Naval Nuclear Reactors and Highly Enriched Uranium

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Agenda

• Why should we care about this issue?
• What are the research objectives and challenges?
• What is the research methodology?
• Who is on the research team?
• What you need to know about the Federation of American Scientists?
• What is your advice?
Why Should We Care?
Concerns about Security of HEU

- Reduced Enrichment for Research and Test Reactors (RERTR) program—ongoing for decades
- Global Threat Reduction Initiative, 2004 and beyond
- 2010, 2012, and 2014 Nuclear Security Summits → push to minimize use and possible eventual phase out of civilian HEU
- 2012 security breach at Y-12: How big of a concern was it?
- Fissile material and weapon security programs with Russia—apparently continuing but tense relations
But Should We Stop Using HEU for Naval Reactors?

• Long-lived reactor cores because of very high energy density due to very highly enriched fuel
• Relatively large U.S. stockpile of HEU dedicated to naval use
• Performance demands from naval reactors—seems better met with HEU
• Long track record of successful reactor designs based on HEU
• 1995 Office of Naval Reactors study assessed that the costs to move away from HEU outweighed the benefits
Two options exist:

(1) substitute LEU fuel for HEU into the current naval fuel system and

(2) develop a new fuel system that can increase uranium loading to offset some impacts of using LEU fuel.
2014 ONR Report continued

• “... recent work has shown that the potential exists to develop an advanced fuel system that could increase uranium loading beyond what is practical today while meeting the rigorous performance requirements for naval reactors. Success is not assured ...”

• “The capability to develop advanced naval fuel resides within a small cadre of highly specialized, experienced, and qualified engineers and scientists...”
2014 ONR Report ... opening the door to LEU use: need lots of time and $$

• “It will not be practical to sustain these capabilities or work on an advanced fuel system without additional sources of funding. Consequently, until this funding can be secured advanced fuel is not being pursued beyond the early concept stage.”

• “The investment to develop a fuel technology and determine its viability is estimated to be up to $2 billion over at least 10 to 15 years. At least another ten years beyond that would be needed to deploy a nuclear reactor with this fuel.”
New designs are well in progress ...

- Next generation SSN, SSBN, and CVN designs require long lead time
- Thus, very unlikely to change these designs in the near term
- But what about the next-next generation?
- Depends on stockpile of available HEU and U.S. nuclear security policy as well as potential for influence on other nations’ nuclear navies
- Depends on national enrichment capacity: USEC, ACP, other enrichment options?
What nations are using HEU-fueled naval reactors?

- U.S., UK, Russia
- France has switched to LEU “caramel” high-density fuel
- China appears to be using LEU but lack of transparency
- India has been receiving help from Russia
- Brazil has had long standing desire for nuclear navy
- Japan and South Korea??
- Others?
Overall Research Objectives

(1) understand the options for alternatives to HEU for naval purposes and

(2) examine effective ways to monitor and possibly safeguard HEU in the naval sector.

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What are the research questions?

• What can be done, if anything, to close the “loophole” in IAEA safeguards?
• What safeguarding (if any) and monitoring can be applied to HEU in the naval sector?
• What are the implications of naval HEU use for the proposed Fissile Material Cutoff Treaty or other variations on an FMCT?
• What has been the experience in using LEU fuel? Can the U.S. work with, for example, the French on development of LEU fueled reactors?
• Are there lessons from research reactors or commercial reactors applicable to naval reactors?
• What are the impacts of tight defense budgets in the U.S. and the UK on naval reactors?
Research Methodology

• Formed a task force of about a dozen experts who have diverse expertise and who are mostly outside DC policy circles

• Assigned aspects of the research agenda to particular task force members and their graduate students

• Decided to highlight specific country cases such as Brazil and India as well as take a global perspective
Research Challenges

• Only have access to unclassified information
• Limited financial and personnel resources
• Limited timeframe
Who is on the research team?

• Dr. Bethany Goldblum, UC Berkeley
• Dr. Ali Haghighat, Virginia Tech
• Mr. Paul Ingram, British American Security Information Council
• Dr. Alan Kuperman, University of Texas
• VADM (ret) Charles “Joe” Leidig, US Naval Academy
• Dr. Bojan Petrovic, Georgia Tech
• Dr. Joe Pilat, Los Alamos National Laboratory
• Dr. Chris Preble, CATO Institute
• Prof. Nick Richie, University of York, UK
• Dr. Michael Rosenthal, independent consultant with Brookhaven National Laboratory
• Graduate students at selected universities
What is the Federation of American Scientists?

- Founded as Federation of Atomic Scientists in November 1945 as a membership organization to educate the public and policymakers
- Oak Ridge was one of the chapters of FAS
- Renewed focus on nuclear issues and on preventing global catastrophes
- Reaching out to form partnerships
- Creating task forces and study groups
- Seeking to educate and train the next generation
- Please see www.fas.org for more information
- Please consider joining as a member
What is Your Advice?

- Feasibility of new designs?
- Security of HEU in naval sector?
- Safeguarding, monitoring, and information transparency about HEU use?
- Future of enrichment capacity in the United States?
- Other issues?