

## POPA Report Proposal

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### POPA Report Title:

Scientific Challenges to Elimination of Highly Enriched Uranium in Civilian Research Reactors

### POPA Proposer Name & Contact Information:

James Wells, University of Michigan, Ann Arbor & Deutsches Elektronen-Synchrotron (DESY), Hamburg. Email: [jwells@umich.edu](mailto:jwells@umich.edu)

### POPA Topical Area (select one):

- Energy & Environment;
- Ethics;
- National Security;
- Physics & the Public;
- To be determined

**Objective:** *Describe goals and examples of envisioned actionable recommendations.*

Enumerate APS member needs for neutrons emanating from civilian research reactors. Identify the scientific obstacles and challenges to meeting those needs without the use of highly enriched uranium.

**Motivation and Background:** *Identifies the relevance of the work to the APS, and (if relevant) how the study relates to previous POPA or other public studies.*

Large fluxes of neutrons are needed by APS members for a variety of pursuits, including fundamental scientific investigations of the nature of matter, study of radiation effects on materials, and production of radioisotopes for scientific investigations as well as medical and industrial applications. The highest neutron fluxes are available from high performance research reactors which have historically been fueled using highly enriched uranium (HEU – enrichment). This level of enrichment is called “weapons grade” uranium and is a proliferation risk.

Since 1978 the U.S. has been seeking to reduce and ultimately eliminate the use of HEU in civilian applications worldwide due to the risks of nuclear proliferation and terrorism. The highest performance research reactors in the U.S. still operate using HEU because a suitable low-enriched fuel (enriched to less than 20% U-235) has not yet been qualified and manufactured. This situation will continue until at least 2035 according to the most recent DOE projections; it is widely believed that even that date is optimistic. These US-based reactors are reaching unprecedented ages for research reactors; the youngest one is nearly 50 years old, and conversion is still nearly two decades away, at best. In most of the world, such reactors are retired by the time they reach such advanced ages.

This report would follow on a study by the National Academies (released in January 2016) on worldwide progress in eliminating HEU from research reactors

worldwide, as well as a statement adopted by the APS Board of Directors on the importance of eliminating HEU from civilian research reactors.

**Opportunity:** *Provides a clear, detailed exposition that justifies POPA interest in the proposed study at this time.*

Members of the scientific community, including members of APS, have a continuing need for the neutron spectra and fluxes that are currently available only from HEU civilian reactors. Yet, there are calls to reduce or eliminate these reactors. Therefore, the primary theme of this report is (1) to enumerate the specific needs for neutrons by the physics community, both in terms of their uses and the specific characteristics of neutrons that are needed; and (2) to suggest ways that the long-term needs for such neutrons can be achieved without the use of HEU, including the identification of scientific and technical challenges to meeting these needs.

A second theme of this report is to highlight the critical stage we are at to ensure safe and plentiful neutron sources. Concerns have been raised worldwide in recent years about the dwindling number of opportunities scientists will have to use neutrons in their research in the future. The discussion of these concerns will make clear the complementary needs for the various sources of neutrons, for example from pulsed spallation facilities to nuclear reactors. The science community in general, and APS members in particular, will find it helpful to have a report that explains the trajectory we are on when it comes to neutron sources. This trajectory analysis combined with a discussion of how the loss of neutrons means loss of benefits to society can help put pressure on policy makers to act.

A third theme is to further emphasize the responsibilities that the United States and others have to minimize proliferation risks, and to report on how these risks may be reduced through thoughtful, coordinated effort among all stake holders in neutron science.

**Approach / Plans:** *Describes the planned study in a manner that indicates the envisioned progression of the work over the duration of the proposed study.*

This study will be conducted in two parts. A workshop will be held at the APS Office of Public Affairs to identify the needs of APS members for neutrons in their work, including the properties that the neutron source and associated instrumentation must have for a particular use. A workshop report will be published. The study committee will, with expert input, identify possible approaches to meeting the neutron needs identified in the workshop without the use of HEU. Possible approaches might include but are not limited to: conversion of existing HEU-fueled reactors to LEU fuel; construction of research reactors specifically designed to operate using LEU fuel; development of new instrumentation to increase the capabilities of existing LEU-fueled research reactors; use of non-reactor-based neutron sources such as spallation sources. In each case, the potential benefits of the approach, along with scientific obstacles and challenges to its implementation will be enumerated.

**Participants:** *Lists necessary participants & institutions, and describes the importance of the key participants towards achieving the goal of a completed study.*

**Deliverables:** *Should include description and delivery dates for specific milestones (e.g., workshop), decision points, and draft report for consideration by POPA.*

If approved at the October POPA meeting, the first workshop could be held in January or February 2017, with a workshop report issued in June 2017. The final report could then be issued in about October 2017.

**Duration and Funding:** *Provides estimated length of study from initiation to draft report delivery, and associated funding needed to achieve each of the deliverables.*  
*NOTE: Completion within one year of approval is desired.*

The duration of this study is estimated to be one year, with a final report for discussion to be provided at the October 2017 POPA meeting. Additional funding for the workshop and study is under discussion.

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POPA Reports provide the opportunity for physicists to respond in a thoughtful and timely manner to pending policy issues. The reports are sharply defined, limited to roughly 25 pages, completed in approximately one year, build on existing APS Policy Statements, and provide actionable policy recommendations. POPA Reports are unclassified, so as to allow for broad public discussion of the topic. Since they are restricted to providing elucidations of existing APS positions, they do not require the APS Council approval. However, they are subjected to independent review and APS Executive Board approval before they can be issued. An APS Study, by contrast, is a more substantial examination of a technical issue, is not limited in length, can explore new policy areas, and requires APS Council approval.