuel merchant marine and submarine reactors, the AEOI would inform the International Atomic Energy Agency so that the agency could facilitate the process of supplying Iran with the required nuclear fuel.

Iran’s technical ability to build nuclear-powered submarines is as dubious as its military requirement for such weapons. And considering that the highest priority demand of the six-powers in the Iran nuclear talks is for Tehran to halt its ongoing production of near-20 percent enriched uranium, the Iranian announcements for naval nuclear reactor fuel were immediately seen as politically motivated.

By concocting an additional justification for enriching in excess of the 3-5 percent needed to fuel civilian nuclear power plants, and possibly in excess of the 20 percent required for refueling the Tehran Research Reactor (TRR), Iran acquires additional leverage in the negotiations. Since the United States and the United Kingdom both use only weapons-grade

uranium in their naval nuclear reactors, Iran can claim a right to do the same without admitting any intent to use the uranium to build nuclear weapons.

Unfortunately, the nuclear material in a military propulsion program may be withdrawn from IAEA safeguards and the stockpiles of potentially weapons-grade uranium would be available to draw on for the production of nuclear weapons. Former Deputy IAEA Director Olli Heinonen has estimated that HEU amounts needed for fueling an Iranian test reactor and a small nuclear powered submarine could instead be used to produce half a dozen nuclear weapons.³

Michael Adler, a Woodrow Wilson Center scholar and long-time observer of Iran’s nuclear program, sees close parallels between the logic developed by Tehran for raising its level of enrichment by saying it will build nuclear submarines and its earlier use of the need to refuel the Tehran Research Reactor as justification for enhancing the level of uranium enrichment beyond 5 percent. By Adler’s reckoning, Iran may be laying the groundwork to justify enriching beyond 20 percent, explaining its need to stockpile fuel for an eventual submarine reactor.⁴

As with other Iranian justifications for enriching above levels needed for power reactors, the submarine gambit does not need to be particularly credible to be useful. Its utility would include providing a cover for Iran’s refusal to accept limits on enrichment and a political argument for fending off IAEA access to sensitive facilities. Just as the U.S. practice of using 90+ percent enriched uranium fuel in its own nuclear-powered submarines will handicap it in seeking to prevent an Iranian nuclear weapons program, so too does it burden international efforts to constrain dangerous nuclear infrastructure and curtail the

Table 1: Nuclear-Powered Submarines

COUNTRY	NUMBER OPERATIONAL (OR PLANNED)	FUEL ENRICHMENT, AS PERCENTAGE OF U-235
United States	71	90+
United Kingdom	12	90+
Russia	30	40-90
France	10	7.5
China	7-8	5
India	(3-5)	40
Brazil	(6)	<20

Other countries expressing an intent to lease or build nuclear-powered submarines include: **Argentina, Iran, Pakistan, Venezuela**

Sources: Various



Antonio Scorza/FP/Getty Images

A Brazilian navy officer stands by a longitudinal section of a scale model of the future Brazilian nuclear-powered submarine at a trade fair in Rio de Janeiro in April 2011.

production of fissile material.

A growing list

Until now, only the five NPT nuclear weapons states have built and deployed nuclear-powered submarines – with either the principal mission of sinking surface ships or submarines (“attack submarines”), or the principal mission of launching ballistic or cruise missiles to attack land targets (SSBNs/SSGNs). Only three of the five (U.S, U.K., Russia) use highly-enriched uranium (HEU) in their propulsion systems; Chinese and French submarine reactors operate on low-enriched uranium (LEU). [See Table 1]

At the present time, India is on the verge of introducing its own nuclear-powered, ballistic missile submarine, expected to use non-weapons grade (40 percent enriched) HEU. Brazil plans to launch the first of six nuclear-powered attack submarines by the middle of the next decade, reportedly fueled by LEU. Pakistan announced in February that it planned to have a nuclear-powered submarine operational by the end of the decade. Argentina and Venezuela have also announced their intention to develop or otherwise

acquire nuclear-powered submarines, according to press reports.⁵

Closing the submarine fuel loophole

Non-nuclear-weapons-state members of the NPT are obligated to accept monitoring of their nuclear facilities and activities by the International Atomic Energy Agency (IAEA) “for the exclusive purpose of verification...with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices.” However, naval nuclear propulsion is a use of nuclear energy for other than nuclear weapons or other explosive devices. NPT member states are therefore allowed to remove from IAEA safeguards nuclear material intended for non-proscribed military uses such as submarine propulsion. These states could even claim that large amounts of weapons grade uranium needed to be stockpiled for this purpose.

Exploitation of the NPT “loophole” for naval reactor fuel by Iran, Brazil, Argentina, and Venezuela is a critical nonproliferation concern for the international community, because the “legitimate” accumulation

of HEU stockpiles by these – or by other states in the future – could put them in a position to rapidly break out of the treaty.

UN Security Council Resolution 1887 in 2009 called upon all states to “minimize to the greatest extent that is technically and economically feasible the use of highly enriched uranium for civilian purposes, including by working to convert research reactors and radioisotope production.” The United States has been actively assisting with this conversion process.

Moving to reduce the use of HEU in non-explosive military pursuits would reinforce the message conveyed by 53 countries in the 2012 Seoul Nuclear Security Summit Communiqué: “We encourage States to take measures to minimize the use of HEU, including through the conversion of reactors from highly enriched to low enriched uranium (LEU) fuel...”

The UN could provide equivalent emphasis to

minimizing HEU use in naval propulsion as part of the action plan for the 2015 NPT Review Conference. Such action would mitigate the threat that enriched uranium would be diverted to weapons use and it would contribute to lowering worldwide HEU stockpiles.

The prospects for achieving such an outcome will be significantly diminished, however, as long as some nuclear-weapons states plan to continue using weapons grade material to fuel their submarine reactors into the indefinite future. Moreover, even the current practice of Russia and India using non-weapons-grade HEU encourages other states to claim similar plans. For nuclear weapons states to argue against HEU use in the submarine reactors of non-nuclear weapons states only invites accusations that a double standard is being applied.

Setting a better example

As planning for the Ohio-class SSBN follow-on moves into high gear, it is high time for the U.S. Navy to seriously consider design changes in its submarine reactors. Although the navy is justifiably proud of the safety and reliability record of its naval nuclear reactors during the last half century, it should revisit the conclusions of the study performed by the Office of Naval Reactors in 1995, which concluded that redesigning reactors and fuel assemblies to burn LEU would be technically disadvantageous.

In the 17 years following release of that study, the technical assumptions underpinning its conclusions appear to have come under challenge. French LEU-powered submarines have demonstrated more efficient operation than was assumed possible by the U.S. Navy and Department of Energy in the study. Moreover, as the relative threat from Russia declines, it is appropriate to weigh more heavily than before non-proliferation impacts against purely technical considerations. As the chief of the U.S. Strategic Command, General Robert Kehler, emphasized in a NDU Breakfast Seminar presentation on July 12, 2012, “the [U.S. Nuclear Policy Review] elevated the prevention of nuclear proliferation and nuclear terrorism to the top of the policy agenda.” The implications for U.S. non-proliferation and nuclear counter-terrorism objectives must therefore also be an important part of the Ohio SSBN follow-on equation.

It is gratifying to note that the House Armed Services Committee (in its report to HR 4310) directed the Office of Naval Reactors to “submit a report to the congressional defense committees by March 1,



U.S. Navy

The Ohio-class ballistic missile submarine USS Alaska (SSBN 732) approaching Kings Bay, Georgia in January 2011.

2013, that describes any updates to the findings and conclusions from the 1995 report, including any changes in the estimated costs for fabricating HEU and LEU life-of-ship cores, the ability to refuel nuclear-propelled submarines and ships without extending the duration or frequency of major overhauls, and the overall health of the technology base that may be required to utilize LEU in Naval nuclear propulsion systems." It is uncertain, however, how Senate action (or inaction) will affect this requirement.

Whatever the United States does, countries like the Islamic Republic of Iran may well continue to complain of a double standard in application of the NPT's joint commitments toward both disarmament and non-proliferation. But just as progress in U.S.-Russian strategic arms reductions demonstrates the seriousness of the two countries' commitment to their disarmament obligations in Article VI of the treaty, tangible movement toward eliminating U.S. use of HEU for purposes of naval propulsion would increase pressure on other states to forego its production as well.

In this way, a follow-on design for the Ohio-class SSBN that utilized an LEU-fueled reactor could contribute both directly and indirectly to constricting opportunities for proliferation and to reducing global HEU stocks. Now is the time to take a serious look at the technical options.

ENDNOTES

1. Zahra Hosseinian, "Iran plans nuclear-powered submarine: report," Reuters, June 12, 2012.
2. "Iran able to design reactor to power ships, submarines: AEOI director, Tehran Times, July 23, 2012.
3. Olli Heinonen, "Nuclear submarine program surfaces in Iran," Belfer Center Power and Policy Blog, July 23, 2012.
4. Conversation with author, July 18, 2012.
5. See, for example: Roberto Godoy, "Submarino nuclear brasileiro sairá do papel em 2016," O Estado de São Paulo, July 8, 2012.