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Comments on Nuclear Proliferation Risk Assessment: Methodologies and NSG Controls

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LANL, like other DOE labs, provides technical support to a variety of activities that relate to assessment of nuclear proliferation and risks, including:

- Foreign nuclear program analyses (all-source assessments; vertical and horizontal proliferation activities)
  - Including, assessment of plans and intentions, and enhancing/augmenting proliferation detection efforts through analysis of proliferant-supplier relationships and proliferant acquisition efforts and trends
- Technical analysis of nuclear fuel cycles and relative material attractiveness
- Avoiding surprise through awareness/assessment of emerging technologies and alternate approaches to nuclear proliferation
- International safeguards
  - Technical support to policy, implementation, hardware development, IAEA inspections
  - Information-driven safeguards and state level approach concepts
- Technical support to international treaties/agreements (NPT, FMCT, etc.)
- Nuclear export controls
  - Technical support to multilateral nuclear export control list development (NSG and Zangger), domestic licensing and nuclear technology transfer decisions, interdiction efforts and policy responses, etc.

Assessment Methodologies

The May 2012 presentation on nuclear proliferation analysis by Davis* (LLNL) aptly captures the high-level principles of analysis and analytic challenges (especially with respect to all-source assessments) and need not be repeated here.

* Lisa Owens Davis, “Proliferation Analysis: Methodologies, Assessments and Warning Indicators,” LLNL-PRES-556151, May 11, 2012

NSG Controls

- Trigger List (NSG Part 1)
  - Specialized, purpose-built items (facilities, systems, equipment, components and materials), and related technology, " … ***especially designed or prepared for the processing, use, or production of special fissionable material*** …"
- Dual-Use List (NSG Part 2)
  - Dual-use items, and related technology, that have ***technical significance*** for nuclear proliferation activities and that are ***controllable***
- "Catch-all" Controls (NSG Part 2, Para. 5)
  - ***End-use*** and ***end-user*** based controls on ***non-listed items***

    [applied at the national level when a proposed transfer presents an unacceptable risk of diversion (including transshipment) to unsafeguarded fuel cycle activities or to weaponization activities]

Proliferation Risk and the NSG Control Lists

- In general, the NSG guidelines/lists do not delineate differing degrees of risk for transfers of controlled items/technology (except for “sensitive exports” in Part 1)
- All Part 1 items/technologies are treated on the same footing, except elevated risk is recognized for transfers involving “sensitive” facilities, equipment and technology and material usable for nuclear weapons
- A policy of special restraint on transfers involving “sensitive exports” is considered essential, and guidance on the criteria/factors to be considered, at a minimum, for enrichment and reprocessing related transfers is provided in paragraph 6 of Part 1
- NSG Part 1 makes no differentiation between different types of facilities and technology of the same class/category:
  - e.g., one reactor type vs. another reactor type, one reprocessing technology vs. another, thorium vs. uranium fuel cycles, etc.
- NSG Part 2 treats all controlled items on the same footing
- All decisions for exports/transfers, including assessment/determination of proliferation risk, is left up to national discretion (for both Part 1 and Part 2 items)

Proliferation Risk and the NSG Control Lists (continued): Concepts of "inherent technology" in physical facilities/equipment and "enabling technology"

- Concept of inherent technology recognized by NNPA of 1978:

  "..information incorporated in a … facility or important component part thereof…"

- Concept recognized by NSG in original guidelines of 1978:

  "… facilities utilizing … technology … derived from transferred facilities, or major critical component thereof …"

- More recently, recognized by NSG (revised paragraph 7 of the Part 1 Guidelines) for enrichment related transfers as a significant proliferation risk factor requiring mitigation via "black box" and/or "turn-key" supply arrangements:

  " … avoid, as far as practicable, the transfer of enabling design and manufacturing technology associated with such items; and

  … seek from recipients an appropriate agreement to accept sensitive enrichment equipment, and enabling technologies, or an operable enrichment facility under conditions that do not permit or enable replication of the facilities …"

  - And more broadly could be considered a "best practices" approach to minimize proliferation risk for possibly certain other Trigger List transfers in specific situations when considered possible and appropriate by national discretion

Some additional comments on NSG Part 1 technology transfers

- Supplier policy and transfer/disclosure decisions must account for not only the capability of the technology as utilized/envisioned/deployed by the supplier but also its broader inherent technical capability as might be exploited by the recipient

  Specific examples for possible discussion:

  – Enrichment technology disclosure case study
  – Reprocessing technology case study

- Transfer/disclosure decisions also need to factor in whether the proposed action risks stimulating a new interest in proliferation and/or reigniting an old interest in proliferation ("supply side push")

- Assessment of risk of retransfer to a third party is also paramount

Criteria employed for NSG Dual-Use List controls

- ***Significance***
  - Important function in nuclear fuel cycle facility/activity or in nuclear weapon design, manufacturing, or testing?
  - Have proliferant programs actually sought the item, or do we expect them to?
  - Will control have an impact?
  - Must alternative technical paths also be controlled?

- ***Controllability***
  - Extent of non-nuclear commercial use?
  - Impact on non-nuclear trade/economics and licensing burden?
  - Number of suppliers?
  - Supply sources outside control regime?
  - Substitution cost?
  - Are there viable alternative technical paths impractical to control?
  - Public availability of the technology?

We speak of the "right" DUL controls as achieving the appropriate balance between nonproliferation equities and non-nuclear commercial trade equities. Proliferation risk assessment is fundamental to this judgment.

NSG Dual-Use List (continued)

- As previously noted, NSG Part 2 treats all listed items on the same footing (although some clearly have more technical significance than others)
- All export decisions are made by national discretion, using the factors (and more) listed in paragraph 4 of the Part 2 guidelines for assessing “unacceptable risk of diversion” (proliferation risk)
- For low risk situations, a presumption of approval is normal
- For something more than low risk, a more nuanced approach is called for
- For high risk, denial is almost certain (“presumption of denial” is the baseline)
- For severe risk (special cases), an embargo situation can be recognized for Part 2 items (and of course Part 1 items) and implemented in the broadest multilateral sense (all UN member nations)
  - e.g., DPRK sanctions pursuant to UNSCR 1718

Some Closing Thoughts on Assessing Proliferation Risk

- Expert judgment/inference/intuition applied to context-specific situations plays an important (perhaps indispensable) role in assessing proliferation risk
- Assessment of proliferation risk is not independent of broader political considerations and context
- These are difficult (impossible?) to fully and properly address with prescriptive approaches

BACKUP SLIDE

Some continuing/emerging/possible developments of interest

- Accelerators and accelerator-driven systems (isotope production, actinide transmutation, power production)
- Renewed interest in fast reactors and closed fuel cycles
- Renewed interest in thorium-based fuel cycles
- Broader interest in extraction of uranium from phosphates
- Small modular reactors (SMRs) utilizing fast reactor related concepts and equipment
- Renewed interest in lithium isotope separation technology (e.g., for molten salt reactors using “Flibe”)
- Fusion and fission-fusion hybrid reactor system concepts (certain technology transfer implications)
- “New” reprocessing approaches (in some cases, old concepts revisited), e.g., fluoride volatility, ion exchange, pyroprocessing, etc.
- Efforts to achieve enhanced actinide partitioning/separation
- New or novel methods for uranium enrichment (including laser), or technology advances reinvigorating older process concepts
- Continuing advances/developments in the laser field
- Plutonium isotope separation possibilities (especially via laser)
- Stable isotope separation systems (employing technologies inherently relevant to uranium and/or plutonium)
- Manufacturing and fabrication (including machine tools) technology advances and broader supply
- Higher quality and broader supply of dual-use equipment directly relevant for nuclear activities