HEU MINIMIZATION: THE TECHNICAL-POLITICAL NEXUS [1]

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ABSTRACT

For over 25 years, the RERTR program has worked to solve the technical challenges to minimizing the use of HEU in the civilian sector. The results of the Technical Workshop on HEU Minimization held June 17-18, 2006 reflect a broad consensus that conversion of research reactors and radioisotope production to LEU is technically feasible. However, difficulties remain in gaining the political support needed to maintain incentives for conversion, allocate the funding necessary for R&D and conversion work, and accelerate conversion in some key states. These difficulties reflect many policymakers' lack of appreciation of the full extent of the nuclear terror threat posed by HEU and of recent technical progress facilitating conversion. Besides measures to accelerate HEU minimization already being pursued through established mechanisms, this paper explores the potential of supplementary approaches that may help to bridge the current technical-political divide and accelerate the process of HEU minimization globally.

Introduction

The RERTR program and related efforts have made great strides in solving the technical challenges to reducing the use of highly enriched uranium (HEU). It has become or will soon be technically possible to convert most HEU-fueled reactors to low-enriched uranium (LEU) fuel; the technical know-how for conversion of medical isotope production also exists. However, converting these facilities to LEU requires not only technical ability, but also understanding on the part of policymakers of what is technically possible and desirable. Current policy does not always take account of the facts on the ground, in part because some of the issues—such as developing high-density fuels—are complex, and also because of a lack of awareness by policymakers of some aspects of the problem. In order to take decisions to pay for conversion, allocate money for research and development work, improve physical protection systems at a facility, or develop new guidelines, rules, or laws, policymakers should understand some basic technical facts, in particular the benefits of conversion vs. the risks posed by HEU. Many nations have embraced the effort to reduce risks by supporting HEU-LEU conversion, but as the program moves forward, most of the "easy cases" have been solved. Piecemeal conversion efforts can and have resulted in the reduction of HEU use worldwide, but truly global reduction is not likely to accelerate without a broader understanding of the risks, benefits, and various options for reducing HEU usage, more clarity as to what best practices in this sphere may be, and stronger incentives to adopt these standards.

Risks

Many policymakers still mistakenly believe that civilian HEU does not pose a significant threat. By contrast, nuclear weapons designers in the NPT-recognized nuclear weapon states (NWS) agree that non-state actors could fabricate a “gun-type” improvised nuclear device (IND) with access to enough HEU [2]. Many policymakers conflate INDs—which would result in a nuclear explosion—with a radiation dispersal device (RDD or “dirty bomb”), which typically would spread minimal levels of radiation locally. They fail to recognize that an HEU weapon poses a threat orders of magnitude greater than RDDs.

The surest way to prevent use of an IND is to make certain HEU does not end up in the wrong hands. Fresh and lightly irradiated HEU fuel (such as the fuel used in many critical assemblies and pulse reactors) presents the greatest risk. Although using nuclear fuel in high-powered reactors initially makes it highly radioactive and dangerous to handle, this radioactivity declines over time. Spent fuel in particular has traditionally received little physical protection, since the material is not of inherent value for research facilities. Considering the current terrorist threat, however, this material now poses substantial risks.

To decrease the danger that terrorist groups will build an IND, HEU must be secured and, wherever possible, eliminated. Some civilian facilities are as secure as the best military facilities. Many civilian sites, on the other hand, are located in universities or other locations that are not suitable for high levels of physical protection; redesigning them to meet today’s threats would be both extremely difficult and prohibitively expensive.

Physical Protection

No current global agreement regulates the physical protection needed at nuclear facilities, or sets clear standards or generally recognized best practices. The Convention on Physical Protection of Nuclear Material provides standards that apply only to material in international transit. In May 2001, most of the parties to the convention agreed to amend it to cover material used or stored domestically. However, no concrete standards for domestic protection were specified, nor have such standards subsequently been negotiated. IAEA INFCIRC 225, Rev. 4 recommends that physical protection be based on design basis threat (DBT), but does not specify any minimum threat to be guarded against (INFCIRC 225 does divide nuclear material into categories, making the strongest protection recommendations for the most sensitive categories, one of which is HEU of 5 kg or more; irradiated fuel is in the next most strongly protected category.) The Nuclear Suppliers’ Guidelines outline some general physical protection guidelines, but suggest that actual standards be negotiated between suppliers and recipients of nuclear fuel [3]. In reality, security requirements for nuclear programs vary greatly from country to country [4]. International standards are sorely needed.

Policymakers also remain confused about the difference between IAEA safeguards—designed to prevent a state from diverting nuclear material into a weapons program—and physical protection, which safeguards inspectors do not examine. Policymakers must first understand what physical protection is and why it is necessary. Then, in order to develop relevant guidelines or best practices, they need input from practitioners with a clear, detailed understanding of DBT, as well as an appreciation for macro-level risks. Indeed, protection of both fresh and spent fuel at university research reactors poses particular difficulties, since research reactor fuel elements are generally small and can typically be moved by one person [5]. However, even when policymakers recognize the threat of nuclear terrorism as real, they are inclined to see it as someone else's problem—important in the abstract, perhaps vital to the overall well-being of the nonproliferation regime, but not a pressing local security concern.

While it is extremely difficult to protect all likely targets, protecting fissile material is feasible. Once material has been obtained, it can be transferred from country of origin to target country with relative ease. Thus, minimizing the number of sites with HEU and applying the highest levels of security at these sites is the best way to meet the threat inherent in this material. Since a theft or diversion from one or a small number of locations can have a large impact on any number of other places, there should be a global approach towards security, not reliance on host sites or countries to devise physical protection solutions. This international problem requires an international solution, including guidelines, sharing of best practices, and continued assistance in improving security and consolidating HEU. It would make sense to have international requirements, or at the very least, standards, for the physical protection of the nuclear materials that can be used to make a weapon—most importantly, HEU. If international guidelines were developed, whether on the basis of INFCIRC 225 or on a separate basis, and reactor owners at sites with inadequate security understood the costs they would have to incur to bring their physical protection systems up to standards, they would be far more likely to support conversion. Currently, only a few countries have updated security requirements; only there do the costs to HEU users reflect the true costs of having this material [6].

Furthering HEU Minimization

HEU use can clearly be greatly reduced; many of the facilities currently using HEU would have been designed to use LEU if they were being constructed today. Indeed, only one new civilian research reactor in Western countries with a power level of more than 1 MW has been built to use HEU since the early 1980s, Germany's FRM-II. By contrast, 17 new research reactors built during that time use LEU. Not only Western countries are concerned about reducing the use of HEU. While the new China Experimental Fast Reactor has been loaded with HEU fuel, Beijing plans to use MOX fuel in its industrial-scale (600 MW) China Prototype Fast Reactor and future fast reactors [7]. Other recent and planned Chinese research reactors use LEU. Furthermore China, though not directly participating in RERTR, has followed the research done under the program and is working along similar lines. It has done a conversion feasibility study on its HFETR reactor, assisted Pakistan in the conversion of the PARR-1 reactor, and has been working on high density LEU fuels [8]. China is also active in a new IAEA program to convert miniature reactors. Nevertheless, some 110 facilities worldwide continue to operate with HEU, while additional sites have HEU in storage. Some of the latter maintain this material in the dubious belief that it could possibly be used in the future. Others do not have the money to fund conversion or have yet to find a third country to accept their fuel. The vast majority are underutilized and underfunded.

In addition to appreciating the threat posed by HEU, policymakers have to know what options exist to counter this threat. While improving security can reduce the risk of theft at a given location, it may suggest to other users that HEU is a valuable material that should be retained. Thus, policymakers also need to know the utility (or lack thereof) of HEU today (including its value at each individual facility), what alternatives exist to pursue valid scientific research goals, and what adopting these alternatives might entail. The answers to these questions can only be given by specialists.

Research Reactors: Information on Reactor Missions Needed

At present, there is no database or detailed survey of research reactors worldwide with information on how these facilities are used and where extremely high neutron flux is critical to research missions [9]. For many sites, particularly those used for training purposes, obtaining the maximum possible neutron flux is simply not necessary.

Many of the facilities now resisting conversion appear to be doing so not because of a scientific need for high flux, but because they view HEU as a "resource," in the sense that it might bring a research program to an institute at some unknown time in the future, or is viewed as prestigious. It is not seen as a "cost" in most places, where expensive new physical protection systems are not required, while some sites instead have received funds to implement security measures and improve facilities [10]. Since such facilities themselves are not likely to state that they do not need HEU, identifying locations that ought to be converted may be difficult. Objective criteria are needed to judge where the scientific activities being pursued at a given reactor might best be undertaken. An impartial assessment would help policymakers determine where they should focus their attention on improving security and where on conversion.

Where is HEU needed today? HEU has already been removed from many locations. However, there are many additional facilities where HEU is unnecessary but the costs of removal or the perception of the opportunity costs of removal are higher than facility operators are willing to bear. At other sites, HEU is still in use, but conversion is already possible. Of course, there are some sites where conversion is not yet possible but will be in the future. And finally, there may continue to be a need to maintain a very small number of reactors with extremely high flux for certain types of experiments.

Other facilities should be converted to LEU. For example, most critical assemblies (CAs), typically used for either basic physics experimentation or to model reactor cores, do not need to employ HEU, though currently many do. A shift to LEU is important, as sites with CAs often contain very large amounts of HEU. Moreover, the fuel in CAs is only lightly irradiated and thus not self-protecting. CAs used to mockup fast reactor cores, on the other hand, cannot use LEU. They require either HEU or plutonium for these mockups, unless new methods for nuclear reactor design and testing are employed [11].

Research Reactor Coalitions

The number of facilities needed for experiments requiring very high flux are quite small—thus the idea of "research reactor coalitions," recently explored at an IAEA workshop, which could establish "centers of excellence" with the best possible equipment and security. If a handful of research reactors using extremely highly enriched uranium provide significant scientific benefits—enough to justify the high security costs that maintaining this sort of fissile material ought to entail—then a small number of top-flight facilities should be maintained and used to maximum possible advantage. Instead of under-funded research reactors that pose risks while providing few scientific benefits, multinational research programs could give all participants equal opportunities to enjoy the commercial and technological dividends of cutting-edge science.

Isotope Production: Continued Questions

Although production of medical isotopes using LEU targets has now been proven, the four major international radioisotope producers have yet to commit to conversion. Most of them appear to expect that they will eventually convert, but are not pushing to take on the expense and effort required as long as policymakers do not demand, support, and fund the enterprise. HEU targets pose a significant risk. Together, the top four isotope producers use about 85 kg of HEU each year—a major portion of global HEU commerce [12]. In addition to unirradiated HEU, production facilities store waste from processed targets that contains hundreds of kilograms of slightly irradiated 90% enriched HEU. The U.S. government has noted, “These are proliferation-attractive materials.” [13]

There are several questions that continue to plague policymakers trying to understand how to make this conversion possible. The first is whether conversion is technically possible. In fact, the technical difficulties to conversion have now largely been overcome—the U.S. Department of Energy maintains that the remaining obstacles to conversion are chiefly financial [14]. Unfortunately, the urgency of finding a conversion path has been waning, particularly since last July, when the U.S. Congress relaxed restrictions on HEU exports for medical isotope production (in large part due to mistaken fears that provision of medical isotopes would be greatly harmed by conversion to LEU).

The second question concerns logistical issues: how significant will logistical hurdles be, and what might it cost to mitigate them? Could there be interruptions in the provision of medical isotopes to patients, a matter of very great concern to policymakers? [15] This technical and organizational question can only be answered with the cooperation of a major producer (or producers). If possible logistical problems are identified, RERTR researchers can assist in finding solutions, while protecting commercial secrets. Surely plans can be devised to avoid any interruptions in the delivery of medical isotopes—indeed, cooperation between the major producers already exists so that facility upgrades and the like can occur without affecting consumers.

Finally, there is the question of whether conversion to LEU targets could affect commercial competitiveness. Clearly, there is a solution to this problem, if indeed it is a problem (the major producers’ agreement to make up shortfalls, noted above, may mean that conversion would not, in fact, affect competitiveness). Several years ago the major producers indicated their willingness to consider joint action to shift to LEU targets. A staged, cooperative approach could have been devised that ensured no one producer gained a competitive advantage during the conversion period. Unfortunately, this opportunity was missed due to interagency disputes, but it could be revived. The real issue is whether policymakers value the risk reduction enough to insist on conversion of these facilities, task producers to develop a rational conversion plan with realistic deadlines, and foot the bill.

Sharing Technical Expertise to Help Overcome Impediments to Policymaker Action

As noted above, there are two paths towards reducing the HEU threat—increasing physical protection and eliminating material stocks. At present policymakers lack the information they need to decide how they can accelerate some of the existing programs in these areas, as well as determine how best to expand current endeavors to new areas.

Understanding the threat posed by HEU is the first step needed to work towards improving security of this material. However, until there is a common global standard for these security measures—a general consensus as to what levels of security are needed to protect various types and quantities of HEU—it is difficult for policymakers to know if the HEU in their country needs improved physical protection. Furthermore, given the interlinked quality of the threat, it is understandable that some policymakers are loathe to expend time, effort and money to reduce a small holding of HEU in their own country if other countries are not eliminating similar holdings. It will be extremely difficult to increase security world-wide without a global norm for the level of security required.

The second path towards reducing the risks posed by HEU—the removal of the material from as many sites as possible—also requires global cooperation to reap maximum benefits. Where an individual site is concerned, a removal decision is only likely if HEU is no longer needed, has lost its value or has become too costly to maintain (something unlikely to happen without increased security costs), there are incentives for giving up the HEU, there is some sort of rule or norm against maintaining HEU at the sort of facility in question, or a combination of these reasons. There must be an incentive to eliminate the material and/or a disincentive for keeping it. In nearly all cases, there is a cost to removing the material: from the simple cost of transport, to more costly conversion efforts, to, in a few cases, the opportunity cost of doing without HEU. Facilities themselves are unlikely to be able to fund these costs or suggest that they engage in this activity for that very reason. While information about the use of HEU at an individual facility can best be answered by that facility, many of the answers needed to adopt good policy are cumulative in nature: determining that a particular type of scientific research is better conducted jointly at installation A than installation B requires a comparative approach, knowledge of both research programs and existing facilities (or the potential to create better, new facilities). Removal of one kilogram of material from a single site, too, makes only a tiny difference to the risks of HEU misuse—it is only significant if many other facilities eliminate their HEU as well. This too argues for a joint approach.

<u>Expanding Current Approaches</u>

Since the 1970s, the international community has taken steps to reduce the civilian use of HEU. Recent measures have assumed an increasingly broad international character, such as the 2004 Global Threat Reduction Initiative (GTRI), which includes programs to repatriate U.S.- and Soviet-origin HEU fuel from reactors worldwide, and a working paper submitted to the 2005 NPT Review Conference by Norway and other states.

At the 2005 NPT Review Conference, Norway, on behalf of itself, Iceland, Lithuania, and Sweden submitted a working paper entitled "Combating the risk of nuclear terrorism by reducing the civilian use of highly enriched uranium" in an effort to seek an international consensus on this issue [16]. The initiative: 1) Encouraged all countries to consider, and if deemed necessary, implement additional measures to protect and control existing stocks of HEU; 2) Supported minimizing the use of and commerce in HEU for civilian purposes and the goal of eliminating HEU in the civilian nuclear sector as soon as technically feasible; 3) Encouraged all countries to eliminate or commit to converting those civilian HEU-fueled installations under their control, for which there is a need, to LEU fuels as soon as technically feasible; 4) Discouraged all countries from undertaking or supporting new civilian projects involving HEU fuel other than for the purpose of down-blending that fuel to LEU.

Although the NPT initiative initially received support from a wide range of states, it has proved difficult to build upon that momentum. At the Oslo symposium, a few participants expressed concern that de-legitimizing the commercial use of HEU could discriminate against non-nuclear weapon states (NNWS). This perspective, however, ignores the fact that the initiative requires greater changes in nuclear weapon states than NNWS, since they have far more HEU in use in the civilian sector. Further, it does not restrict nuclear fuel cycle technology or commerce. It is only directed at denying non-state actors access to the type of fissile material most easily used to make an IND, not at restricting technologies to enrich uranium to LEU for use in research or power reactors or limiting civilian nuclear sector development. Clarification of this technical difference is another area where scientific experts could help policymakers to move this project forward.

Another issue, which received little attention by the scientific experts at the Oslo symposium but has been raised elsewhere, is the question of whether HEU minimization could give some states unfair scientific or commercial advantages. If there are advantages to be had, what can be done to make certain they either accrue to those forgoing HEU, or at the very least do not disadvantage these countries? Some developing countries may worry that once they have converted their reactors (and eliminated the problem of HEU vulnerability), they will no longer receive external assistance and funding. To address these reservations, various multinational programs need to be devised that provide all states with the opportunity to participate in cutting-edge nuclear research projects. The exploratory workshop held at the IAEA on research reactor coalitions, mentioned above, is a step in this direction and should be supported and expanded.

Conclusion: New International Approaches Are Needed

In the final analysis, the reason why many of the facilities that continue to use HEU are not interested in converting is not based on scientific needs or commercial advantage. Instead, it is largely a result of inertia, lack of funding and lack of political will. Those interested in converting are already working in this direction, but reducing the terrorist threat to the minimum possible level means getting policymakers to engage facilities that have yet to consider conversion. The most effective way to persuade policymakers to support such initiatives is for them to see that their peers throughout the world are making the same choice. This implies the creation of a global norm de-legitimizing the use of HEU. While international rules would be desirable, a norm also could be very effective: it is not the details of conversion or elimination that are important, but the acceptance of the principle that would motivate policymakers to act.

One way to promote such a norm is to devise a set of general guidelines for the use and handling of HEU that could be codified in a code of conduct [17]. While some codes are international conventions that result from international meetings or are developed by international organizations, others are not specifications of detailed, long-negotiated legal obligations but an explication of general standards. Though such standards are not strictly speaking legally binding, they can spread knowledge and promote a norm, so that states conform to the standards on a voluntary basis, not through legal obligation.

In the area of nuclear power, the World Association of Nuclear Operators was formed after the 1986 Chernobyl disaster in order to maximize the safety and reliability of nuclear power plant operations worldwide, spreading best practices. Similarly, the World Nuclear Association has a Charter of Ethics that includes a set of principles to promote safe operations. Two decades ago, safety was the most important goal for nuclear operators. Today, security is equally critical.

In the sphere of HEU use, a broad, normative document could prove most beneficial. The development of such a code, which could initially be adopted by one state or even a single organization, and then adhered to in whole or in part by other interested parties, requires an understanding of the security, scientific, and other issues involved in the use of HEU. Instead of determining how to institutionalize such a code or how to implement it, it would be a useful first step to bring scientists together to discuss what the contents of such a code should include.

As Norwegian Minister of Foreign Affairs Jonas Gahr Støre noted in his address to the Olso symposium, “states, academic institutions, industries and international organizations… have unique roles to play and insights to share … Knowledge needs to be spread – including to the politicians – as ‘yes-able’ propositions.” What can scientists and reactor operators propose that might reduce risks without impairing scientific research or commercial efforts? Some of the sections such a document should have likely include:

- Types of risks and concomitant physical protection measures
- Best practices for the management of HEU stocks
- Types of scientific and other benefits from facilities that have used HEU and suggested means to continue these benefits in the safest and most secure manner possible (including via the use of LEU or other materials, computers or other different technologies, and a list of those uses that may best be met in international centers of excellence that continue to employ HEU)

- Measures to be supported that will help to make conversion possible (such as development of very high density LEU fuels, support for research and development in the area of medical isotope production using LEU targets, etc.)
- Agreement that new research reactors will be designed to use only LEU, or, if scientific experts feel that this is too stringent, a statement limiting the cases where the use of HEU might be considered acceptable

General guidelines and norms are needed so that controls to limit weapons-grade HEU can be strengthened at an international level. Should HEU fall into the hands of terrorists, an attack would surely bring horror to much of the world. In the aftermath, the peaceful use of the atom would clearly suffer. It is therefore in the interest of all nuclear scientists and nuclear facility operators to assist in developing the strongest possible guidelines to secure this material, and ways to reduce its use as much as possible, so that the benefits of the peaceful use of nuclear energy can be maintained while minimizing the risk of nuclear terrorism.

References

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[2] Russian scientists' comments as related by former Los Alamos Laboratory Director Siegfried Hecker, speaking at the conference "G8 Global Security Agenda: Challenges & Interests. Towards the St.-Petersburg Summit," Moscow, 20-22 April 2006; U.S. view in: Committee on Science and Technology for Countering Terrorism, *Making the Nation Safer: The Role of Science and Technology in Countering Terrorism* (Washington, DC: National Academy Press, 2002), pp. 40, 45, as cited by Charles Ferguson and William Potter, eds., *The Four Faces of Nuclear Terrorism* (New York: Routledge, 2005), p. 132.

[3] The Nuclear Suppliers' Guidelines specify that HEU and spent fuel rods should be used and stored within a *protected area,* "an area under constant surveillance by guards or electronic devices surrounded by a physical barrier with a limited number of points of entry under appropriate control, or any area with an equivalent level of physical protection." HEU of five kg or more should, in addition, be used and stored within a *highly protected area* inside the outer protected area with "access restricted to persons whose trustworthiness has been determined and which [area] is under surveillance by guards who are in communication with response forces." George Bunn, Chaim Braun and Fritz Steinhausler, "Nuclear terrorism potential: Research reactors vs power reactors?" *Proceedings,* EU-High Level Conference on Physical Protection, Salzburg, Austria, 8-13 September 2002, http://www.numat.at.

[4] For a detailed discussion of this issue, and illustrations of the variety of physical protection systems from site to site, see Bunn, Braun and Steinhausler.

[5] Unlike power reactor fuel elements, which can require heavy machinery to transport, research reactor fuel elements may be four feet long, weigh just a few dozen pounds, and can be disassembled. Bunn, Braun and Steinhausler.

[6] Two cases in point are Australia and the United States. After 9/11, security costs at the eight U.S. national labs increased by $500 million per year, resulting in the U.S. decision to remove HEU fuel from the Sandia Pulse Reactor in lieu of the security upgrades that would otherwise have been necessary; in Australia, physical protection expenditures at the new OPAL reactor increased $25-30 million. Statements by Frank von Hippel (Princeton) and Ron Cameron (ANSTO), International Symposium on Minimisation of Highly Enriched Uranium in the Civilian Nuclear Sector, Oslo, Norway, 17-20 June 2006.

[7] Mark Hibbs, "Chinese Breeder Reactor Criticality Delayed until 2008," *Nucleonics Week*, 18 August 2005.

[8] The China Advanced Research Reactor, currently under construction, will use 19.75% dispersion fuel with a density of 4.3g/cm3. This fuel is being developed by the Nuclear Power Institute of China (NPIC). Changgeng Yin, "Development of Fuel Element for Research Reactor in Nuclear Power Institute of China," *Atomic Energy Science and Technology*, Vol. 39 (July 2005).

[9] Neutron flux is the intensity of neutron radiation. High flux is useful for research on the structure and dynamics of matter: as the number of neutrons per second striking a target area increases, more detailed information on physical and biological materials can be obtained. In the search for a brighter source of neutrons, several countries are developing spallation sources; as these are completed, some research will move from reactors to these new installations. At the same time, as higher density fuels are developed and instruments improved research options at reactors worldwide can be enhanced, such that they no longer require HEU to obtain sufficient flux.

[10] The exceptions are the United States and Australia; see footnote 6, above.

[11] "The Future Use of Critical and Sub-critical Assemblies," Report of a Consultation held at IAEA HQ, Vienna, 7-10 February, 2005, p. 1; Glaser and von Hippel, "Global Cleanout." Computing power has advanced to the point that computer simulations can produce the same degree of accuracy as a critical or subcritical assembly.

[12] Kasia Mendelsohn and John Pantaleo, "Molybdenum-99 (^{99}Mo) Production with LEU Targets," 6 December 2005, http://dels.nas.edu/nrsb, as cited in Alan J. Kuperman, "Bomb-grade Bazaar," *Bulletin of the Atomic Scientists,* Vol. 62, No. 2 (March/April 2006), pp. 44-50.

[13] Mendelsohn and Pantaleo, as quoted by Kuperman.

[14] Daniel Horner, "Main Barriers to LEU Conversion for Isotopes not Technical, U.S. Says," *Nuclear Fuel*, 2 January 2006, pp. 3-5.

[15] For a discussion of U.S. policymaker worries regarding the supply of medical isotopes to the United States, which were never actually at risk, see Kuperman.

[16] "Combating the Risk of Nuclear Terrorism by Reducing the Civilian Use of Highly Enriched Uranium," Working paper submitted by Iceland, Lithuania, Norway, and Sweden at the 2005 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, NPT/CONF.2005/MC.III/WP.5.

[17] The idea of a code of conduct on HEU was suggested by Lars Van Dassen of the Swedish Nuclear Power Inspectorate in his talk "HEU Minimisation: If it is a good idea – what should we do next?" at the Oslo Symposium, June 20, 2006.