Building an International Norm to Minimize HEU: National & International Measures

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"Getting Bomb-Grade Uranium Out of Civilian Hands: Toward the Nuclear Security Summit"

Washington, DC – February 1, 2010 Photo: Idaho national lab

Why focus on HEU?

 Nuclear terrorism – HEU is the most potent material for a crude nuclear bomb

 Nonproliferation – HEU can be used to create a national deterrent without testing

 Disarmament – preparing the conditions necessary for a stable nuclear-free world

Uranium enrichment levels

U235 enrichment



Why do we need a norm against HEU?

 The easy HEU minimization cases have been tackled, the hard cases remain

Unloading fuel from a research reactor, Chile. http://www.rertr.anl.gov

- Generally, the issues are political
- Without international norms, some users/countries will not alter the way they handle HEU

 Without international norms, new facilities are free to use HEU

The beginnings of a norm

Recognition of the nonproliferation benefits of HEU minimization:

- International Fuel Cycle Nuclear Evaluation (INFCE) report, 1980
- 2000 NPT Review Conference Final Document





Non-Proliferation Treaty Review Conference

Working paper submitted by Iceland, Lithuania, Norway and Sweden at the 2005 NPT Review Conference:



"we recommend that this Conference...

- Implement additional measures to protect and control existing HEU stocks;
- Express the view that minimizing [HEU] use ... is desirable, as is the goal of total <u>elimination of HEU in the civilian nuclear sector</u> as soon as technically feasible;
- Encourage all countries to eliminate or commit to <u>converting</u> those civilian HEU-fuelled installations under their control, for which there is a continuing need, to LEU fuels as soon as technically feasible;
- Discourage all countries from undertaking or supporting <u>new civilian</u> projects involving HEU fuel ...
- Encourage the IAEA to establish a comprehensive <u>global inventory</u> of <u>HEU</u> in civilian use

NPT/CONF.2005/MC.III/WP.5, 20 May 2005

U.N. Security Council Resolution 1887 (Sept. 2009)



"Calls upon all States to manage responsibly and <u>minimize to the greatest extent</u> that is technically and economically feasible <u>the use</u> of <u>HEU</u> for civilian purposes, including by working to convert research reactors and radioisotope production processes to the use of LEU fuels and targets"



Towards the Nuclear Security Summit

Improving security of HEU

- Consolidating HEU to plants with weapons-level security
- Greatest risk at fuel cycle facilities can't be eliminated until their services aren't required
- Rethinking "self-protection"
- Clearly identifying and committing to best practices: the need for measures like an HEU Code of Conduct to codify norms



Opening inspection of Australia's OPAL reactor – designed and built for LEU

Improving HEU Security: Reactor conversion & HEU removal

Global Threat Reduction Initiative (GTRI) Programs:



<u>Convert</u> research reactors and isotope production facilities from the use of HEU to LEU

Effect permanent threat reduction by minimizing and, to the extent possible, eliminating the need for HEU in civilian applications



<u>Remove</u> and dispose of excess nuclear and radiological materials

Eliminates bomb material at civilian sites, moving it to topsecurity facilities in the U.S. and Russia.

Depend on willingness of facilities/states to cooperate

Improving HEU Security: GTRI "Protect" program



<u>Protect</u> high priority nuclear and radiological materials from theft and sabotage

Improving security on the bomb material remaining at civilian sites – each vulnerable building that is protected reduces the risk until a permanent threat reduction solution can be implemented

➢ Not a permanent solution

Threats posed by large quantities of HEU at fuel cycle facilities remain

Program can only be as successful as far as "security culture" and management practices are sustained at each site (physical measures alone are not enough)

Best security practices: rethinking "self-protection"

IAEA recommendations for the physical protection of nuclear materials: (INFCIRC/225/Rev.4) \rightarrow Graded System according to enrichment, amount and radioactivity.

Dose exceeding 1 Gy/hr (100 rads/hr) at 1 m unshielded enjoys a lower security category (1975 regulation)

Logic of "self-protection": Irradiated fuel/targets protected from theft by psychological deterrent (high dose deters theft)

Many authors have criticized the 1 Gy/hr criterion (E. Lyman, F. Von Hippel, *Arms Control Today*, April 2008)

Evaluating "Self-Protection"

- Instead of psychological deterrent, "incapacitance" is a more useful concept in an age where terrorists & states desperate to develop nuclear bombs are willing to die
 - Coates *et al*, ORNL, 2005 examined concept of "incapacitance" and found that dose must be increased by 2 orders of magnitude (50-100 Gy/hr)
 - Koeling and Barts (LANL, 1982) found that spent nuclear fuel could be easily stolen before "incapacitance"
 - Based on the literature a more appropriate criterion for self-protection would be 10 Gy/hr

2005 ORNL Study on Incapacitation

 The Oak Ridge study determined that a "dose rate of 100 Gy/hr (10,000 rad/h) at 1 m was ... the level that significantly affected performance of the perpetrator & offered limited self-protection (in the range of minutes)"



COATES, C. et al, Radiation Effects on Personnel Performance Capability and a Summary of Dose Levels for Spent Research Reactor Fuels", ORNL/TM-2005/261, Dec. 2005.

Can Estimate Dose from a Typical Spent Fuel Assembly (Nuclear Waste)



A simple time rule could be established: do not consider self-protecting after 5 months

10 Gy/hr Iso-Dose Curves Different Power Densities



Typical flat-plate fuel assemblies (Tirr>4 Months & power density > 1 MW/kg U-235) 10 Gy/hr is sustained for < 5 months

Codifying best security practices

- Training programs for domestic & foreign operators
- INFCIRC 225 Physical Protection Guidelines



INFCIRC/225

Printed by the International Atomic Energy Agency in Austria - September 1975



- Need vigorous support for Revision 5
- Reexamine (or eliminate) "self-protection" concept
- Convention on the Physical Protection of Nuclear Materials (CPPNM) amendment
- Voluntary Code of Conduct

Codifying norms: An HEU Code of Conduct

- A commitment to eventual elimination
- Could be adopted by states, nuclear operators, universities, and other stakeholders

 Good for business while encouraging states to make a firm political commitment to HEU minimization

Some Key Elements of an HEU Code

- Commitment to eliminate or convert installations from HEU to LEU as soon as technically feasible
- Ending transfers of HEU except on an interim basis to facilities actively pursuing conversion to LEU
- Maintaining security at levels concomitant with the risks
- Undertaking activities help to make conversion possible
- Promising to develop and maintain a strategy for the management and eventual elimination of HEU, to ensure the safe and secure use, storage and eventual elimination of the material

Establishing a norm: doctors are charting the moral path



- "Eliminating Highly Enriched Uranium from Radiopharmaceutical Production," resolution passed by the Malaysian Medical Association, June 2008
- "Highly Enriched Uranium in Radiopharmaceutical Production," California Medical Association, adopted October 6, 2008

 Draft resolution World Health Assembly: "Reducing the contribution of the health sector to nuclear proliferation and terrorist risks by eliminating highly enriched uranium (HEU) from production of radiopharmaceuticals"





Excerpts from the Resolution of the Malaysian Medical Association

"This house resolves to urge:

- ... expedite[d] universal conversion of isotope production targets and reactor fuel from HEU to LEU;
- governments ... to require isotope production reactors within their jurisdiction, utilizing HEU fuel or targets, to promptly be converted to LEU fuel and targets...
- governments which supply HEU... to institute coordinated incentives for radiopharmaceutical producers to convert to LEU in the future...
- the development of a code of conduct against the civilian production, trade, and use of HEU

Governments should follow doctors' lead & ensure security

- National measures:
 - committing to end HEU use in the civilian sphere
 - converting reactors from HEU to LEU
 - conditioning HEU exports on conversion commitments & repatriation
 - ending production of HEU for civil use
 - increasing "security culture" efforts/setting up training centers

• U.S. examples:

- Commitment to convert all HEU-fueled reactors by 2014
- U.S. Energy & Water Act:
- Supports LEU-based production of medical isotopes
- Congress considering bill that would:
- Phase out HEU exports

Everyone: committing to a code of conduct

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Questions or Comments?

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